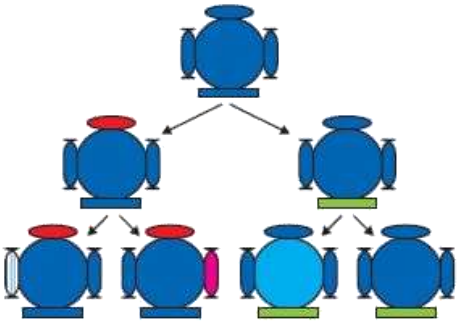
Heredity

8 Chapter

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?

Ans: Asexual reproduction requires the involvement of a single parent and does not involve the fusion of haploid gametes. In this, the offspring produced are identical to the parents i.e., they are a nearly exact copy of their parents DNA. However, sometimes, copying of DNA is similar but not identical to the original which leads to change in variations. Hence, the newly formed DNA has some variations giving rise to a new trait. Thus, future generations inherit this trait and successive generations keep accumulating variations. Thus, if 10% of the population exists in trait A and 60% of the same population exists in trait B, it can be concluded that trait B has arisen earlier because the trait continued to replicate and exist in a higher percentage of the population.

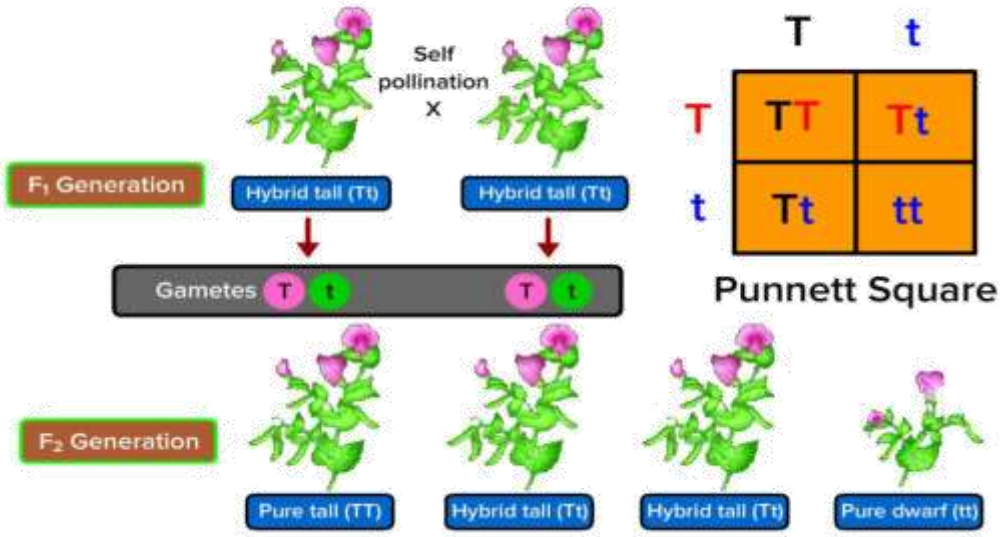


2. How does the creation of variations in a species promote survival?

Ans: In any circumstances, species get adapted to survive in a particular habitat. Sometimes, the habitat gets disturbed due to drastic changes in the environment and proves fatal for certain species. For example, many microorganisms inhabit freshwater ponds. The bacteria living in freshwater will get killed if there is a sudden temperature rise. it. However, some of the species will be able to survive in the heat of those who are resistant to it. These species will survive and reproduce within the changing environment. If there have been no heat-resistant variants, the whole species of bacteria would be extinct. Hence, the survival of species is promoted.

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

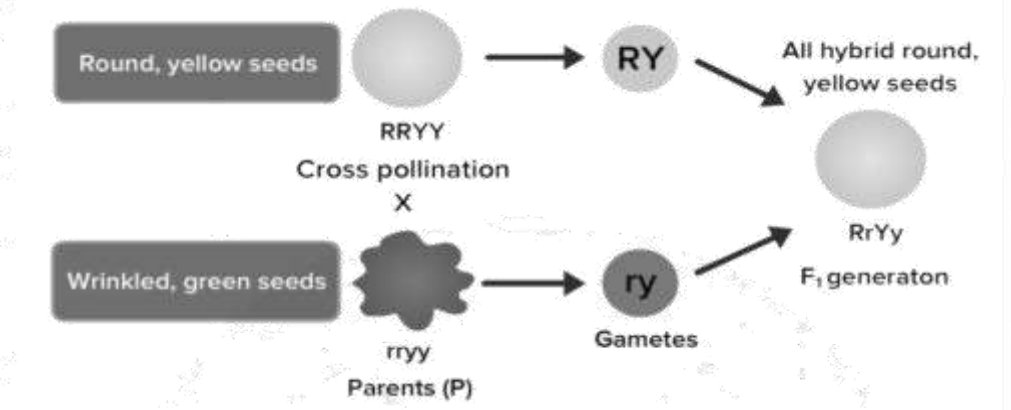
Ans: Mendel began his genetic experiment on pea plants in 1856 with a single character (with two alternative traits) called a monohybrid cross. The crossing was done between true-breeding tall plants (TT) and true breeding dwarf plants. In the first filial generation, he received only tall plants, no dwarf trait was seen. Now, Self-pollination of the F1 progeny was done which resulted in both tall and dwarf plants. Based on the monohybrid cross, Mendel's conclusion was made that out of the two traits of a character, one is dominant and the other is recessive. The dominant trait is an allele that always expresses itself externally while the expression of the recessive trait is masked in the presence of the dominant trait when present in homozygous or heterozygous conditions. Thus, the recessive trait is expressed only in homozygous conditions. Eventually, the tall plants present in F1 were not true-breeding. They were heterozygous (Tt) tall plants. Hence, the expression of the recessive allele (t) gets suppressed by the dominant allele.



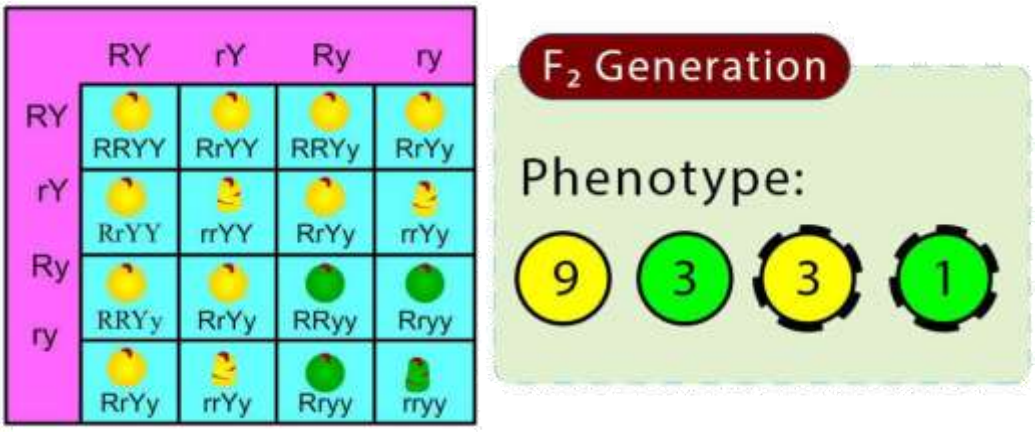
2. How do Mendel's experiments show that traits are inherited independently?

Ans: Mendel directed his attention to two pairs of contrasting characters. The cross which involves two pairs of alleles is known as a dihybrid cross. He did a hybrid cross on pea, taking two characters at a time. His dihybrid cross demonstrated an independent assortment of genes. Mendel chose seed colour and seed shape as the two characters for his experiment. Mendel crossed round and yellow seeds (RRYY) with wrinkled and green seeds (rryy) (parental generation). First filial generation (F1) showed all round and yellow seeds (law of dominance) since round seed shape

is dominant over wrinkled seed shape and yellow seed colour is dominant over green seed colour.



Self-pollination is the F1 generation that resulted in the F2 generation that showed a variety of seeds. In F2 progeny the yellow round seeds, green round seeds, yellow wrinkled seeds, and green wrinkled seeds were seen in the ratio of 9:3:3:1.



The F2 generation had two new variants of seeds - round green and yellow wrinkled (different from the parental types). Thus, the conclusion can be made that the genes for the two characters are assorted independently.

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?

Ans: No, the given information is not enough to tell whether which of the traits is dominant, either A or O.

Blood groups are inherited from our biological parents. It has three alleles A, B and O. This can be explained via two cases:

CASE I: When A is dominant and O is recessive

Combination of man can be I^AI^A OR I^AI^O

A combination of women will be I^OI^O

The blood group of a child is A when A is dominant and father is pure I^AI^A but the Blood group of children if the father is I^AI^O:

	I^o	I^o
I^A	I^A I^o	I^A I^o
I^o	I^o I^o	I^o I^o

Here 50% of the progeny is blood group A while 50% has blood group O when the father is heterozygous $_IA_IO$.

CASE II: When A is recessive and O is dominant

Combination of father - I^AI^A

Combination of the mother can be I^AI^O OR I^OI^O

Blood group of the child when a mother is I^AI^O:

	I^A	I^o
I^A	I^A I^A	I^A I^o
I^A	I^A I^A	I^A I^o

Here also 50% of the progeny has blood group A while 50% Of them has blood group O. The blood group of the child would have been O, mother was homozygous I^OI^O.

From the above cases, we conclude that the blood group of the child will be O if any of the characters are dominant. Thus, it is difficult to determine the dominant character.

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

Ans: In human beings, the sex of the child is determined by the chromosomal combination of parents. An ideal pair of sex chromosomes i.e. XX is seen in women, and a mismatched pair i.e. XY is seen in men. The eggs produced in females will carry the X chromosome and half of the sperms will carry the Y chromosome and the other half will carry the X chromosome in the case of males. Now, when

fertilization is done between them, two cases can be considered:
Case 1: when the egg fuses with a sperm carrying the Y chromosome, the child will be a boy.
Case 2: when the egg fuses with a sperm carrying an X chromosome, the offspring will be a girl.

Parents XX (Female) XY(Male)

↓

↓

Gametes X X Y

Female → Male↓	X	X
X	XX (female)	XX(female)
Y	XY (male)	XY (male)

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
(d) TtWw

Ans. (c) There are two flower colours violet and white but F1 showed only violet flowers which means that violet flower colour (V) is the dominant trait that masks the recessive trait (v) (white flower colour). The F1 progeny had half tall and half short plants. Thus, both dominant and recessive traits are expressed in the F1 progeny. So, it can be said that the tall plants were not true-breeding and must be genetically heterozygous for the character height (Tt). Hence, the genetic make-up of the tall parent can be represented as TtVV. Therefore, the cross involved in the given question is:

TtVV × ttvv
↓
TtVv − ttVv
Therefore, half the progeny is tall, but all of them have violet flowers.

2. 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: Children with light-coloured eyes can either have LL or Ll or ll genotypes. An assumption can be taken that the children have LL (both dominant alleles) genotype. This can be only when both the parents are also of the LL genotype.

LL × LL

↓

LL

If ll genotype is present in children with light-coloured eyes, then their parents will also have ll genotype.

II × II

↓

II

Therefore, it would be difficult to conclude whether light eye colour is dominant or recessive.

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

Ans: There are a variety of genes present in dogs that govern coat colour. At least eleven identified gene series (A, B, C, D, E, F, G, M, P, S, T) are present that influence coat colour in dogs.

One gene from each of its parents is inherited by the dog. The dominant gene gets expressed in the phenotype. For example, If, the "B" gene is inherited by a dog, it can be genetically either black or brown. Let us assume that :

(i) one parent is homozygous black (BB),

(ii) the other parent is homozygous brown (bb).

bb	BB		
		B	B
	b	Bb	Bb
	b	Bb	Bb

Since. Thus, the phenotype is black as black (B) is dominant so, all the offspring are black i.e. However, genotypically they are heterozygous for the B allele (Bb). That is all offspring are heterozygous black.

If the F1 heterozygous pups are crossed, they will produce 25% homozygous black (BB), 50% heterozygous black (Bb), and 25% homozygous brown (bb) offspring.

	B	b
B	BB	Bb
b	Bb	Bb

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

Ans: The somatic cell of the body of each human being contains 23 pairs of chromosomes. Out of the 23 pairs of chromosomes, 22 pairs are known as autosomes and the remaining one pair is called sex chromosomes which are represented as X and Y. Two X chromosomes are present in females and one X and one Y chromosome are present in males. In the process of gametogenesis (gamete formation), meiosis occurs and the gametes receive half the number of chromosomes. Therefore, the male gametes have 22 autosomes and either X or Y chromosomes. The female gamete, on the other hand, has 22 autosomes and X chromosomes.

In the process of sexual reproduction, male and female gametes fuse and the number of chromosomes is again restored in the zygote. Thus,

(i)From male- the progeny receives 22 autosomes and one X or Y chromosome from male parent and

(ii) From female- the progeny receives 22 autosomes and one X chromosome from the female parent.