NCERT CBSE Solutions for Class 10 Science Chapter 9

Heredity and Evolution

Back of chapter questions

1. A Mendelian experiment consisted of breeding tall pea plants bearing violet flowers with short pea plants bearing white flowers. The progeny all bore violet flowers, but almost half of them were short. This suggests that the genetic make-up of the tall parent can be depicted as

(A) TTWW

(B) TTww

(C) TtWW

(D) TtWw

Solution: (C)

As all progeny bore violet flowers, the parent plant with violet flower must be homozygous for the violet flower color (*WW*). If this parent were *Ww*, few progenies would produce white flowers. As some progeny were tall while some were short, the parent plant must be heterozygous for tallness (*Tt*). Thus the genetic make-up of the tall parent plant must be *TtWW*.

2. An example of homologous organs is

(A) Our arm and a dog's fore-leg.

(B) Our teeth and an elephant's tusks.

(C) Potato and runners of grass.

(D) All of the above.

Solution: (D)

Homologous organs are the organs derived from a common ancestor (common origin) which have the same structure but they perform different functions. All the given organ pairs are homologous. Our arm and dog's fore-leg have the same bone structure but perform different functions. Same is the case with our teeth and elephant tusk. Potato and runners of grass are both modified stem but the potato has storage function while grass runner helps in growth and propagation.

3. In evolutionary terms, we have more in common with

(A) A Chinese school-boy.

(B) A chimpanzee.

(C) A spider.

(D) A bacterium.

Solution: (A)

A Chinese schoolboy is a human, that is a member of the same species that we are of- *Homo sapiens*. Thus, we are evolutionarily most similar to him. The variations seen in humans living in different geographical regions is due to the difference in environmental conditions which cause morphological variations over time.

4. A study found that children with light-colored eyes are likely to have parents with light-colored eyes. On this basis, can we say anything about whether the light eye color trait is dominant or recessive? Why or why not?

Solution:

According to the law of dominance, a **dominant character is always expressed in the progeny.** Thus, if light eye color is expressed in a child and is also expressed in the parents, it should be a dominant character.

5. How are the areas of study – evolution, and classification – interlinked?

Solution:

Organisms are grouped based on the similarities in their characteristics. Characteristics are details of behavior or appearance. If two species have a lot of characteristics in common, they are closely related. The more closely species are related, the more recently they will have had a common ancestor. Thus, evolution and classification are interlinked.

6. Explain the terms analogous and homologous organs with examples.

Solution:

Homologous Organs- Homologous organs are the organs derived from a common ancestor which have the **same structure but they perform different functions**.

The table below summarizes the homologous organs in various organisms and their varied functions. Even though the shape and size of these organs differ, they are structurally same- they are made up the same set of bones.

An organism with Homologous Organ	Functions
Human Arm	Holding things, grasping

Forelimb of Horse	Running
Wing of Bird	Flying
Flippers of Seal	Swimming

Analogous Organs

Analogous organs are the organs which have the **same function but differ in structure.** They do not have a common ancestor but have evolved separately to carry out the same function.

An example of analogous organs is **wings of bats and the wings of birds.** Wings in both bats and birds are flight organs but their structures are different. Bats have elongated fingers between which the skin fold is stretched to become a wing. The wings of birds, on the other hand, are the forearm with a feathery covering. Thus, the designs of the two wings, their structure, and components, are very different.

7. Outline a project which aims to find the dominant coat color in dogs.

Solution:

Let us also assume that we are investigating two coat colors- dark and light which are governed by a pair of factors 'B' and 'b'.

For the investigation of dominant characteristic, the below steps can be followed-

(i) Firstly, create pure line dogs for dark as well as light coat colors will be created.

(ii) The pure line dogs with a dark coat and light coat will be crossed (parental generation).

(iii) The character appearing in the progeny will be observed (F_1-generation).

Observation:

Case 1

If dark cat color characteristic is dominant cross between a dark coat colored dog and a light coat colored dog will produce always produce dark coat colored offspring.

Case 2

If light coat color is a dominant characteristic cross between a dark coat colored dog and a light coat colored dog will produce always produce light coat colored offspring.

8. Explain the importance of fossils in deciding evolutionary relationships.

Solution:

Fossils are the preserved traces of living organisms. Fossils are available for many organisms which once existed but are now extinct. Study of these fossils helps in determining the characteristic similarities and hence evolutionary relationships between organisms. They help in identification of connecting links between organisms as well. Determining the age of the fossils also helps in establishing evolutionary links.

9. What evidence do we have for the origin of life from inanimate matter?

Solution:

Hypothesis

In 1929, J.B.S. Haldane, a British scientist suggested that life must have developed from the simple inorganic molecules.

Experimental Proof

To prove Haldane's hypothesis, in 1953, Stanley L. Miller and Harold C. Urey conducted an experiment. They artificially created an atmosphere which was similar to the atmosphere of the early earth. It contained molecules like ammonia, methane, hydrogen sulfide and water vapor. Oxygen was absent in the earth's atmosphere. In the experiment, these gases were maintained at a temperature just below 100°C and sparks were introduced in the mixture of gases to simulate lightning. In a few days, they observed that around 15% of the carbon from methane had been converted to simple compounds of carbon such as amino acids. Amino acids make up protein molecules which form an essential component of life.

Conclusion

The experiment proved that life arose from inorganic substances of the primitive earth.

10. Explain how sexual reproduction gives rise to more viable variations than asexual reproduction. How does this affect the evolution of those organisms that reproduce sexually?

Solution:

In asexual reproduction, the offspring produced is genetically identical to its parent. Thus, there are no variations produced.

Sexual reproduction creates genetic variations in organisms. As two parents are involved in sexual reproduction, there is an intermixing of characters. Due to sexual reproduction, variations get accumulated in a population over several generations.

The useful variations are naturally selected, that is, a variation that is advantageous to the survival of an organism is passed on to generations. Several such variations get accumulated and eventually form a new species. Thus, sexual reproduction, which contributes to the accumulation of variations, leads to the evolution of organisms.

11. How is the equal genetic contribution of male and female parents ensured in the progeny?

Solution:

Sexual reproduction involves the fusion of male and female gametes through fertilization to produce the zygote. Male gamete or sperm and female gamete or egg contain only one set of chromosomes, that is, they are haploid. So a sperm has 23 chromosomes while an egg also has 23 chromosomes. When they fuse during fertilization, the zygote formed receives two sets of chromosomes (diploid)- one from the sperm and the other from the egg, thereby maintaining equal genetic contribution from both parents. Thus the zygote produced contains 23 pairs of chromosomes or 46 chromosomes. It undergoes mitotic divisions to eventually develop a diploid individual.

12. Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement? Why or why not?

Solution:

No, it is not entirely agreeable that only advantageous variations can survive in a population. While advantageous variations are passed on over generations and get accumulated, in small populations even chance variations which do not confer any advantage can also get selected due to genetic drift.

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In between chapter questions

1. If a trait A exists in 10% of a population of an asexually reproducing species and a trait B exists in 60% of the same population, which trait is likely to have arisen earlier?

Solution:

There will be very minor differences produced due to incorrect DNA copying in the population of the given species as they reproduce asexually. Therefore, trait B

is more likely to arise earlier as 60% of the population carries it 10% of the population carries trait A which may have been arisen due to variation.

2. How does the creation of variations in a species promote survival?

Solution:

Favourable variation in a species helps in the adaptation to the changing environment which promotes the survival of a species.

3. How do Mendel's experiments show that traits may be dominant or recessive?

Solution:

One tall pea plant and one short pea plant were taken by Mendel and progeny were produced from them.

Parents:	**TT** (tall plant)	**tt** (small plant)	
Gametes:	**T**	**t**	
Progeny: F_1	**Tt** (tall plant)	**Tt**	
F_2	**TT** (tall)	**Tt** (tall)	tt (short)

He found that tallness is dominant over shortness in nature after performing this test. Because in F_2 generation heterozygous plant carries one gene for tall plant and one gene for short plant of which tallness has been expressed. Thus it was concluded by him that in a contrasting pair of characters one character is dominant, whereas the other is recessive.

Concept Insight: Recall ***Mendel's law of inheritance.***

4. How do Mendel's experiments show that traits are inherited independently?

Solution:

Mendel conducted a dihybrid cross. He took two characters:

(i) Round and yellow seeds (*RRYY*)

(ii) Wrinkled and green seeds (*rryy*)

In the F_1 generation, he got plants with Round and yellow seeds (*RrYy*) Then he self crossed F_1 plants. The following result was obtained by him:

(i) Round yellow - 9

(ii) Round green - 3

(iii) Wrinkled yellow - 3

(iv) Wrinkled green- 1

From the above result, it is concluded that genes controlling different characters are not linked. Thus, in the F_2 generation, two new characters (round, green and wrinkled, yellow) other than parental characters (round, yellow and wrinkled, green) were obtained.

5. A man with blood group **A** marries a woman with blood group '**O**' and their daughter has blood group '**O**'. Is this information enough to tell you which of the traits- blood group A or '**O**' - is dominant? Why or why not?

Solution:

No, the information provided is not enough to predict whether blood group '**A**' or '**O**' is dominant. A pair of alleles control every character. In the question, it is not mentioned whether the man and woman have homozygous or heterozygous traits.

6. How is the sex of the child determined in human beings?

Solution:

Human male carries one X-chromosome and one Y-chromosome. In other words, half of the male gametes carry X-chromosomes and the other half carries Y-chromosomes. On the other hand, a female carries two X-chromosomes. Therefore, all female gametes carry only X-chromosomes. If a sperm carrying Y-chromosome fertilizes an ovum then the child born will be a boy. If a sperm carrying X-chromosomes fertilizes an ovum then the child born will be a girl.

7. What are the different ways in which individuals with a particular trait may increase in a population?

Solution:

The population of individuals with particular traits may increase in the following ways:

(i) By variations initiated by natural selection during the course of time.

(ii) By accidental changes in the frequency of some genes in a population i.e. genetic drift.

(iii) Variations

8. Why are traits acquired during lifetime of an individual is not inherited?

Solution:

Traits acquired by an organism during its lifetime are known as acquired traits. These traits are not inherited because they do not lead to any changes in the DNA of the organism.

9. Why are the small numbers of surviving tigers a cause of worry from the point of view of genetics?

Solution:

(i) Small numbers of tigers infer that fewer variations in terms of genes are available. This infers that when these tigers reproduce, there are fewer chances of producing progeny with some useful variations.

(ii) If any natural calamity occurs and kills these small numbers of surviving tigers, they will become extinct, resulting in the loss of these genes forever.

(iii) Less number of species infers less number of diversity and a lesser number of traits which reduces the chances of adaptability in respect to change in the environment.

10. What factors could lead to the rise of a new species?

Solution:

Factors responsible for the rise of a new species are:

(i) Genetic variation

(ii) Natural selection

(iii) Genetic drift.

11. Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?

Solution:

No, However, since the plants are self-pollinating, which means that the pollen is transferred from the anther of one flower to the stigma of the same flower or of

another flower of the same plant, so geographical isolation cannot prevent speciation in this case.

12. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?

Solution:

No. Gene flow between populations of a species is prevented geographical isolation whereas generally, only one individual is involved in asexual reproduction. In an asexually reproducing organism, variations can occur only when the copying of DNA is not accurate. Therefore, geographical isolation cannot prevent the formation of new species in an asexually reproducing organism.

13. Give an example of characteristics being used to determine how close two species are in evolutionary terms.

Solution:

Analogous organs are one of the evidence to be used to determine how close two species are related. The presence of feathers in dinosaurs and birds indicates that they are evolutionarily related. Dinosaurs had feathers, not for flying but these feathers provide insulation to these warm-blooded animals. However, the feathers in birds are used for flight. This proves that reptiles and birds are closely related and that the evolution of wings started in reptiles.

14. Can a wing of butterfly and a wing of bat be considered homologous organs? Why or why not?

Solution:

No, a wing of a butterfly and wing of a bat cannot be considered as homologous organs because the wings of a bat are skin folds in between the fingers and wings of an insect are membrane supported by muscles. Both the organs are analogous organs which have different basic structure but have a similar appearance and perform similar functions.

15. What are fossils? What do they tell us about the process of evolution?

Solution:

Fossils are dead remains (may be a part of the organism or the whole organism) of plants and animals that existed on earth millions of years ago.

Fossils help us in the following ways:

(i) To mark the path of evolution.

(ii) They help us in establishing evolutionary relations between present organisms. Example: Archaeopteryx (connecting link between reptiles and birds).

16. Why are human beings who look so different from each other in terms of size, color and looks said to belong to the same species?

Solution:

Although human beings look so different from each other, they belong to the same species because

(i) The number of chromosomes are the same.

(ii) They all have a common ancestor.

(iii) They interbreed among themselves. So, they are able to produce fertile offspring.

17. In evolutionary terms, can we say which among bacteria, spiders, fish, and chimpanzees have a 'better' body design? Why or why not?

Solution:

In evolutionary terms, we can say that bacteria have a 'better' body design than spiders, fish, and chimpanzees because though bacteria is one of the simplest and primitive life forms but still it adapts and survives in some of the most unfavorable habitats such as hot springs, deep-sea thermal vents and ice in Antarctica. Other organisms are not able to survive in such harsh habitats.

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