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**CBSE Class 12 Biology**  
**NCERT Exemplar Solutions**  
**CHAPTER 7**  
**EVOLUTION**

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**Multiple Choice Questions (MCQs)**

**1. Which of the following is used as an atmospheric pollution indicator?**

- (a) Lepidoptera**
- (b) Lichens**
- (c) Lycopersicon**
- (d) Lycopodium**

**Ans.** (b) Lichens

**Explanation:** Lichens do not possess roots and hence air is their primary source for most elements. They will not grow in the areas that are polluted. So, lichen is used as a reliable indicator of atmospheric pollution.

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**2. The theory of spontaneous generation stated that:**

- (a) life arose from living forms only**
- (b) life can arise from both living and non-living**
- (c) life can arise from non-living things only.**
- (d) life arises spontaneously, neither from living nor from the non-living.**

**Ans.** (c) life can arise from non-living things only.

**Explanation:** This theory was based on the assumption that life could have formed from non-animate matters. Option 'c' is correct.

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**3. Animal husbandry and plant breeding programmes are the examples of:**

- (a) reverse evolution**
- (b) artificial selection**
- (c) mutation**
- (d) natural selection**

**Ans.** (b) artificial selection

**Explanation:** Animal husbandry and plant breeding programmes need human intervention and desirable characters are introduced in plants and animals through manipulation. Hence, these are examples of artificial selection.

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**4. Palaentological evidences for evolution refer to the:**

- (a) development of embryo**
- (b) homologous organs**
- (c) fossils**
- (d) analogous organs.**

**Ans.** (c) fossils

**Explanation:** In fact, study of fossils is called palaentology. The term 'palaeo' is related to old and historic items.

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**5. The bones of forelimbs of whale, bat, cheetah and man are similar in structure, because:**

- (a) one organism has given rise to another**
  - (b) they share a common ancestor**
  - (c) they perform the same function**
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**(d) they have biochemical similarities**

**Ans.** (b) they share a common ancestor

**Explanation:** Similarity in structural design indicates towards a common ancestry.

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**6. Analogous organs arise due to:**

**(a) divergent evolution**

**(b) artificial selection**

**(c) genetic drift**

**(d) convergent evolution**

**Ans.** (d) convergent evolution

**Explanation:** Analogous organs have evolved from different ancestors but all of them show similar function. Hence, they show convergent evolution.

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**7.  $(p + q)^2 = p^2 + 2pq + q^2 = 1$  represents an equation used in:**

**(a) population genetics**

**(b) mendelian genetics**

**(c) biometrics**

**(d) molecular genetics**

**Ans.** (a) population genetics

**Explanation:** (a) population genetics

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**8. Appearance of antibiotic-resistant bacteria is an example of:**

**(a) adaptive radiation**

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**(b) transduction**

**(c) pre-existing variation in the population**

**(d) divergent evolution**

**Ans.** (c) pre-existing variation in the population

**Explanation:** Adaptive radiation is related to evolution of different designs for a single organ according to varied needs of different groups. Transduction is related to transfer of viral or bacterial genetic material. Divergent evolution is related to homologous organs. Hence, option 'c' is correct.

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**9. Evolution of life shows that life forms had a trend of moving from:**

**(a) land to water**

**(b) dryland to wet land**

**(c) fresh water to sea water**

**(d) water to land**

**Ans.** (d) water to land

**Explanation:** Most of the primitive organisms live in water, while most of the complex organisms live on land. This shows that evolution of life progressed from water to land.

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**10. Viviparity is considered to be more evolved because:**

**(a) the young ones are left on their own**

**(b) the young ones are protected by a thick shell**

**(c) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival**

**(d) the embryo takes a long time to develop**

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**Ans.** (c) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival

**Explanation:** (c) the young ones are protected inside the mother's body and are looked after they are born leading to more chances of survival

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**11. Fossils are generally found in:**

**(a) Sedimentary rocks**

**(b) Igneous rocks**

**(c) Metamorphic rocks**

**(d) Any type of rock**

**Ans.** (a) Sedimentary rocks

**Explanation:** Igneous rocks are formed from lava and hence no fossil can be found in them. Metamorphic rocks can be made from igneous or sedimentary rocks. Hence, 'a' is the correct answer.

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**12. For the MN-blood group system, the frequencies of M and N alleles are 0.7 and 0.3, respectively. The expected frequency of MN-blood group bearing organisms is likely to be**

**(a) 42%**

**(b) 49%**

**(c) 9%**

**(d) 58%**

**Ans.** (a) 42%

**Explanation:** This can be solved by using the binomial expression:

$$(a + b)^2 = a^2 + 2ab + b^2$$

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Here;  $M = a$  and  $N = b$

$$\begin{aligned} \text{So, } (M + N)^2 &= M^2 + 2MN + N^2 \\ &= 0.7^2 + 2 \times 0.7 \times 0.3 + 0.3^2 \\ &= 0.49 + 0.42 + 0.09 \end{aligned}$$

In this equation; value of  $2MN = 0.42 = 42\%$

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**13. Which type of selection is industrial melanism observed in moth, *Biston bitularia*:**

- (a) Stabilising
- (b) Directional
- (c) Disruptive
- (d) Artificial

**Ans.** (b) Directional

**Explanation:** Industrial melanism is not a mean character but is acquired by most of the individuals. Hence, it is an example of directional change.

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**14. The most accepted line of descent in human evolution is:**

- (a) Australopithecus → Ramapithecus → Homo sapiens → homo habilis
- (b) Homo erectus → Homo habilis → Homo sapiens
- (c) Ramapithecus → Homo habilis → Homo erectus → Homo sapiens
- (d) Australopithecus → Ramapithecus → Homo erectus → Homo habilis → Homo sapiens.

**Ans.** (c) Ramapithecus → Homo habilis → Homo erectus → Homo sapiens

**Explanations:** (c) Ramapithecus → Homo habilis → Homo erectus → Homo sapiens

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**15. Which of the following is an example for link species?**

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**(a) Lobe fish**

**(b) Dodo bird**

**(c) Sea weed**

**(d) Chimpanzee**

**Ans.** (a) Lobe fish

**Explanation:** Lobe fish shows characters from cartilaginous fishes and from amphibia. They belong to bony fishes. Since, they show characters from two other groups of animals, they are considered as link species.

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**16. Match the scientists listed under column 'A' with ideas listed under column 'B'.**

|       | <b>Column A</b> | <b>Column B</b>                   |
|-------|-----------------|-----------------------------------|
| (i)   | Darwin          | M. abiogenesis                    |
| (ii)  | Oparin          | N. use and disuse of organs       |
| (iii) | Lamarck         | O. continental drift theory       |
| (iv)  | Wagner          | P. evolution by natural selection |

**(a) (i) M; (ii) P; (iii) N; (iv) O**

**(b) (i) P; (ii) M; (iii) N; (iv) O**

**(c) (i) N; (ii) P; (iii) O; (iv) M**

**(d) (i) p; (ii) O; (iii) N; (iv) M**

**Ans.** (b) (i) P; (ii) M; (iii) N; (iv) O

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**Explanation:** (b) (i) P; (ii) M; (iii) N; (iv) O

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**17. In 1953 S. L. Miller created primitive earth conditions in the laboratory and gave experimental evidence for origin of first form of life from preexisting non-living organic molecules. The primitive earth conditions created include:**

**(a) low temperature, volcanic storms, atmosphere rich in oxygen**

**(b) low temperature, volcanic storms, reducing atmosphere**

**(c) high temperature, volcanic storms, non-reducing atmosphere**

**(d) high temperature, volcanic storms, reducing atmosphere containing CH<sub>4</sub>, NH<sub>3</sub> etc.**

**Ans.** (d) high temperature, volcanic storms, reducing atmosphere containing CH<sub>4</sub>, NH<sub>3</sub> etc.

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**18. Variations during mutations of meiotic recombinations are:**

**(a) random and directionless**

**(b) random and directional**

**(c) random and small**

**(d) random, small and directional**

**Ans.** (a) random and directionless

**Explanation:** (a) random and directionless

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**Very Short Answer Type Questions**

**1. What were the characteristics of life forms that had been fossilised?**

**Ans.** Fossilised life forms had some hard parts which could be preserved between layers of rocks.

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**2. Did aquatic life forms get fossilised? If, yes where do we come across such fossils?**

**Ans.** Many aquatic life forms too got fossilized. Many such fossils have been found from oil wells. Many others have been found from sedimentary rocks because many water bodies got filled up by sedimentation.

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**3. What are we referring to? When we say 'simple organisms' or 'complex organisms'.**

**Ans.** When we say 'simple organisms' or 'complex organisms' we refer to the complexity of division of labour and relative level of organization in the organisms.

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**4. How do we compute the age of a living tree?**

**Ans.** Age of a living tree can be determined by comparing the diameter of the trunk with average growth factor of that species. Average growth factor of a species can be found from records. Diameter can be calculated by measuring the girth of the trunk.

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**5. Give an example for convergent evolution and identify the features towards which they are converging.**

**Ans.** Similar evolution in species of different lineage is called convergent evolution. Convergent evolution happens in an isolated geographical area. Flippers of dolphin and

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penguin are examples of convergent evolution. In both animals; flippers have different origins but serve similar purpose.

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**6. How do we compute the age of a fossil?**

**Ans.** Age of a fossil is computed by using carbon dating. Relative presence of  $^{14}\text{C}$  (radioactive carbon) is calculated to compute the age of a fossil.

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**7. What is the most important pre-condition for adaptive radiation?**

**Ans.** Common ancestry is the most important pre-condition for adaptive radiation.

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**8. How do we compute the age of a rock?**

**Ans.** Age of a rock is computed by using carbon dating. Relative presence of  $^{14}\text{C}$  (radioactive carbon) is calculated to compute the age of a rock.

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**9. When we talk of functional macromolecules (e.g. proteins as enzymes, hormones, receptors, antibodies etc), towards what are they evolving?**

**Ans.** Functional macromolecules are evolving towards living forms.

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**10. In a certain population, the frequency of three genotypes is as follows:**

|                  |     |     |     |
|------------------|-----|-----|-----|
| <b>Genotypes</b> | BB  | Bb  | bb  |
| <b>Frequency</b> | 22% | 62% | 16% |

**What is the likely frequency of B and b alleles?**

**Ans.** Frequency of B alleles =  $BB + \frac{1}{2}Bb$

$$= 22\% + 31\% = 53\%$$

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Frequency of b alleles =  $bb + \frac{1}{2}Bb$

= 16% + 31% = 47%

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**11. Among the five factors that are known to affect Hardy Weinberg equilibrium, three factors are gene flow, genetic drift and genetic recombination. What are the other two factors?**

**Ans.** Mutation and Natural Selection are the other two factors.

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**12. What is founder effect?**

**Ans.** When a new species evolves are by a small number of individuals from a larger population; the loss of genetic variation in the new species is called the founder effect.

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**13. Who among the Dryopithecus and Ramapithecus was more man-like?**

**Ans.** Ramapithecus

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**14. By what Latin name the first hominid was known?**

**Ans.** Homo habilis

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**15. Among Ramapithecus, Australopithecines and Homo habilis - who probably did not eat meat?**

**Ans.** Homo habilis

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**Short Answer Type Questions**

**1. Louis Pasteur's experiments, if you recall, proved that life can arise from only pre-existing life. Can we correct this as life evolves from pre-existent life or otherwise we will never answer the question as to how the first forms of life arose? Comment.**

**Ans.** For this experiment, Louis Pasteur used a sterilized flask and another flask which was open to air. Killed yeast did not produce new organism in sterilized flask, while yeast new organisms could come into origin in the second flask. This experiment helped in rejecting the theory of spontaneous generation. But later experiments by Miller showed that organic molecules could develop from inorganic molecules; subsequently leading to origin of life. So, Pasteur's observation could be corrected to some degree by Miller's experiment.

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**2. The scientists believe that evolution is gradual. But extinction, part of evolutionary story, are 'sudden' and 'abrupt' and also group-specific. Comment whether a natural disaster can be the cause for extinction of species.**

**Ans.** As the theory about extinction of dinosaurs tells; a natural disaster can be the cause for extinction of species. A majority of scientists agree that a meteor hit the earth which led to large scale destruction and eventual extinction of dinosaurs.

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**3. Why is nascent oxygen supported to be toxic to aerobic life forms?**

**Ans.** Nascent oxygen is a highly reactive substance. It can react with many molecules; including the DNA. This can result in unwanted mutations which may threaten the life forms. Hence, nascent oxygen is supposed to be toxic to aerobic life forms.

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**4. While creation and presence of variation is directionless, natural selection is directional as it is in the context of adaptation. Comment.**

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**Ans.** Variations keep on occurring in each subsequent generation. But most of them may not be retained by the organism because nature may not support such variations. When a particular variation passes the test of natural selection, then only it is inherited in a species in the long run. Hence, it can be said that creation and presence of variation is directionless but natural selection and adaptation are directional.

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**5. The evolutionary story of moths in England during industrialisation reveals, that 'evolution is apparently reversible'. Clarify this statement.**

**Ans.** In the story of moths in England; white winged moths survived because whitish lichens proliferated on tree trunks during pre-industrialisation days. White-winged moths had better chances of survival against a whitish background. But when the tree trunks become dark due to pollution, the white-winged moths perished; and dark-winged moths reappeared and survived. Thus, evolution of white wings was reversed because of pollution. This shows that evolution is apparently reversible.

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**6. Comment on the statement that "evolution and natural selection are end result or consequence of some other processes but themselves are not processes".**

**Ans.** This is a debatable point that evolution and natural selection are end result or consequence of some other processes but themselves are not processes. When we discuss about success of life on the earth then we treat evolution and natural selection as process. But when discuss about how life has evolved from simple forms then evolution and natural selection appear to results of some other processes. Among the scientific community; this issue is still a moot point.

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**7. State and explain any three factors affecting allele frequency in populations.**

**Ans.** following are the three out of five factors which affect allele frequency in populations:

**(a) Genetic Drift:** The change in the frequency of a gene variant in a population due to random sampling is called genetic drift. Genetic drift may cause a gene variant to disappear completely and result in reduced genetic variation.

**(b) Genetic Recombination:** Production of offspring with traits which differ from parents is

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called genetic recombination.

**(c) Natural Selection:** This theory is based on the premise that nature selects only those traits which help an organism to survive in the changed conditions. Natural selection leads to survival of the fittest. Those which are not fit to survive perish in the long run; paving the way for evolution of a new species.

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**8. Gene flow occurs through generations. Gene flow can occur across language barriers in humans. If we have a technique of measuring specific allele frequencies in different population of the world, can we not predict human migratory patterns in pre-history and history? Do you agree or disagree? Provide explanation to your answer.**

**Ans.** Yes, I agree. With human genome project turning into a reality; it is now possible to understand gene flow in different populations of the world. This can help us in assessing and predicting human migratory patterns in pre-history and history.

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**9. How do you express the meaning of words like race, breed, cultivars or variety?**

**Ans. Race:** A race is an informal taxon and is kept below the species. This means that members from different races of the same species can interbreed.

**Breed:** A breed is a specific group of domestic animals which are homogenous in appearance. This homogeneity has been achieved through selective breeding.

**Cultivar:** A selected group of plants which can be raised through vegetative propagation is called cultivar.

**Variety:** Variety is similar to a race but is used for the plants. Thus, a variety is an informal taxon which is kept below the species in the plant kingdom.

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**10. When we say "survival of the fittest", does it mean that**

**(a) those which are fit only survive, or**

**(b) those that survive are called fit?**

**Comment.**

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**Ans.** Survival of fittest means that those that survive are called fit. Organisms with useful adaptations survive in the long run and are considered to be fit.

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**11. Enumerate three most characteristic criteria for designating a Mendelian population.**

**Ans.** The three most important criteria for designating a Mendelian population are as follows:

- Population must be sufficiently large.
  - Free flow of genetic materials is ensured through sexual reproduction.
  - There should be negligible or nil migration in the population.
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**12. "Migration may enhance or blurr the effects of selection". Comment.**

**Ans.** Natural selection involves selection of a beneficial gene and rejection of a harmful gene. But migration can disturb natural selection by enriching the gene pool of the population. Hence, it can be said that migration may enhance or blur the effects of natural selection.

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**Long Answer Type Questions**

**1. Name the law that states that the sum of allelic frequencies in a population remains constant. What are the five factors that influence these values?**

**Ans. Hardy Weinberg Principle:** This principle says that the sum of allelic frequencies in a population remains constant and remains the same through generations. The sum total of allelic frequencies in a population is 1. If  $p$  represents the frequency of allele A and  $q$  represents the frequency of allele a then in a diploid individual the frequency of allele AA can be shown by  $p^2$  and that of allele aa can be shown by  $q^2$ . Additionally, frequency of alleles Aa can be shown by  $2pq$ . This can be shown by the following equation which is derived from the algebraic identity  $(p+q)^2 = p^2 + 2pq + q^2 = 1$

When a measured frequency differs from this value; it indicates the extent of evolutionary change.

Following five factors influence these values:

- (a) Gene migration or gene flow
- (b) Genetic drift
- (c) Genetic recombination
- (d) Mutation
- (e) Natural selection

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**2. Explain divergent evolution in detail. What is the driving force behind it?**

**Ans.** The accumulation of differences that can lead to formation of new species is called

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divergent evolution. When two groups of the same species face isolation from each other, group adapts to the changed circumstances in its own way. Natural selection and adaptation result in formation of adaptations in a particular group. These variations accumulate over various generations and finally a new species comes into origin.

Homologous organs are results of divergent evolution. We know that organs which are similar in basic design but serve different purposes in different organisms are called homologous organs. Forelimbs of mammals and birds are very good examples of divergent evolution. In most of the mammals, the forelimbs are suited for walking, running and for doing various other chores. In birds, the forelimbs are modified into wings as part of flight adaptations in birds. In both organisms; the forelimbs are composed of humerus, radio-ulna, carpals and metacarpals. But they serve different purposes in mammals and birds. Homology indicates towards common ancestry.

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**3. You have studied the story of Pepper moths in England. Had the industries been removed, what impact could it have on the moth population? Discuss.**

**Ans.** Before industrialisation population of white-winged moths was more than the black-winged moth. This is because white wings of moth helped them in camouflaging. Thus, they were not picked by the predators and survived. But dark-winged moths were picked up by the predators due to their contrasting colour.

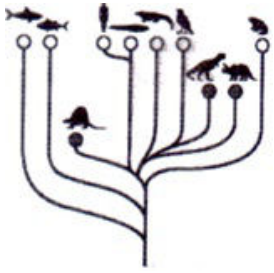
When lichens did not survive and tree trunks become dark because of industrial smoke or soot. This resulted in better chances of survival of dark wings in moths. This showed that evolution is apparently reversible. The same theory would apply when industries will be removed. Removal of industries would help in bringing down population level. This will help in lichens to once again flourish on tree trunks and the tree trunks will gain a whitish layer of lichens. This will result in survival of more white wings in the moths.

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**4. What are the key concepts in the evolution theory of Darwin?**

**Ans.** Branching descent and natural selection are the two key concepts in the evolutionary theory of Darwin.

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**Branching Descent:** This is based on the premise that various life forms can be represented as branches coming out of the same tree. This is often referred to as the “Tree of Life”. Following is a simple illustration of this which shows branching descent.

It is obvious from the given diagram that all the life forms we see today have evolved from a common ancestor. A branch has evolved into fishes and another branch has evolved into amphibians. A third branch has given rise to various land animals; like reptiles, aves and mammals. Darwin used various proofs to show that living beings have evolved from a common ancestor.

**Natural Selection:** Environmental conditions keep on changing. These changes offer new challenges to the organisms. All living beings try to come up with the changed environment by developing certain adaptations. Organisms with useful adaptations are able to produce more progenies. Thus, organisms with useful adaptations are able to maintain their lineage. Nature selects only those which are fit to survive and others perish in the long run. Thus, natural selection has an important role to play in biological evolution.

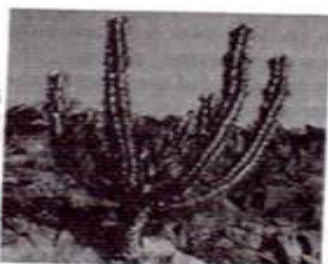
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**5. Two organisms occupying a particular geographical area (say desert) show similar adaptive strategies. Taking examples, describe the phenomenon.**

**Ans.** When two organisms in a particular geographical area show similar adaptive strategies, this is called convergent evolution. Many desert plants show convergent evolution in spite of the fact that they are not closely related. *Cereus peruvianus* is a species of cactus which is primarily found in the South America. *Euphorbia virosa* is found in most parts of the world.



*Cereus peruvianus*



*Euphorbia virosa*

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Both the plants are unrelated but show similar adaptations in order to conserve water. Following are some similarities in them:

- Stem is modified into fleshy succulent greenish parts which store water and carry out photosynthesis.
- Leaves are modified into spines in order to prevent water loss through transpiration.
- Roots penetrate much deeper in the ground to access water.

These examples show analogous organs which are manifestations of convergent evolution.

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**6. We are told that evolution is a continuing phenomenon for all living things. Are humans also evolving? Justify your answer.**

**Ans.** Some scientists have been studying this aspect of human evolution and have come with interesting observations which suggest the evolution is indeed taking place in modern humans. Some of the observations are as follows:

- Human evolution has accelerated since the discovery of farming about 10,000 years ago. There is substantial genetic difference between hunter gatherers and current humans.
- Human reproductive period has prolonged than it was 10,000 years ago. Earlier, the average life expectancy of human beings was about 30 years which is now more than double.
- Lactase persistence into adulthood is another sign of human evolution. All other mammals develop lactose intolerance because young ones are weaned away from mother's milk after a certain age. Unlike humans; other mammals do not have the facility to consume other mammal's milk. But human beings consume milk throughout their life because they get it from domesticated animals.
- Humans have also developed resistance to many infectious diseases. This is another sign of evolution.

However, evolution of modern humans cannot happen through geographical isolation because modern means of transport has blurred geographical boundaries. But evolution can happen because of genetic drift.

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**7. Had Darwin been aware of Mendel's work, would he been able to explain the origin of variations. Discuss.**

**Ans.** Mendel conducted a series of experiments on pea plants to come out with his theories on variations. For this, Mendel observed reproduction of pea plants for many generations and tabulated and analysed those findings. He could attribute the origin of variations to some 'factors' which may have been present in the organism. At that time, scientists did not know about genes.

Darwin was about 10 years older than Mendel and hence it can be said that he was born in the same era. He would have had access to same technology and information as Mendel had. Moreover, he was on an exploration in which conducting a Mendelian experiment could not have been possible. While Mendel's study was focused on a single species; Darwin's study was encompassing much wider scope, i.e. of almost the whole species present at that time. Their respective goals of study were also entirely different.

There is least likelihood that Darwin would have been able to explain the origin of variations.

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