HEREDITY & EVOLUTION

Solved Intext Exercises

Q1. 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?

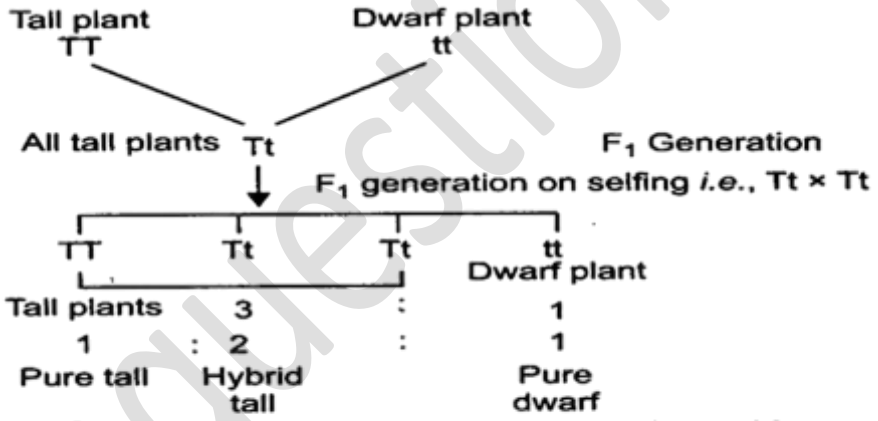
Ans. Trait B is likely to have arisen earlier in a population of an asexually species.

Q2. How does the creation of variation in a species promote survival?

Ans. Variations in a species arises due to errors in DNA copying. Force of natural selection selects individuals with useful variations in the prevailing environment so as to ensure their survival. The individuals with useful variations increase in numbers through differential repro duction in the population.

Q3. How do Mendel's experiments show that traits may be dominant or recessive?

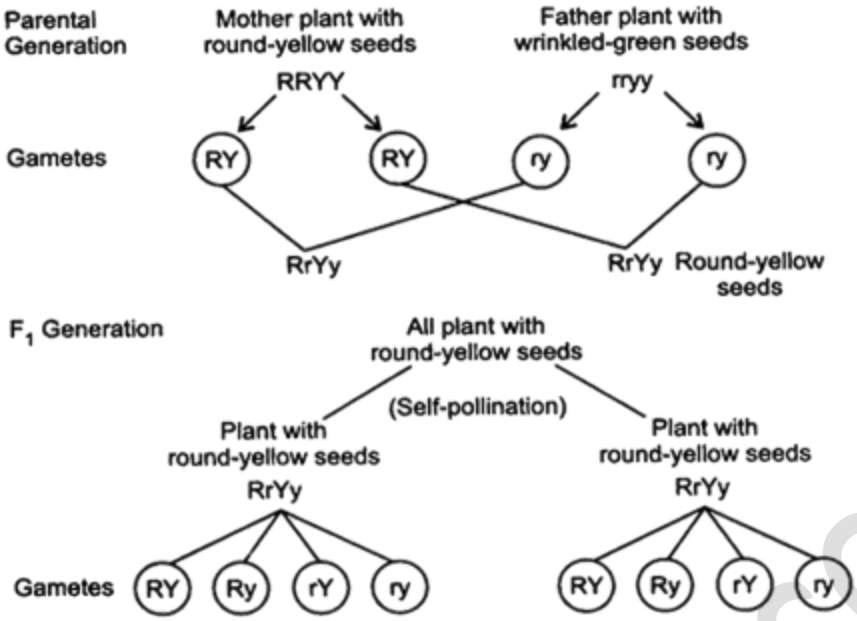
Ans. When Mendel first crossed pure tall pea plants with pure dwarf pea plants and found that only tall plants were produced in the first-generation of F_1 generation. No dwarf pea plants were obtained in the first-generation of progeny. When F_1 tall plants were self-pollinated, Mendel got both tall and dwarf plants in F_2 generation in 3 : 1 ratio. In other words, in the F_2 generation three-fourth plants were tall and one-fourth were dwarf. Mendel called this tall character as dominant trait and dwarf char acter as recessive trait.



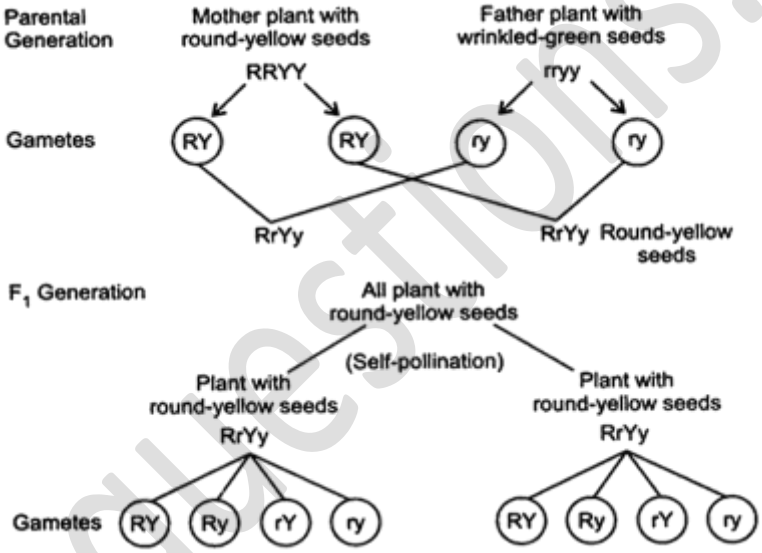
A typical monohybrid cross conducted by Mendel between true-breeding tall plant and true breeding dwarf plant

Q4. How do Mendel's experiments show that traits are inherited independently?

Ans. When Mendel first crossed pure-bred pea plants having round-yellow seeds with pure bred pea plants having wrinkled-green seeds and found that only round-yellow seeds were produced in the first-generation. No wrinkled green seeds were obtained in the F_1 generation. From this, it was concluded that round shape and yellow colour of the seeds were dominant traits over the wrinkled shape and green colour of the seeds. When the F_1 generation pea plants having round-yellow seeds were cross-bred by self-pollination, then four types of seeds having different combinations of shape and colour were obtained in second-generation (F_2). These were round-yellow, round-green, wrinkled-yellow and wrinkled-green seeds.



Such a cross is known as dihybrid cross as two sets of corresponding characters are considered.



Thus, ratio of F_2 generation is

Round yellow : Round green : Wrinkled yellow : Wrinkled green

9 : 3 : 3 : 1

Thus, the ratio of each phenotype (or appearance) of the seeds in the F_2 generation is 9 : 3 : 3 : 1. Mendel observed that round-yellow and wrinkled-green, and two new combinations of characteristics had appeared in the F_2 generation round-green and wrinkled-yellow. On the basis of this observation, Mendel concluded that though the two pairs of original characteristics (seed colour and shape) combine in the F_1 generation but they get separated and be have independently in the substance generation.

Q5. 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?

Ans. The information is insufficient to tell whether the trait - 'A' or 'O' is dominant.

In case 1st let us assume that trait 'A' is dominant. Then father may have I^AI^A or I^AI^O and I^OI^O

In this case, 50 per cent of the progeny will have blood group A and 50 percent of the progeny will have blood group O, when father's blood group is AO and mother's is O. In case 2nd let us, we see that trait 'O' is dominant.

In this case also, we see that the child may have blood group O.

Since, in both the assumption the child can have blood group O so, we cannot establish which trait is dominant.

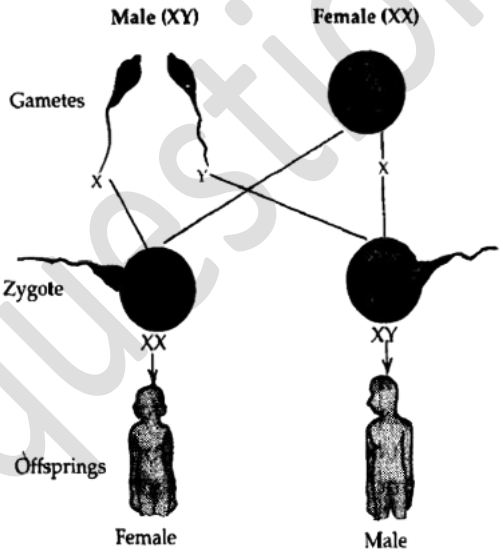
Q6. What are the different ways in which individuals with a particular trait may increase in population.

Ans. There are following ways in which individuals with particular trait may increase in a population.

- By natural selection
- By genetic drift.

Q7. How is the sex of the child determined in human beings?

Ans. In human beings, sex of the child depends upon which kind of male gamete fertilises with the female gamete. If sperm carrying X chromosome fertilises with ovum carrying X chromo some, then the child born will be a girl. If a sperm carrying Y chromosome fertilisers with ovum which carries X chromosome, then the child born will be boy.



Q8. Why are trait acquired during the life-time of an individual not inherited?

Ans. The changes in the non-reproductive body cells, i.e., somatic cells of an organism cannot be inherited by its offsprings, because only those traits can be transmitted to future generation in which changes have occurred in the DNA present in the reproductive cells of parents organisms.

Q9. Why are small numbers of surviving tigers a cause of worry from the point of view of genetics?

Ans. The small numbers of surviving tigers are a cause of worry from the point of view of genetics because if they all die out and become extinct, their genes will be lost forever and coming generations will not be able to see tigers at all. Also, small number of tigers means less chances of variations. Variations are important in stability of a species by natural selection.

Q10. What factors could lead to the rise of new species?

Ans. Genetic variation, natural selection and reproductive isolation are factors that could lead to the rise of a new species.

Q11. Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?

Ans. Geographical isolation will not be a major factor for the speciation of a self-pollinating plant species because it does not have to look to other plants for its process of reproduction to be carried out.

Q12. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?

Ans. Geographical isolation will not be a major factor in the speciation of an organism that repro duction asexually, because it does not require any other organism to carryout reproduction.

Q13. Give an example of characteristics being used to determine how close two species are in evolutionary terms.

Ans. Forelimbs of humans and wings of birds show the closeness between these two species. Since, the forelimbs of a human and wings of birds have similar structure but perform different functions. Thus, the presence of homologous organs in different animals provides evidence for evolution by telling us that they have evolved from the same ancestor who had the basic design of the organ on which all the homologous organs are based.

Q14. Can the wing of butterfly and the wing of a bat be considered homologous organs?

Ans. The wings of a butterfly and the wings of a bat cannot be considered as homologous organs because they have different basic designs even though they perform similar functions, they are therefore analogous organs.

Q15. What are fossils? What do they tell us about the process of evolution?

Ans. Fossils: When organic die, their bodies will decompose and be lost. But every once in a while, the body or at least some parts may be in an environment that does not let it decom poses completely. If a dead insect gets caught in hot mud, for example, it will not decompose quickly, and the mud will eventually harden and retain the impression of the body parts of the insect. All such preserved traces of living organisms are called fossils.

About the process of evolution, the fossils indicates that:

- In helps to identify an evolutionary relationship between apparently different species.
- The fossils present in the bottom rocks are simple while the most recent fossil found in the upper strata are highly complex. This geographical succession completely agrees with the concept of evolution.

Q16. Why are human beings who look so different each other in terms of size, colour and looks said to belong to the same species?

Ans. The human beings are different from each other in terms of size, colour and looks are said to be of the same species (Homo sapiens) because they can interbreed to produce fertile offsprings (son and daughter). The earliest members of Homo Sapiens have been traced back to Africa. Some of our ancestors stayed back in Africa and spread across these continents; other left Africa and slowly spread across the whole earth. They moved forward and back ward in groups, revelling separation or mixing of groups at times. These groups of

ancestors, like other species, lived their lives in the prevailing environment and developed genetic variation to become different coloured with specific features in different geographical regions in modern times.

Q17. In evolutionary times, can we say which among bacteria, spiders, fish and chimpanzees have a 'better' body design? Why or why not?

Ans. There is no real 'progress' in the idea of evolution. Evolution is simply the generation of diversity by environmental selection. The only progressive trend in evolution seems to be that more and more complex body designs have emerged over time. However, designs still not as if the older designs are inefficient. So many of the older and simpler designs still survive. In fact, one of the simplest life forms-bacteria inhabit the most inhospitable habitats like hot springs, deep-sea thermal vents and ice in Antarctica. In other words, human beings are not the pinnacle of evolution, but simply yet another species in the teeming spectrum of evolving life.

Solved NCERT Exercises

Q1. 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

Ans. (c)

Q2. An example of homologous organ is

(a) our arm and dog's fore-leg

(b) our teeth and an elephant's tusks

(c) potato and runners of grass

(d) all of the above

Ans. (d)

Q3. In evolutionary terms, we have more in common with —

(a) a Chinese school-boy

(b) a chimpanzee

(c) a spider

(d) a bacterium

Ans. (a)

Q4. A study found that children with light-coloured eyes are likely to have parents with light-coloured eyes. On this basis, can we say anything about whether the light eye colour trait is dominant or recessive? Why or why not?

Ans. In this study, light-coloured eye is dominant trait because children born from parents having light-coloured eyes also had light-coloured eyes.

Q5. How are the areas of study-evolution and classification-interlinked?

Ans. Characteristics of organisms refer to the details of their external and internal appearance or behaviour that distinguish them from one another. These characteristics of organism also form the basis for the classification of organ ism. The more characteristics two species will have in common, the more closely they are related. And the more closely they are related the more recently they will have had a common ancestor. By identifying hierarchies of characteristics between species, we can work out the evolutionary relationships of the species we see around us. Thus, we can appreciate that classification of species is in fact re flection of their environary relationship.

Q6. Explain the terms analgous and homologous organs with examples.

Ans. Homologous organs: Those organs which have the same basic structural design and developmental origin but may have different functions.

Example: The forelimb of a frog, a lizard, a bird and a man seem to be built from the same basic design of bones, but they perform different functions.

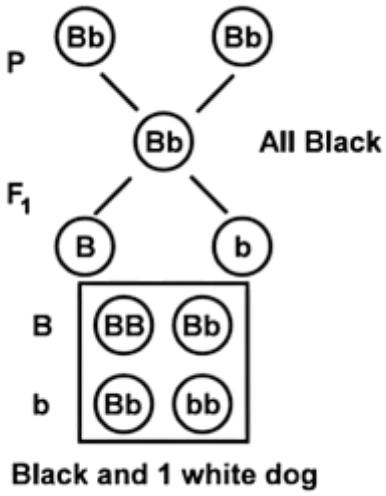
Analogous organs: Those organs which have different basic structural design and develop mental origin but have similar functions.

Example: The wings of birds and insect.

Q7. Outline a project which aims to find the dominant coat colour in dogs.

Ans. Select a homozygous black (BB) male dog and a homozygous white (bb) female dog. Cros breed them and produce offspring (F_1 generation).

If all in the F_1 offsprings are black, we can conclude that black coat colour is dominant over white coat in colour dogs.



Q8. Explain the importance of fossils in deciding evolutionary relationships.

Ans. Fossils are the remains or impressions of dead plants or animals which died millions of years ago. The study of fossils helps us to know about the evolution or links between two species. Fossils tell us how new species are developed from the old ones. So, fossils have an importance in deciding evolutionary relationships.

Q9. What evidence do we have for the origin of life from inanimate matter?

Ans. An experiment conducted by Stanley L. Miller and Harold C. Urey in 1953 proved that origin of the life takes place from inanimate matter. They assembled an apparatus to create an early earth atmosphere which was supposed to consist of gases like methane, anomia and hydrogen sulphide but no oxygen, over water. This was maintained at a temperature just below 100°C and spark were passed through the mixture of gases to stimulate lighting. At the end of a week, 15% of the carbon (from methane) had been converted to simple compounds of carbon including amino acids which make up protein molecules.

Q10. 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?

Ans. The sexual reproduction gives rise to more viable variations than asexual reproduction. In asexual reproduction, the offsprings are almost identical to their parents because they have the same genes as of their parents. Thus, much genetic variation is not possible in asexual reproduction. Asexual reproduction inhibits the further evolution of the organism. In sexual reproduction, the offsprings although similar to their parents, are not identical to them or to one another. This is because the offsprings receive some genes from the mother and some form the father. Because of the mixing of genes of mother and father in various different combinations, all the offspring will exhibit genetic variations. In this way, sexual reproduction leads to a greater variation in the population. Thus, genetic variation leads to the continuous evolution of various species to form better and still better organisms.

Q11. How is the equal genetic contribution of male and female parents ensured in the progeny?

Ans. In case of human beings 23 pairs of chromosomes have maternal and a paternal copy. Out of 23 pairs, 22 pairs are said to be autosomes and one pair is called sex chromosome. These pairs contain half chromosomes form mother and half from father. At the time of fertilisation, the egg cell fuse with the sperm cell which is haploid (n) to form zygote. Zygote is diploid (2n) which contains 23 pairs of chromosomes from mother and we from father. In this way, an equal genetic contribution of male and female parents is ensured in the progeny.

Q12. Only variations that confer an advantage to an individual organisms will survive in a population. Do you agree with this statement? Why or why not?

Ans. We agree with this statement that only variations that confer an advantage will survive in a population. All the variations do not have an equal chance of surviving in the environment in which they find themselves. The chances of survival depends on the nature of variations. Different individuals would have different kinds of advantages. A bacteria that can withstand heat will survive better in a heat wave. Selection of variants by environmental factors forms the basis for evolutionary processes.