Chapter – 9 Heredity and Evolution

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Q1. If a trait A exists in 10% of 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:

The trait B which exists in 60% of the population is likely to have arisen earlier. This is because the traits produced in an organism during successive generations get accumulated in the populations of the species.

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

Answer:

Due variations, a species adjust to the changing environment. And promotes the survival of the species. Example, 'heat resistant' variation in some bacteria will ensure its survival, when the temperature rises due to a heat wave, the bacteria which did not have this variation would not survive under and will die.

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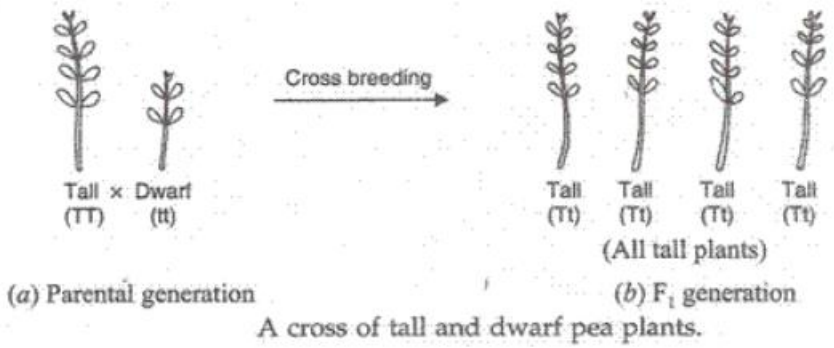
Q1. How do Mendel's experiments show that traits may be dominant or recessive?

Answer:

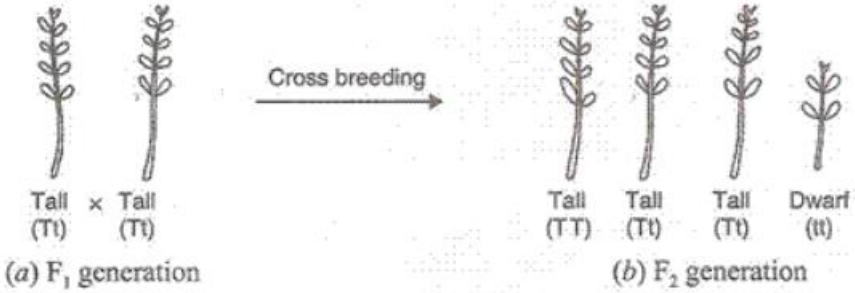
Mendel crossed tall pea plants with dwarf pea plants and found that tall pea plants were produced in the first generation or F_1 generation. No dwarf pea plants (or short pea plants) were produced in the first generation of progeny.



A cross of tall and dwarf pea plants.

Mendel concluded that the first generation (or F_1 cross) showed the traits of the parent plants: tallness, dwarfness did not show up in the progeny of first generation.

Mendel then crossed the tall pea plant of the first generation $(F_1\ generation)$ and found that tall the first dwarf plants were obtained in the second generation $(or\ F_2\ generation)$ in the ration 3:1. In F_2 generation, three-fourth plants were tall and one-fourth were dwarf. Mendel observed that the dwarf trait which disappeared in the first-generation progeny, reappeared in the second generation.



A cross of tall plants of F_1 generation.

Thus, trait of dwarfness had not been lost, it was merely supressed in the first-generation to re-emerge in the second-generation. Mendel named the repressed trait of 'dwarfness' as 'recessive trait' and the expressed trait of 'tallness' as the 'dominant trait'. This is how Mendel's experiments with tall and dwarf pea plants showed that the traits may be dominant or recessive.

Q2. How do Mendel's experiment show that traits are inherited independently?

Answer:

When Mendel crossed pure-breed tall pea plant plants with pure-breed dwarf pea plant, he found the tall pea plants were produced in the F_2 generation. Now, when Mendel crossed the tall pea plants of the F_1 generation, tall plants and dwarf plants were obtained in the ration 3:1 in the F_2 generation. There were no plants with medium height. In this way, the traits are inherited independently. This is because if the traits had blended, then medium sized pea plants have been produced.

Q3. 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?

Answer:

No, this information is insufficient to tell us which of blood group A or blood group O, is dominant. This is because:

i) If the blood group A is dominant and blood group O is recessive trait, the daughter have blood group O, and

ii) the blood group A is recessive but blood group O is dominant trait, the daughter still has blood group O.

Possibility 1: When blood group A is dominant trait but blood group O is recessive trait.

When father's blood group A is dominant trait, it has two genotypes: I^AI^A and I^AI^O. And when mother's blood group O is recessive trait it has one genotypes: I^OI^O. if one recessive allele I^O is from father and one recessive allele I^O is from mother, then the daughter has the genotype I^OI^O with blood group O.

Possibility 2: When blood group A is recessive but blood group O is dominant trait

When father's blood group A is recessive trait, it has one genotype: I^AI^A. And when mother's blood group O is dominant trait, then it has two genotypes: I^OI^O and I^OI^A, if one dominant allele I^O is from the mother and one recessive allele I^A is from the father, the daughter has genotype I^OI^A with blood group O.

Q4. How is the sex of the child determined in human beings?

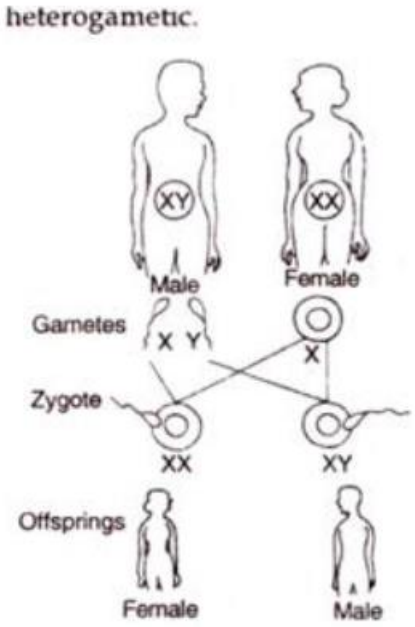
Answer:

Genetics help in the determination of the sex of a child, the chromosomes which are called sex chromosomes, one is called X chromosome and the other is Y chromosome.

i) A male has X chromosome and Y chromosome, that is half the sperms have X chromosomes and the other have Y chromosome.
ii) A female has two X chromosome, which means that all the female ova have X chromosome.

The sex of a child depends on:

a) If a sperm carrying X chromosome fertilisers an ovum which carries X chromosome, then the child born will be a girl, because the child will have XX combination of sex chromosomes.
b) If a sperm carrying Y chromosome fertilisers an ovum which carries X chromosome, then the child is a boy, as it have XY combination of sex chromosome.



Determination of sex of a child

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Q1. 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 increase in a population are:

i) Process of natural selection, the characteristics of individual organism to survive and reproduce are passed on to offspring.
ii) Process of genetic drift caused by changes in the frequencies of particular genes.

Q2. Why are the trait acquired during the life-time of an individual inherited?

Answer:

For a trait to be inherited, it brings change in the genes present in the reproductive cells of organism. The trait acquired during the life-time of a person do not bring about a change in the genes present in its gametes and hence they are not inherited by the offspring.

Q3. Why are the small number of surviving tigers a cause of worry from the point of view of genetics?

Answer:

a species completely become extinct and its genes are lost. The small number of surviving tigers are a cause of worry because if they all become extinct, their genes will be lost for ever.

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Q1. What factors could lead to the rise of a new species?

Answer:

The important factors which lead to the rise of a new species are the following:

i) Geographical isolation of a population caused by barriers like mountain ranges, rivers and sea leads to reproductive isolation due to which there is no flow of genes between separated groups of population.
ii) Genetic drift caused by drastic changes in the frequencies of particular genes.
iii) Variation due to natural selection.

Q2. Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?

Answer:

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

Q3. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually?

Answer:

Geographical isolation is not a major factor in the speciation of an asexually reproducing organism as it does not require any other organism for reproduction.

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Q1. Give an example of the characteristics being used to determine how close two species are in evolutionary terms.

Answer:

The changes in DNA are responsible for evolution which go on accumulating from one generation to the next. So, if the changes in the DNA of any two species are less, then the two species are close to one another. But if the changes in the DNA of two species are more, then the two species are far apart from one another.

Q2. Can the wings of a butterfly and the wings of a bat be considered homologous organs? Why or why not?

Answer:

The wings of a butterfly and a bat are not homologous organs because though the function of wings is the same but they have different design. The butterfly has a fold of membranes as wings with a few muscles but no bones. A skeleton made of bones supports the bat's wings.

Q3. What are fossils? What do they tell us about the process of evolution?

Answer:

The remains of dead animals or plant are known as fossils which is evidence for evolution. Example, a fossil bird called Archaeopteryx looks like a bird but has features of reptiles. Archaeopteryx has feathered wings like birds but teeth and tail like reptiles. Archaeopteryx is a connecting link between the reptiles and birds, and hence the bird has evolved from the reptiles. Thus, fossils provide the evidence that the present animals have originated from existing ones through the process of continuous evolution.

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Q1. Why are human beings who look so different from each other in terms of size, colour and looks said to belong to the same species?

Answer:

The human beings who look so different in size, colour and looks belong to the same species (Homo sapiens) because they can interbreed.

Q2. 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 than spiders, fish and chimpanzees, because though bacteria is simplest and primitive life forms but it inhabits and survives in hot springs, deep-sea thermal vents harsh environments.

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Q1. A Mendelian experiment consists 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 suggest that the genetic make-up of tall parent can be depicted as:

a) **TTWW**
b) **TTww**
c) **TtWW**
d) **TtWw**

Answer: Option c)

T is the gene for tallness, t is the gene for dwarfness, W is the gene for violet colour and w is the gene for white colour. All the progeny bore violet flowers, so the parent tall plant contains dominant genes for colour. the parent plant has the gene pair WW, half of progeny plants were short, this means parent tall plant contain genes for tallness as well as shortness. That is, the parent plant has genes Tt. Now, combining Tt and WW the genetic make-up of the parent plant becomes TtWW.

Q2. An example of homologous organs is:

a) **Our arm and a dog’s foreleg**
b) **Our teeth and an elephant’s tusks**
c) **Potato and runners of grass**
d) **All of the above**

Answer: Option d)

All of the pairs mentioned above are structurally same and have similar evolution.

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

a) **A Chinese school boy**
b) **A chimpanzee**
c) **A spider**
d) **A bacterium**

Answer: Option a)

As far as evolution is concerned, the organisms belonging to the same species have more in common than organism belonging to different species of the same genus or different genus. We have more in common with a Chinese school-boy because both belongs to the same species of Homo sapiens and thus share a common ancestor.

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?

Answer:

Children with light-coloured eyes are have parents with light-coloured eyes, we cannot say, the light eye colour trait is dominant or recessive., because two copies of a trait are inherited from both parents. Recessive traits appear when both the parents contribute recessive gene.

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

Answer:

The classification of organisms is their evolutionary relationships. Classification is based on similarities and differences amongst organisms:

i) The more characteristics two organisms have in common, the more closely they are related. And they will have common ancestor in the evolutionary chain.
ii) The more different characteristics two organisms have, the more remotely they are related. And they will have common ancestor in the more remote past.

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

Answer:

Those organs which have different basic structure but similar appearance and similar functions are called analogous organs. The wings of an insect and bird are analogous organs. The wings of an insect and a bird have different structures but they perform the same function of flying.

Those organs which have the same basic structure but different functions are called homologous organs. The forelimbs of humans and a lizard are homologous organs. Both these organs have the same basic design of bones but they perform different functions. The forelimbs of a human are used for grasping whereas the forelimbs of a lizard are used for running.

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

Answer:

to find the dominant coat colour or hair colour in dogs, first select pure-bred male and female dogs having black colour and pure-bred male and female dogs having brown colour. Then:

i) Cross the pure-bred black male dog with pure-bred brown female dog
ii) Cross the pure-bred brown male dog with pure-bred black female dog.
iii) If all the progeny are black in colour, then black will be the dominant coat colour in dogs.
iv) If all the progeny are brown in colour, then brown will be the dominant coat colour in dogs.

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

Answer:

The importance of fossils is that they provide evidence that the present animals (and plants) have originated from existing animals through the process of evolution. Example, a fossil bird called Archaeopteryx looks like a bird but it has features of reptiles, because Archaeopteryx has feathered wings like birds but teeth and tail like reptiles. Archaeopteryx is, a connecting link between the reptiles and birds and hence birds have evolved from the reptiles.

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

Answer:

The evidence for the origin of life from inanimate matter was shown by an experiment, conducted in 1953, by Stanley L. Miller and Harold C. Urey, they assembled an atmosphere of ammonia, methane and hydrogen sulphide, but no oxygen, over water, similar to atmosphere that exist on early earth, maintained at a temperature below 100°C and sparks were passed through the mixture of gases to simulate lightning. At the end of a week, 15% of the carbon from methane was converted to simple compounds like amino acids which make protein molecules and support the life in basic form. From this it was inferred that life arose afresh on earth.

Q10. Explain how sexual reproduction gives rise to move viable variations than asexual reproduction. How does this affect the evolution of those organisms that reproduce sexually?

Answer:

a) The asexual reproduction gives small variations because in this process the DNA of one parent is copied. Due to this, the offspring produced look same. Example, sugarcane reproduces by the process of asexual reproduction with little variations in various sugarcane plants. All look alike. Sexual reproduction gives large variations because DNA from the gametes of two parents male and female is combined together. Example, due to the large variations by sexual reproduction, no two human beings look alike.
b) The large genetic variations during sexual reproduction led to the continuous evolution of those organisms which reproduce sexually. Sexual reproduction plays an important role in the origin of new species having different characteristics.

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

Answer:

The genetic contribution of male and female parents in a progeny is through the gametes which have half the amount of DNA as compared to other body cells, called non-reproductive cells. So, when the gametes from male and female parents combine to form a fertilised egg called zygote, they contribute equal amount of DNA. Example, the normal body cells of human beings contain 46 chromosomes each (made of DNA), the human sperm cell has 23 chromosomes and the human egg cell has also 23 chromosomes. Hence, the combination of 23 chromosomes from male and 23 chromosomes from female during sexual reproduction ensures equal genetic contribution in the progeny to give 23 + 23 = 46 chromosomes.

Q12. 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, variations that confer advantage to an individual organism will survive in a population. Suppose there is a population of red beetles in the green bushes and a colour variation arises during reproduction so that one beetle is green in colour. This variation offers advantage of survival because the green beetle can mix up with green bushes, it cannot be spotted and eaten by a crow and its population will increase. If the variation had produced a blue coloured beetle, then this colour could not offer any survival advantage because blue beetle in green bushes could be easily spotted by a crow and eaten by it.