

Chapter – 8

Heredity and Evolution

Questions:

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

Questions:

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 F₁ 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.

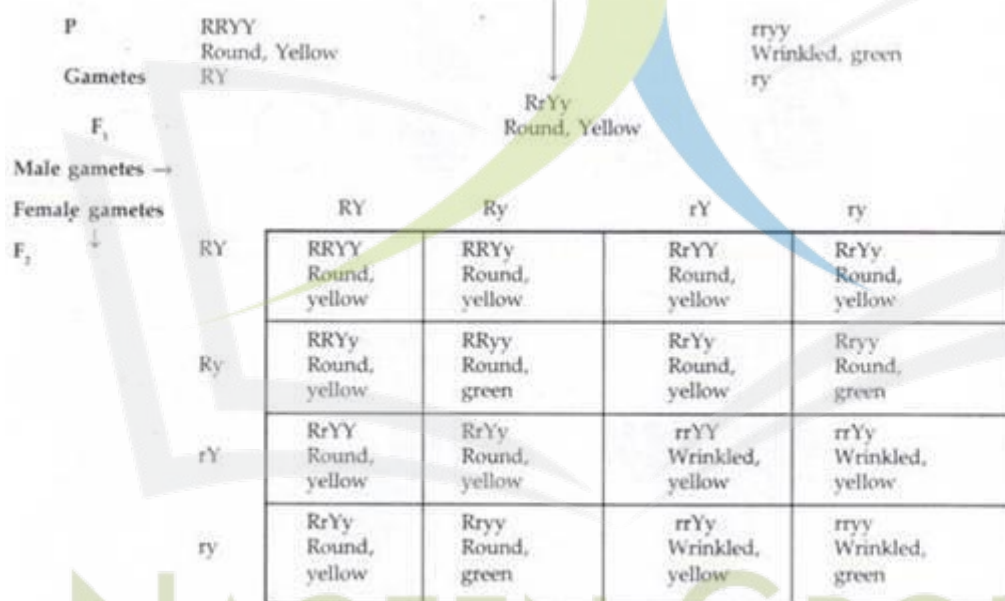


Fig. 5.15: Results of a dihybrid cross between pure breeding plants with round, yellow and wrinkled, green seeds and Mendel's explanation for the mode of inheritance.

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 O -is dominant? Why or why not?

Answer:

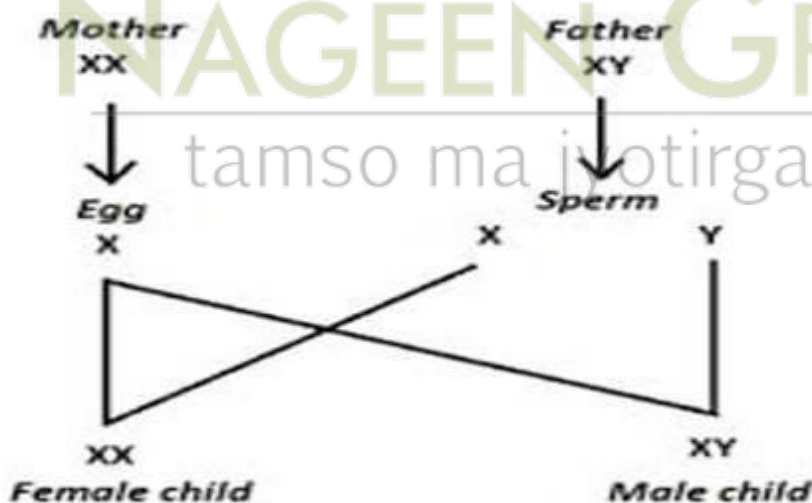
Case 1: Man with blood group A married a woman with blood group O. Blood group for man can be expressed by dominant genotype $I^A I^A$ or $I^A I^O$ and blood group O for woman is expressed by recessive genotype $I^O I^O$. The daughter will have O blood group type as a result of this $I^O I^O$ inheritance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

Case 2: Blood group A in father if has recessive genotype $I^A I^A$ and mother has dominant genotype $I^A I^O$ or $I^O I^O$. 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.



Questions:

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:

- 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 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.3 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.4 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.