Chapter – 4
Heredity and Evolution

In Text Questions-Pg-143

Q. 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?

Answer: Trait B is likely to have arisen earlier because in asexual reproduction traits are carried from parents to offspring with least variations so since trait B has higher percentage it is likely to have arisen earlier.

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

Answer: Short answer: Variations bring about favourable changes in an organism that allow it to survive better than others in the population.

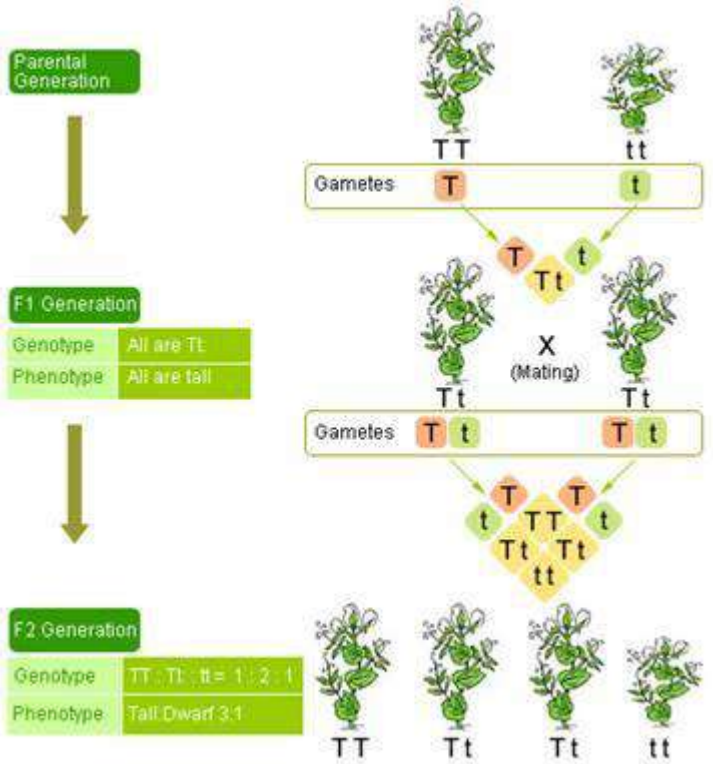
Sometimes there occur changes in the environment that are so drastic that they make survival for certain organisms very difficult. For example, let us assume that a group of beetles can only survive upto 50 degrees celcius of temperature, but there are few beetles in the population with a variation that allows them to withstand or tolerate higher temperature. So, if the temperature rises all those beetles that could only survive upto 50 degrees of temperature would die off. Those beetles that could tolerate the higher temperature would survive and reproduce. Note: Keep in mind that not all variations are necessarily useful. It depends on the extrenal environment

In Text Questions-Pg-147

Q. 1 How do Mendel's experiments show that traits may be dominant or recessive?

Answer: In his experiment with Pea Plant, Mendel crossed pure tall plants (TT) with pure dwarf plants (tt) and he obtained all tall plants in the F1 generation (Tt) which suggested that only one of the traits of parental plant showed in the F1 generation i.e. tall and the other trait-dwarf plants were not obtained.

He crossed these tall plants of F1 generation amongst each other and obtained tall and dwarf plants in the ratio of 3:1 as the second generation (F2 generation). So he observed that the dwarf trait that had disappeared in the F_1 generation reappear in the Second generation (F2 generation). Mendel concluded that the traits of dwarf-ness remained hidden in the first generation to re-emerge in the second generation. Thus this shows that the traits may be dominant or recessive wherein, tall traits are dominant and dwarf traits are recessive.



Q. 2 How do Mendel's experiments show that traits are inherited independently?

Answer: Mendel performed another experiment with Pea plants, this time taking two traits into consideration, yellow round seeds and green wrinkled seeds. He crossed these two plants and in the F1 generation and obtained all yellow round seeds. Yellow and round were dominant so they were expressed and Green and wrinkled were recessive so they remain suppressed. He self-pollinated these F1 generation plants to produce F2 generation and found yellow round seeds, green wrinkled seeds. Also he found yellow wrinkled seeds and green round seeds. Thus this experiment showed that the traits are inherited independently.

P RRYY (Round, Yellow) × rryy (Wrinkled, green)

Gametes: RY, ry

F_1: RrYy (Round, Yellow)

Male gametes → / Female gametes ↓ / F_2

	RY	Ry	rY	ry
RY	RRYY Round, yellow	RRYy Round, yellow	RrYY Round, yellow	RrYy Round, yellow
Ry	RRYy Round, yellow	RRyy Round, green	RrYy Round, yellow	Rryy Round, green
rY	RrYY Round, yellow	RrYy Round, yellow	rrYY Wrinkled, yellow	rrYy Wrinkled, yellow
ry	RrYy Round, yellow	Rryy Round, green	rrYy Wrinkled, yellow	rryy Wrinkled, green

Fig. 5.15. Results of a dihybrid cross between pure breeding plants with round, yellow and wrinkled, green seeds and Mendel's explanation for the mode of inheritance.

Q. 3 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 0 -is dominant? Why or why not?

Answer:

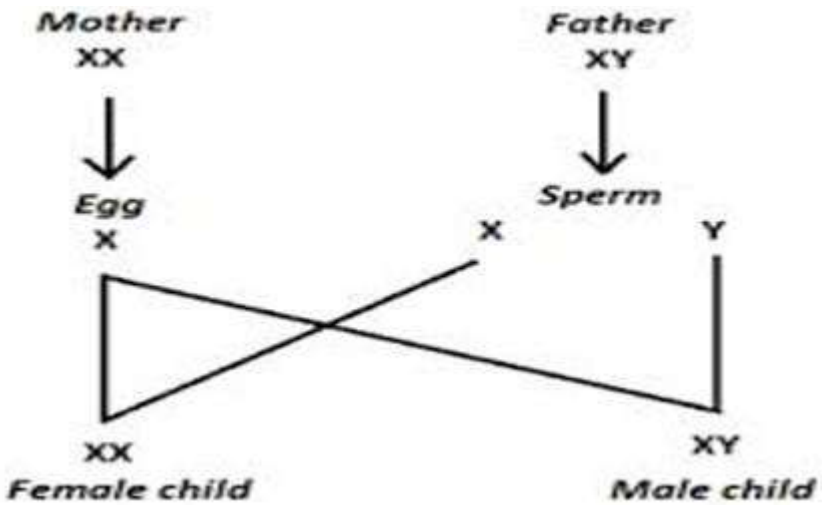
Case 1: Man with blood group A married a woman with blood group O. Blood group for man can be expressed by dominant genotype IAIA or IAIO and blood group O for woman is expressed by recessive genotype IOIO. The daughter will have O blood group type as a result of this IOIO inheritance of recessive traits from mother and father.

Case 2: Blood group A in father if has recessive genotype IAI A and mother has dominant genotype I_AI_O or I_OI_O. The daughter will have O blood type as a result of inheritance of dominant allele I_O from mother and recessive allele I_A from father.

Blood group A is expressed in both homozygous and heterozygous condition but Blood group O is expressed in recessive condition.

Q. 4 How is the sex of the child determined in human beings?

Answer: Sex of a child depends on the chromosome in the gamete of the father. The unfertilized egg has one X chromosome. The sperm either has X chromosome or Y chromosome. If sperm carrying Y chromosome fertilizes with the egg, male child will be born with the genetic constitution XY. But if sperm carrying X chromosome fertilized with the egg, female child will be born with the genetic constitution XX.



In Text Questions-Pg-150

Q. 1 What are the different ways in which individuals with a particular trait may increase in a population?

Answer: The various ways in which individuals with a particular trait may increase in population are-

• Geographical barrier- if sexually reproducing organisms are isolated by geographical barriers then the gene flow through gametes stops and the isolated members interbreed thus leading to the formation of new species hence increasing the traits.

• Natural Selection- Nature selects individuals that are better adapted to the environment. Those organisms who are better adapted, survive and reproduce more, there characteristics are passed on whereas the organisms that are not adapted well to the environmental conditions are slowly erased from the environment as there characteristics are not passed on.

• Genetic drift- is when the frequency of some genes is changed due to any reasons. It can give rise to differential changes in sub-population. Genetic drift rarely produces adaptations to environment.

Q. 2 Why is the traits acquired during the life-time of an individual not inherited?

Answer: A trait can be only inherited when it brings a change in genes present in the gametes of an organism. Changes in non-reproductive tissues cannot be passed on to DNA of germ cells. Therefore traits acquired during lifetime of an individual are not inherited by the offspring because they are changes in somatic cells and not in germ cells.

Q. 3 Why are the small numbers of surviving tigers a cause of worry from the point of view of genetics?

Answer: Small numbers of surviving tigers are a cause of worry from the point of view of genetics because if all the tigers in the world die and become extinct, their genes will be lost forever, they will not come into sight ever again if they become extinct.

In Text Questions-Pg-151

Q. 1 What factors could lead to the rise of a new species?

Answer: Various factors that could lead to formation of new species are Geographical barrier, natural selection, genetic drift, and variations.

Geographical barrier-if sexually reproducing organisms are isolated by geographical barrier then the gene flow through gametes stops and the isolated members interbreed thus leading to the formation of new species.

Variations by Natural Selection- Nature select individuals that are better adapted to the environment. The organisms that are better adapted survive and reproduce more, whereas the organisms that are not adapted well to the environmental conditions are slowly erased from the environment.

Genetic drift- genetic drift is changes in the relative frequency of particular genes which which leads to disappearance of those genes as individuals either die or they do not reproduce.

Q. 2 Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?

Answer: No, geographical isolation will not be a major factor in the speciation of a self-pollinating species because self-pollinating plants do not require any other plant to reproduce. Hence, No new gene variants will be introduced into the population and thus there will be no evolution of new species.

Q. 3 Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?

Answer: No; geographical isolation will not be a factor in the speciation of an organism that reproduces asexually. This is because asexual reproduction is a reproduction wherein an organism does not require another organism to reproduce i.e. there is no fusion of gametes. There is very little variation over generations. Thus, geographical isolation cannot be a major factor in the speciation of an organism that reproduces asexually since variations in DNA are not enough to raise a new species.

In Text Questions-Pg-156

Q. 1 Give an example of the characteristics being used to determine how close two species are in evolutionary terms.

Answer: • If different organisms have common ancestors then it is possible that they have similar characteristics due to inheritance. These similarities are used to determine their close relations in evolutionary terms. For example – forelimbs of bird and forelimb of humans have similar basic structure of bones which suggests that they have a common ancestor i.e. they are closely related in evolutionary terms. Over time these structures have developed to function as per the requirement. Thus homologous organs help in determining closeness in evolution.

• During evolution, the changes that take place in DNA of species are accumulated over time. If these changes are very less in two species then those 2 species are said to be closely related. On the other hand, if these changes in DNA of 2 species are large, then the species are said not to be closely related in evolutionary terms.

Q. 2 Can the wings of a butterfly and the wings of a bat considered homologous organs? Why or why not?

Answer: No; The wings of a butterfly and wings of a bat cannot be considered homologous organs because they don't have similar basic structure, even if they perform similar functions (flying). The wings of bat are supported by bones whereas the wing of a butterfly has no bones but is supported by membranous folds which are attached with muscles and not bones. Wings of a butterfly and wings of a bat are analogous organs which have similar functions but different origins.

Q. 3 What are fossils? What do they tell us about the process of evolution?

Answer: Fossils are the dead remains of plants and animals which undergo several physical and chemical processes after they are dead.

Example- Archaeopteryx lithographica is a fossil that resembles a bird (has feathers and wings) but has several features of reptiles (tail and teeth). So Archaeopteryx is supposed to be the connecting link between have and reptiles thus suggesting that birds have evolved from reptiles

In Text Questions-Pg-158

Q. 1 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?

Answer: This is because human beings reproduce. There are no geographical barriers so they interbreed easily and produce viable offspring. It is the result of variations that human beings look different from each other in terms of size, color and looks.

Q. 2 In evolutionary terms can we say which among bacteria, spiders, fish and chimpanzees have a 'better' body design? Why or why not?

Answer: Bacteria has a better body design in evolutionary terms because they can survive hot springs, deep sea and even freezing environment which most of the other organisms cannot.

Exercise-Pg-159

Q. 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:

Give reason for your choice.

A. TTWW

B. TTww

C. TtWW

E. Tt Ww

Answer: According to the question, tall pea plant bearing violet flower plants were bred with short pea plant bearing white flower plants. The progeny had short pea plant bearing violet flower plants. Genetic make-up of tall parent is decided as follows-

The parent should have dominant genes for violet flower color to be inherited by the progeny, so WW must be gene pair.

For height, the parent should have one recessive gene and one dominant for height in it, so Tt must be the genes in parent plant. Thus TtWW is the genetic make-up of the parent in order so that the progeny should have short violet flowers.

Q. 2 An example of homologous organs is:

A. Our arm and dog's foreleg

B. Our teeth and an elephants' tusks

C. Potato and runners of grass

D. all of the above

Answer: Homologous organs are those which have a common ancestor but have evolved differently and adapted suitable functions according to their needs. Our arm and dog's foreleg has the basic structure of bones but they have different functions, a dog uses it for walking while human beings use it for holding/ grasping.

Our teeth and elephant's tusks again have same structure but they serve different functions. Likewise, potatoes and runners of grass, both grow underground but they have different uses, potatoes serve as food whereas grass as vegetation.

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

A. a Chinese school boy

B. a chimpanzee

C. a spider

D. a bacterium

Answer: Human beings belong to same species and the variations that are seen are usually less among same species, than compared between different species.

Q. 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?

Answer: Just On the given basis, we cannot say anything about whether the light eye color trait is dominant or recessive because 2 copies of traits are inherited from each parent. We cannot tell which

gene is dominant or recessive because we do not know the nature of these 2 variants.

A recessive trait will appear only when both the parents contribute recessive allele. A dominant trait will appear if both or at-least one parent contributes dominant allele. So from the give data, we can only say that both parents are contributing recessive alleles which results in light colored eye children.

Q. 5 How are the areas of study-evolution and classification-interlinked?

Answer: Classification involves grouping of organism into a formal system based on similarities in internal &external structure/ evolutionary history. Two species are said to be closely related if they have more characteristics in common which is only possible when they have common ancestor. With generations, an organism adapts according to its environment and becomes different from its ancestor. Classification of an organism is on the bases of their resemblance which is similar to making an evolutionary history.

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

Answer: Analogous organs are organs that are similar in function but have different basic structure which means that they have different origin. For example- Wings of a bird and wings of an insect are analogous organs which have same function of flying but have different basic structure of wings.

Homologous organs are organs that have different functions but have similar basic structure i.e. they have common origin. For example- Forelimbs of man, forelimbs of frog and forelimbs of lizard are similar in structure but they perform completely different functions. Forelimbs of frog are used to prop up at front ends while at rest, forelimbs of

lizards are used for running whereas forelimbs of human are used for grasping.

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

Answer: There are 11 identified genes that influence coat color in dogs. Dog inherits one gene from each parent and only the dominant gene gets expressed.

Case- A dog may be genetically black or brown, if one parent is homozygous black BB and the other is homozygous brown bb. The offspring produced will be heterozygous Bb and will be black in color. So, black will be the dominant coat color.

If these heterozygous offspring Bb are crossed amongst themselves, homozygous black BB, heterozygous black Bb, and homozygous brown bb offspring will be produced in the ratio 1:2:1

The dominant coat color in this case will be black.

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

Answer: Fossils are the dead remains of plants and animals which undergo several physical and chemical processes after they are dead.

Fossils help us in determining how a presently living species evolved or developed from the old species.

Example- Archaeopteryx lithographica is a fossil that resembles a bird (has feathers and wings) but has several features of reptiles (tail and teeth). So Archaeopteryx is supposed to be the connecting link between aves and reptiles thus suggesting that birds have evolved from reptiles

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

Answer: The evidence for the origin of life from lifeless matter was given by Stanley Miller and Harold Urey in 1953. They recreated the probable conditions of primitive atmosphere of early earth and demonstrated that simple organic compound like amino acids, hydroxyl acids, sugars and urea can by synthesized in the laboratory from a mixture of methane, hydrogen, water vapor and ammonia. They supplied energy by heating the chamber containing the above mixture to 800 degree C and discharges by electric sparks. After about one week, the liquid was found to contain a number of amino acids such as glycine, alanine and aspartic acid. Amino acids make up proteins molecules in living organisms. Thus, the experiment is a evidence that life originated from inanimate matter.

Q. 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?

Answer: Sexual reproduction involves two parents. Gametes from male and female fuse to form the zygote. In the process, exchange of genes occurs, which results in variation in the offspring.

On the other hand, asexual reproduction involves a single parent and the organism produced is identical to the parent. Hence there are little or no variations in an organism produced by asexual reproduction.

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

Answer: The equal genetic contribution of male and female parents is ensured in the progeny by sexual reproduction. The male gamete, sperm, fertilizes the female gamete, egg to form a zygote. Both, sperm and egg are haploid but when they form a zygote, the zygote becomes

diploid (haploid+ haploid), having 23 chromosomes from mother and 23 from father i.e. half the chromosome number comes from the mother and the other half comes from the father. Thus the genetic contribution of male and female parent is ensured in the progeny in this way.

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

Answer: Yes; only variations that confer advantage to an individual organism will survive in a population.

For example- In a population of red beetles, some sudden variation in reproduction produces a green colored beetle. Red beetles are a easy source of prey as they can be easily spotted on the green bushes. The green colored beetle that was produced by a variation could mix up with the green bushes and protect itself from being a prey to predator. If the variation that has occurred in the color of the beetle was blue, then it would have been of no advantage to help in surviving, as it would be easily open to predation like the red beetles.