CLASS X/ BIOLOGY

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HEREDITY AND EVOLUTION

Heredity : Heredity refers to the transmission of characters from parents to offsprings. An inherited trait is a particular genetically determined feature that distinguishes a person from the others for example; attached or free ear lobes in human beings.

Genes :Gene is the functional unit of heredity.
Every gene controls one or several particular characteristic features in living organisms

Mendel's Contribution

•Gregor Johann Mendel, known as 'Father of Genetics', was an Austrian Monk who worked on Pea plants to understand the concept of heredity.

•His work laid the foundation of modern genetics.

•He made three basic laws of inheritance – The Law of Dominance, The Law of Segregation and The Law of Independent Assortment.

Rules for the inheritance of traits:

The rules for inheritance of traits in human beings are related to the fact that both mother and father contribute an equal amount of genetic material i.e. DNA to their offspring. So an offspring will get two versions of that trait from the two parents. Mendel worked out rules for inheritance of these traits. Gregor Johann Mendel performed his experiments with garden peas (Pisum sativum) in the garden behind his monastery. He observed a number of contrasting characters in garden peas and observed their inheritance

Dominant traits

The traits that express themselves in an organism in every possible combination and can be seen are called Dominant traits.

•In Mendel's experiment, we see that tall trait in pea plants tends to express more than the short trait.

•Therefore, the tall trait of the plant is said to be dominant over the short trait.

Recessive traits

A trait which is not expressed in presence of a dominant allele is known as recessive.

•So, recessive character/trait is present in an organism but cannot be seen if a dominant allele exists.

Homozygous: A condition in which both the genes of same type are present for example; an organism has both the genes for tallness it is expressed as TT and genes for dwarfness are written as tt.

Heterozygous: A condition in which both the genes are of different types for example; an organism has genes Tt it means it has a gene for tallness and the other for dwarfness only tall character is expressed.

Genotype: It is genetic make up of an individual for example; A pure tall plant is expressed as TT and hybrid tall as Tt.

Phenotype: It is external appearance of the organism for example; a plant having Tt composition will appear tall although it has gene for dwarfness.

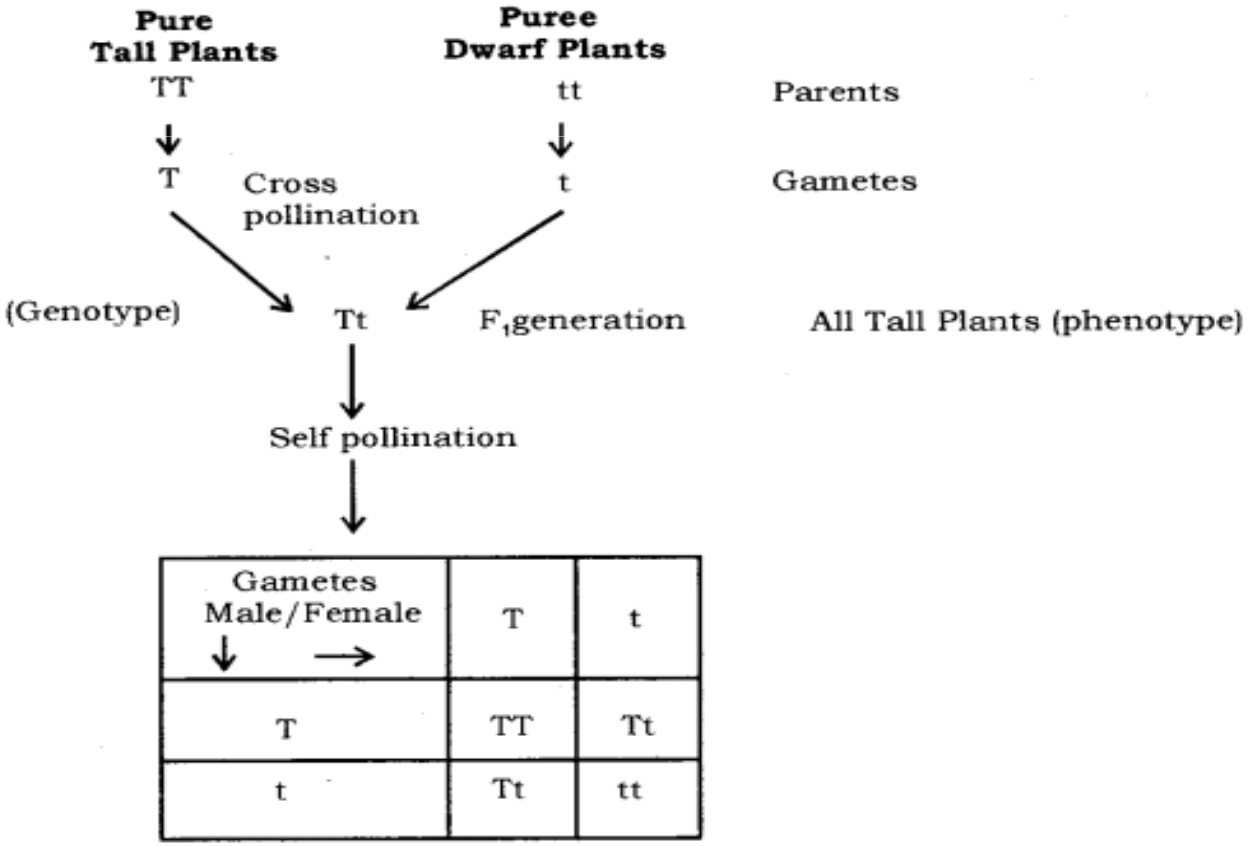
Monohybrid cross

•When only one character is considered while crossing two organisms, then such a cross is known as monohybrid cross.

•The ratio of characters, arising out of this cross, at F2 generation is called monohybrid ratio.

•E.g., If tall plant (TT) is crossed with a dwarf plant (tt), we get 3 tall:1 short plant at the end of the F2 generation.

•So, 3:1 is monohybrid ratio.



Gametes Male/Female ↓ →	T	t
T	TT	Tt
t	Tt	tt

he took pure tall (genotype TT) and pure dwarf (genotype tt) pea plants and cross pollinated them to obtain first generation or first filial generation. In this figuration (F1 generation) he obtained only tall plants. This meant that only one of the parental traits was seen, not the mixture of the two. The plants of F generation or progeny are then self pollinated to obtain F2 generation or progeny. Now all plants were not tall. He obtained 75% tall plants and 25% dwarf plants i.e. the phenotypic ratio was 3:1. This indicates that in the F, generation both tall and dwarf traits were inherited but tallness expressed it self. Tallness is a dominant trait and dwarfness is a recessive trait. F2 generation has a genotypic ratio of 1 : 2 : 1 of three types of plants represented by TT, Tt and tt as shown in the cross.

Conclusion: Phenotypic ratio—Tall : Dwarf 3 : 1

Genotype ratio—Pure Tall : Hybrid Tall : Pure Dwarf 1 : 2 : 1

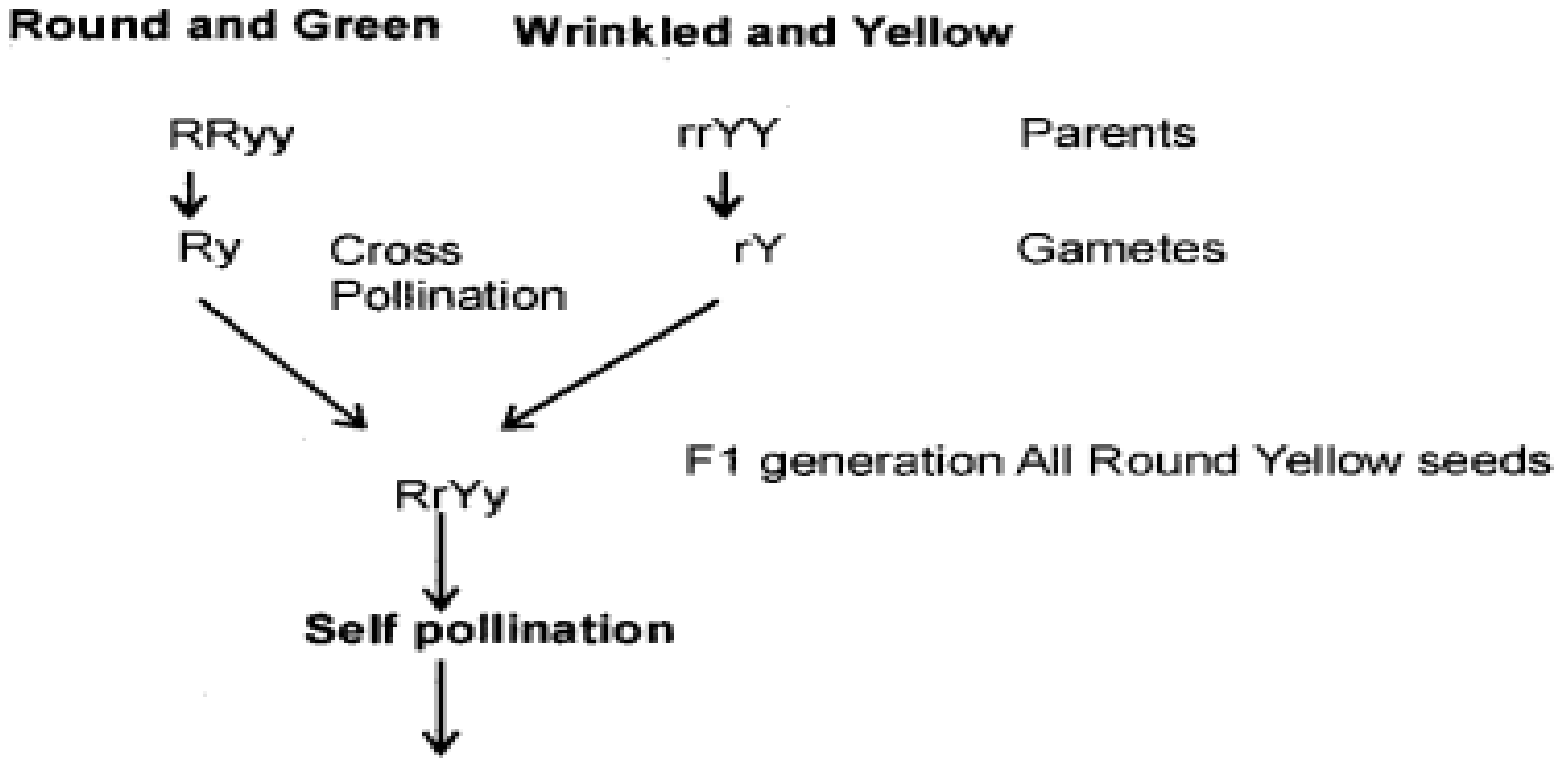
Law of Dominance: When parents having pure contrasting characters are crossed then only one character expresses itself in the Ft generation. This character is the dominant character and the character/factor which cannot express itself is called the recessive character.

Dihybrid Cross: Mendel also carried out experiments to observe inheritance of two pairs of contrasting characters, which is called dihybrid cross. He cross breed pea plants bearing round green seed with plants bearing wrinkled and yellow seeds. In the F1 generation he obtained all round and yellow seeds it means round and yellow traits of seeds are dominant features while wrinkled and green are recessive. He self-pollinated the plants of F: generation to obtain F2 generation, he obtained four different types of seeds round yellow, round green, wrinkled yellow and wrinkled green in the ratio of 9 : 3 : 3 : 1. He concluded that traits are independently inherited

Conclusion

- Round and yellow seeds-9.
- Round and green seeds-3.
- Wrinkled and yellow seeds-3.
- Wrinkled and green seeds-1.

•When two characters are considered while crossing two organisms, then such a cross is known as a dihybrid cross.
•The ratio of characters, arising out of this cross, at F2 generation is called dihybrid ratio.
•E.g., If a plant with round and green pea is crossed with a plant with wrinkled and yellow pea,
•The first generation plants would all have round and green pea.
•On crossing the same for an F2 generation, we would observe four combinations of characters in the ratio of 9:3:3:1.
•Thus, 9:3:3:1 is the dihybrid ratio.



Gametes	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Laws of Mendel

Law of Dominance says that a gene has two contrasting alleles and one always expresses itself in the organism.It is called the dominant gene and it expresses in any possible combination.

Law of Segregation says that traits get segregated completely during the formation of gametes without any mixing of alleles.

Law of Independent Assortment says that the traits can segregate independently of different characters during gamete formation.

Acquired Traits: Acquired traits are those which are not inherited over generations as they are caused due to change in the non-reproductive tissue and are not passed on the DNA of the germ cells for example if a person is a dancer child may not be good dancer.

Inherited Traits: Inherited traits are traits which are inherited from generation to generation.

Autosomes: Those chromosomes which do not play any role in sex determination.

Sex chromosomes: Those chromosomes which play a role in determining sex of the newborn.

- If the sperm having X chromosome fertilizes with ovum with X chromosome then the baby will have XX chromosome and it will be female.

If the sperm having Y chromosome fertilizes with ovum with X chromosome then the baby will have XY chromosomes and it will be male.

Sex determination in human beings: In human beings, all chromosomes are not paired. 22 chromosomes are paired but one pair called sex chromosome is odd in not having a perfect pair in males. Females have a perfect pair both represented by XX. On the other hand males have a normal sized X but the other is short called Y so it is shown as XY. All gametes or ova formed by the homogenetic female are similar i.e. have X chromosome. Males heterogenetic form two types of sperms i.e. half with X chromosome and the other half with Y chromosome. Sex of the baby will depend on fertilization. There are two possibilities :

Sex determination in human being (flow chart)