THE VILLAGE
INTERNATIONAL SCHOOL
"We Nurture Dreams"

CHAPTER : 9

HEREDITY AND EVOLUTION

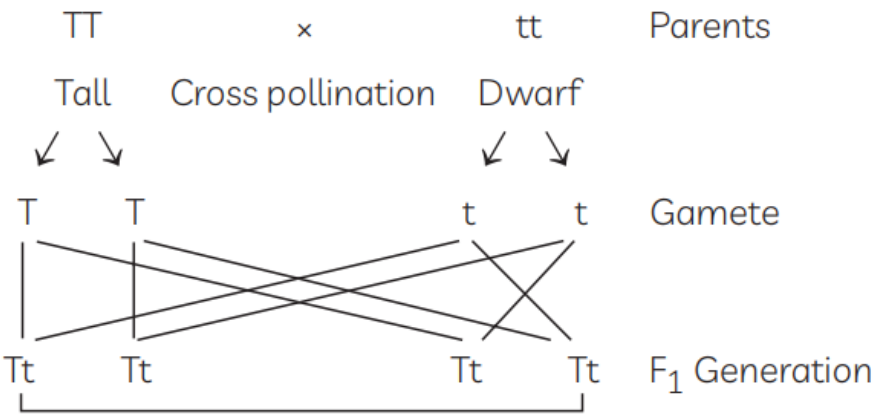
Question bank

1. Mendel took tall pea plants and short pea plants and produced F1 progeny through cross-fertilisation. What did Mendel observe in the F1 progeny?
   Ans. When Mendel cross fertilized tall pea plants and short pea plants, he observed that all plants in the F1 progeny were tall.
2. . In a study it was found that fused ear lobes were found in more numbers within a population rather than free ear lobes. What can you infer from the above observation with respect to dominant / recessive trait?
   Ans. It can be inferred from the observation that fused ear lobes were found in more numbers within a population that fused ear lobes is a dominant trait whereas free ear lobes is a recessive trait
3. The gene type of green stemmed tomato plants is denoted as GG and that of purple stemmed tomato plants as gg. What colour of stem would you expect in F1 progeny when these two are crossed?
   Ans. As green stem is a dominant trait as compared to purple stem, the colour of stem would be green in F1 progeny.
4. Mendel crossed the round and green seeded pea plants with the wrinkled and yellow seeded pea plants. Give the phenotypic ratio of F2 generation.
   Ans. The phenotypic ratio of F2 generation when round and green seeded pea plants were crossed with the wrinkled and yellow seeded pea plants is: Round Yellow : Round Green : Wrinkled Yellow : wrinkled Green = 9 : 3 : 3 : 1.
5. If a pure tall pea plant is crossed with a pure dwarf pea plant, then in F1 generation only tall plants appear. What happens to the traits of the dwarf plant?
   Ans. Although in F1 generation only the tall plants appear, both the tallness and dwarfness traits are inherited in the F1 plants but as the tallness trait is dominant, it is expressed, whereas, dwarfness trait being recessive is not expressed. It is expressed in F2 generation.
6. Are there any organisms where sex of the new-born is not genetically determined? Give example.
   Ans. Yes, there are organisms in which sex of the new-born is not genetically determined. An example is snail, which can change its sex.
7. How is the normal number of chromosomes restored in the progeny of sexually reproducing organisms?
   Ans. Each cell has two copies of each chromosome, one each from the male and female parents. Each germ cell or gamete takes one chromosome from each pair and when two germ cells combine, the original number of chromosomes is restored in the progeny.
8. Do all variations in a species have equal chances of surviving in the environment in which they find themselves?
   Ans. No, all variations in a species do not have equal chances of surviving in the environment in which they find themselves. Depending upon the nature of variations, each individual would have different advantages of survival.
9. Give reason: Phenotypic and genotypic ratios are different.
   Ans. The phenotypic ratio in F2 generation when F1 tall plants are crossed with each other is Tall : Dwarf = 3 : 1 Whereas, the genotype ratio will be TT : Tt : tt

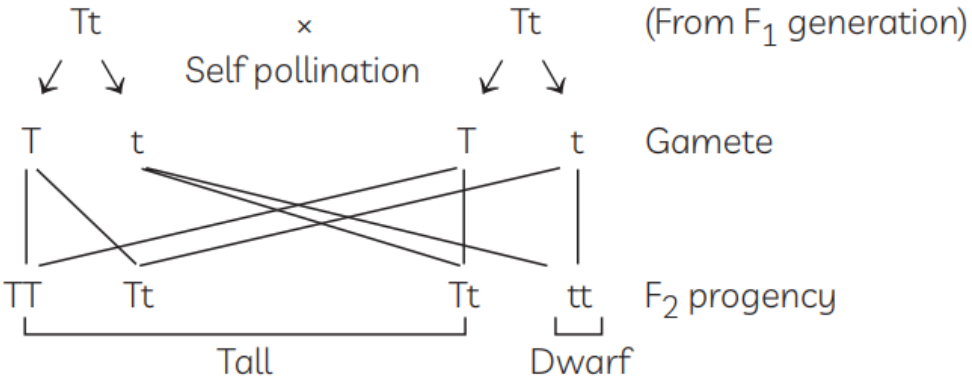
= 1 : 2 : 1 . Here, both TT and Tt refer to tall plants, they have the same phenotype but different genotype.

10. Why is the F1 progeny always of tall plants when a tall pea plant is crossed with a short pea plant?
How is F2 progeny obtained by self-pollination of F1 progeny different from C1 progeny? Give reason for this observation.
State a conclusion that can be drawn on the basis of this observation.

Ans. (A) F2 progeny always show the traits of only one of the parent plants.



(B) F1 progeny obtained by self pollination of F1 progeny is different from F1 progeny because both the parental traits are expressed in definite proportion in F2 generation.



(C) There are a pair of factors for each character eq. Tallness (TT). When gametes are formed these factors segregate and each gamete receives only one factor of each character. This is called Law of segregation.

11. Why did Mendel carry out an experiment to study inheritance of two traits in garden-pea?
What were his findings with respect to inheritance of traits in F1 and F2 generation?
State the ratio obtained in the F2 generation in the above mentioned experiment.

12. Ans. (A) Mendel carried out an experiment to study inheritance of two traits in garden pea to see the interaction and basis of inheritance between them. He also concluded that also traits segregate during gamete formation and fnally he gave three laws. (1) Law of segregation (2) Law of Dominance (3) Law of Independent Assortment (B) Mendel observed that—In F1 generation, feature of only one parental type appear. The features of other parents were not expressed. He called the first one which appeared as dominant features/ character and the other features which did not appear called them as recessive. The characters are not

lost even when they are not expressed. When F1 of springs were allowed to be self pollinated, both the parental traits were expressed in definite proportion in F2 generation. He had started with two combinations of characteristics and two new combinations of characteristics and appeared in F2 generation. From the F2 generation of a dihybrid cross Mendel postulated that inheritance of factors which control a particular trait in an organism are independent of the other. This is called law of Independent Assortment. (C) Ratio obtained in the F2 generation in the above mentioned experiment 9 : 3 : 3 : 1

13. In one of his experiments with pea plants Mendel observed that when a pure tall pea plant is crossed with a pure dwarf pea plant, in the first generation (F1) only tall plants appear. (a) What happens to the trait of dwarfness in this case? (b) When the F1 generation plants were self-fertilised, he observed that in the plants of second generation, F2 both tall plants and dwarf plants were present. Why it happened? Explain briefly.
Ans: (a) In the F1 generation, the trait of dwarfness is recessive. (b) Both parents contribute equally in sexual reproduction. So each pea plant inherited genes of both tallness and dwarfness in the F1 generation. But only the dominant trait, tallness got expressed. When F1 plants are crossed, in the F2 generation, there are some plants (25%) which carry only the dwarfness character and hence the same got expressed in the F2 generation.
14. In a monohybrid cross between tall pea plants (TT) and short pea plants (tt) a scientist obtained only tall pea plants (Tt) in the F1 generation. However, on selfing the F1 generation pea plants, he obtained both tall and short plants in F2 generation. On the basis of above observations with other angiosperms also, can the scientist arrive at a law? If yes, explain the law, if not, give justification for your answer.
Ans: On the basis of the experiment, the scientist can arrive at a law as below: (i) Both the parents must be contributing a copy of the same gene. (ii) For each trait, a plant carries two copies, one from each parents. (iii) If the copies of the traits are not same, the dominant trait shall gets expressed. (iv) When F1 generation are crossed, the recessive trait of F1 generation shall also get expressed in the F2 generation at a ratio of 3:1.
15. "We cannot pass onto our progeny the experiences and qualifications earned during our life time". Justify the statement giving reason and examples.
Ans: Experiences of life and qualifications we earn do not make any change in the genes of the individual. Changes made in the gene are only passed on from one generation to the next. These qualities are acquired by an individual in his life, and are called acquired traits which cannot be passed on to future progeny. For example, if a person reads a book on birds, the knowledge he earns by reading the book does not make any change in his genes. Hence, this knowledge will not get automatically transmitted to his next generation.
16. A pea plant with blue colour flower denoted by BB is cross-bred with a pea plant with white flower denoted by ww.
    (a) What is the expected colour of the flowers in their F1 progeny?
    (b) What will be the percentage of plants bearing white flower in F2 generation, when the flowers of F1 plants were selfed?
    (c) State the expected ratio of the genotype BB and Bw in the F2 progeny.
Ans. a) All flowers in F1 progeny will be blue in colour. (b) When F1 progeny are selfed, 25% of the flowers in F2 progeny will be white. (c) Expected ratio of the genotype BB and Bw will be 1 : 2.
17. "It is a matter of chance whether a couple will have a male or a female child." Justify this statement by drawing a flow chart.

Ans: There are 23 pairs of chromosomes present in human beings. Out of these 23 pairs, one pair is of sex chromosomes. There are two type of sex chromosomes found in human being, X and Y. A female has X chromosomes and a male has one X and one Y chromosome.

Sex of a child depends on what happens during fertilization:

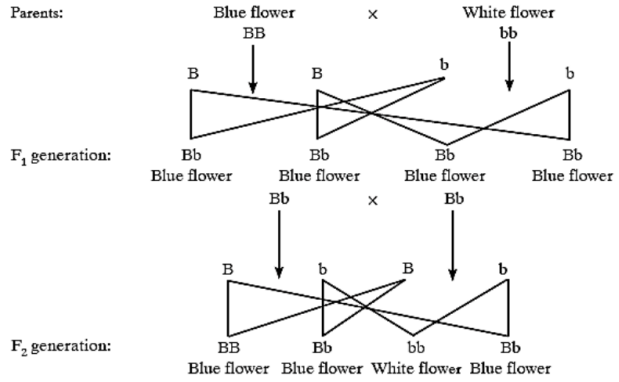
(i) The female gamete, ova always contribute an X chromosome during fertilization. (ii) The male gamete, sperm contributes either X or Y chromosome during fertilization. But whether sperm will contribute the X chromosome or Y chromosome is a matter of chance and the man do not have any control on it. (iii) If a sperm carrying X chromosome fertilizes an ova which always carries an X chromosome, then the child born will be a girl. But if a sperm carrying Y chromosome fertilizes an egg which always carries X chromosome, then the child born will be a boy. (iv) Thus, sex of a new born child is a matter of chance and none of the parents may be considered responsible for it.

18. "It is possible that a trait is inherited but may not be expressed." Give a suitable example to justify this statement.
Ans: The statement "It is possible that a trait is inherited but may not be expressed" can be explained with the help of Mendel's experiment on pea plant with one visible contrasting character. Mendel took pure breeding pea plant with one visible contrasting character viz. height of the plant (tall and short plant). The pure breed tall and short plant were crossed and it was found that all the plants in the F1 progeny were tall. Mendel then allowed the F1 progeny plants for self-pollination. It was found that all the F2 progeny plants are not tall, some are short. This indicates that both tallness and shortness traits were inherited separately in the F1 progeny but shortness trait was not expressed in the F1 progeny.

19. How do Mendel's experiment show that traits are inherited independently?
Ans: Mendel performed an experiment in which he took two different traits like tall and dwarf plant and round and wrinkled seeds. In second (F2) generation, some plants were tall with round seeds and some were dwarf with wrinkled seeds. There would also be dwarf plants having round seeds. Thus, the tall/short traits and round/wrinkled seed traits are independently inherited.

20. Explain with the help of suitable examples why certain traits cannot be passed on to the next generation. What are such traits called?
Ans: There are certain traits which are developed during the lifetime of an individual. For example, many people get their gall bladder removed by surgery due to certain complications. But the children of these people are born with gall bladder. Thus, this trait is not passed on from one generation to the next generation. Traits whose characteristics are not genetically controlled and cannot be passed on from one generation to the next generation are called acquired traits.

21. A blue coloured flower plant denoted by BB is crossbred with that of white coloured flower plant denoted by bb. (a) State the colour of flower you would expect in their F1 generation plants. (b) What must be the percentage of white flower plants in F2 generation if flowers of F1 plants are self-pollinated? (c) State the expected ratio of the genotypes BB and Bb in the F2 progeny.

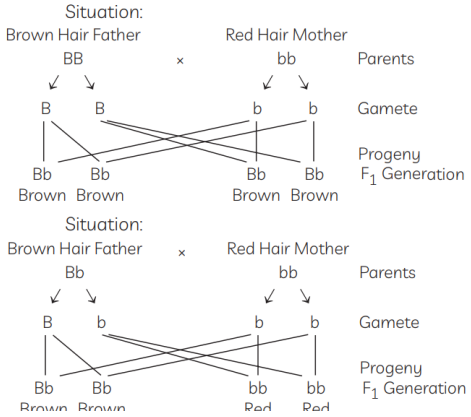


(a)The colour of all the flowers in F1 generation will be blue. (b) Percentage of white flower plants in F2 generation will be 25. (c) The ratio of genotypes BB and Bb in F2 progeny will be 1 : 2.

22. If we cross pure-bred tall (dominant) pea plant with pure-bred dwarf (recessive) pea plant we will get pea plants of F1 generation. If we now self-cross the pea plant of F1 generation, then we obtain pea plants of F2 generation. (a) What do the plants of F1 generation look like? (b) State the ratio of tall plants to dwarf plants in F2 generation. (c) State the type of plants not found in F1 generation but appeared in F2 generation, mentioning the reason for the same.
Ans: (a) All plants of F1 generation will be tall plant. (b) 3 : 1 (c) Dwarf trait is recessive trait which was not expressed in the F1 generation, the recessive trait gets expressed in the F2 generation after self pollination.

23. How do organisms, whether reproduced asexually or sexually maintain a constant chromosome number through several generations? Explain with the help of suitable example.
Ans: In sexually reproducing organisms the parents are diploid (2N) as each of them has 2 sets of chromosomes. They form haploid (1N) male and female gametes through the process of meiosis. The haploid gamete has one set of chromosomes. Since these gametes fuse during fertilisation the original number of chromosomes is restored in the offspring. In asexually reproducing organisms only one parent is involved. The part of the body which develops into a new organism contain cells having same number of chromosomes as any other cell in the body of the organism. This separated part only develops into a new organism.

24. A red haired woman marries a brown haired man, and all the children are brown haired. Explain this genetically.
Ans. A red haired woman marries a brown haired man, and all the children are brown haired. The brown hair colour genes are dominant to the red hair colour genes. A brown haired man can have BB factors or Bb as only one dominant factor expresses itself in the next generation.



In situation 1 brown hair man bas a pure strain i.e. BB and all the children an brown haired. (2) In situation 2 brown hair man carriers recessive red coloured hair trait gametes formed fertilize and results into 50% brown and 50% red haired children. So in the given situation, brown haired man has passed the pure factors i.e., BB because all the children are brown haired. That is why the children were having brown coloured hairs.

25. Mention the function of cellular DNA. Taking tallness as a characteristic for a plant, explain how proteins control the characteristic.
Ans. The major function of the DNA is to store information and pass it to offspring. It also directs the synthesis of proteins, which are necessary for a cell to perform its functions. The part of DNA that provides information for protein synthesis is called gene. Proteins control specific characteristic or trait of an organism. For example, a plant species has gene for the characteristic called 'tallness'. Now, the gene for tallness will give orders to the plant cells to make a lot of plant growth hormones. Due to the formation of excess of plant growth hormones, the plant will grow tall. If the plant has genes for dwarfness, then plant growth hormones production will be low. As a result, the plant will not grow tall and will remain short. The above examples explain how proteins control the characteristic.
26. Give reasons for the appearance of a new combination of characters in the F2 progeny.
Ans. F1 plants have round and yellow seeds. In F1 generation, the dominant alleles suppress the recessive ones. So, as a result, only dominant alleles are expressed. Thus, all the progenies in the F1 generation; showed dominant traits only. However, genes for recessive traits were present in all the plants. When the F1 generation is crossed, it gives rise to new combinations in the F2 generation with round-yellow, round-green, wrinkled yellow and wrinkled-green in the ratio of 9: 3: 3: 1. This indicates that the chances for the pea seed to be round or wrinkled do not depend on their chances to be yellow or green. Each pair of alleles is independent of the other pair. This is known as 'principle of independent assortment'.

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