Class 10th

BIOLOGY

(SHORT NOTE)

HEREDITY AND EVOLUTION

Genetics: The study of heredity and variations.

Heredity: Heredity refers to the transmission of characters from one generation to the next generation.

Variations: The differences in characters of parents and offspring.

There are two types of variations:

SOMATIC VARIATIONS	GAMETIC VARIATIONS
They occur in the somatic cell of the body. They are not inherited or transmitted to the next generation.	They occur in the germ cells of the body. They are inherited to the next generation.

IMPORTANCE OF VARIATIONS:

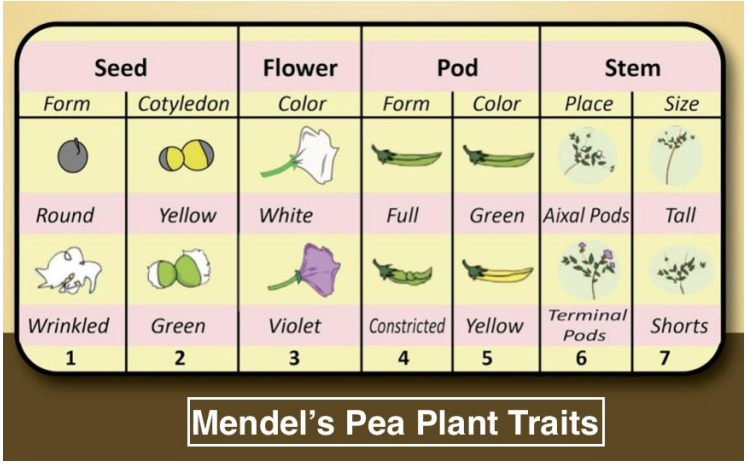
1. It is the basis of heredity.
2. It forms the basis of evolution.
3. It increases the chances of the survival of the organism according to the changing environment.

CAUSES OF VARIATIONS:

- The most common causes of variations are mutation, recombination and random mating.
- Recombination or crossing over is one of the important caused for variation.
- Recombination is the exchange of chromosome segments at the time of gamete formation.

CONTRIBUTION OF MENDEL IN GENETICS:

- G.J. Mendel started his work on ***Pisum sativum*** **(garden pea).**
- He was known as the **Father of genetics.**
- He had chosen seven pairs of contrasting characters



The reasons for choosing garden pea for the experiment were as follows:

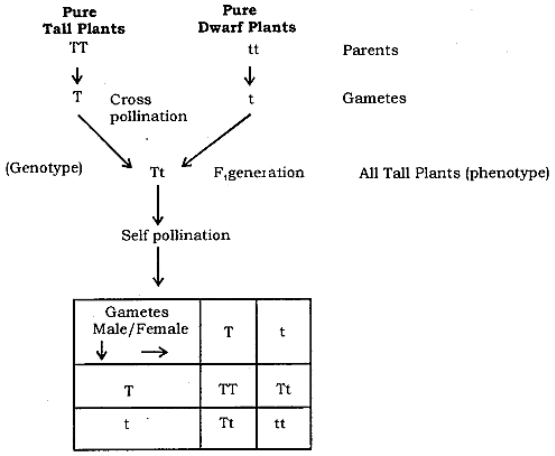
- Short life cycle.
- A large number of seeds produced.
- Self-pollination
- Several contrasting characters can be found in the pea plant. **(NTSE)**

MENDEL'S LAW OF INHERITANCE:

- **Law of Dominance:** If the two alleles at a locus differ, then one, the **dominant allele**, determines the organism's appearance; the other, the **recessive allele**, has no noticeable effect on the organism's appearance.
- **Law of Segregation:** The two alleles for a heritable character separate (segregate) during gamete formation and end up in different gametes.
- **Law of Independent Assortment:** Each pair of alleles segregates independently of other pairs of alleles during gamete formation.

MONOHYBRID CROSS:

When one pair of contrasting characters is taken to cross two pea plants, it is known as a monohybrid cross.

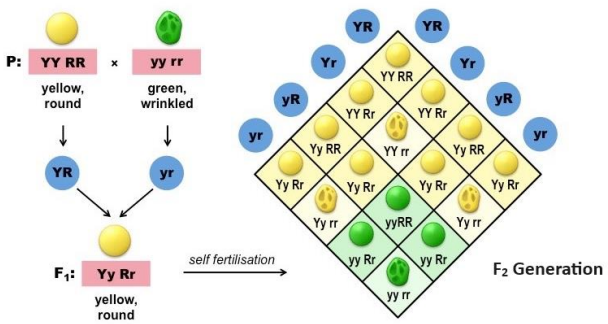


Conclusion:

- Phenotypic ratio: Tall : Dwarf (3 : 1)
- Genotype ratio: Pure Tall : Hybrid Tall : Pure Dwarf (1 : 2 : 1)

Dihybrid Cross

When two pairs of contrasting characters are taken to cross two plants, it is known as a dihybrid cross.



CONCLUSION:

The phenotypic ratio was found to be 9:3:3:1

9 : round yellow

3 : round green

3 : wrinkled yellow

1 : wrinkled green

But the genotypic ratio was found to be 1:2:1: 2:4:2: 1:2:1.

Sex Determination

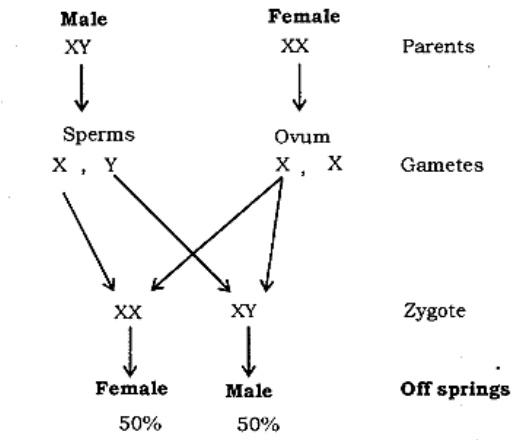
- Sex determination is used to determine the sex of the offspring.
- Environmental and genetic factors determine the sex of the offspring.
- In turtles, gender is determined by environmental factors such as temperature.

Types of Sex Determination

Different types of sex determination are as follows:

- XX-XY type (humans)
- XX-XO type (insects)
- ZW-ZZ type (birds)
- ZO-ZZ type (moths and butterflies).
- Genetic factors include the presence of sex chromosomes. For example, in humans, the presence of two 'X' chromosomes forms the female offspring whereas the presence of one 'X' and one 'Y' chromosome forms male offspring.
- In human beings, there are 23 pairs of chromosomes. Out of these, 22 pairs of chromosomes are known as **autosomes** whereas the "23rd" pair of chromosomes are known as sex chromosomes or **"allosomes"**. The sex of the offspring is determined by the chromosome inherited from the father. **(NTSE)**

Sex determination in human being (flow chart)



Evolution

- It is the sequence of gradual, irreversible changes which took place in the primitive organisms over millions of years to form new present-day species.
- Variations that resulted in formation of new species occurred basically due to errors in DNA copying as well as due to sexual reproduction.
- J.B. Lamarck was the first scientist who gave the theory of evolution. He gave the theory of **"inheritance of acquired characters".**
- Later on, Charles Darwin came and gave the "theory of natural selection" or **"Darwinism"**. According to his theory, evolution occurs through natural selection.

1. Theory of Lamarckism

This theory is also known as the "Theory of inheritance of acquired characters". Lamarckism is based on the following postulates:

1. Living organisms tend to increase in size.
2. New needs lead to the formation of new organs.
3. Continued use of a particular organ makes it more developed and disuse of an organ leads to its degeneration.
4. New characters are acquired by individuals during their lifetime.

2. Theory of Darwin

Darwin's theory was also known as the "Theory of Natural selection".

Postulates of Darwin's theory:

1. Speciation (formation of species): Useful variations from generation to generation gives rise to the formation of new species.
2. The struggle of existence due to the multiplication of organisms and limited food and space, there exists competition among the organisms.
3. Survival of the fittest or Natural selection: Nature selects those characteristics or organisms that are useful and are best adapted to the prevailing conditions. For example, "industrial melanism observed in peppered moths in Britain"

Speciation

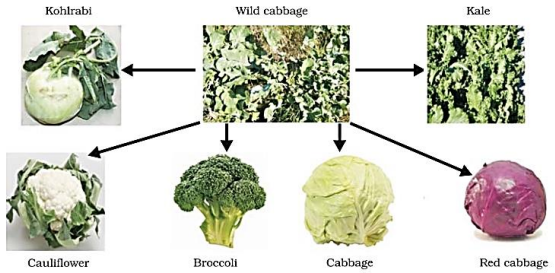
The origin of new species from already existing species is known as speciation. Speciation can take place through:

1. **Gene flow** can lead to speciation. It is a transfer of genetic variations from one population to another.
2. Random change in allele frequency known as **genetic drift** which can also lead to speciation.
3. **Natural selection** is another reason through which speciation can take place.
4. Geographical barriers such as mountains, rivers can also lead to speciation. This is known as **geographical isolation**.

Evolution by stages :

- Complex organs like eye has evolved from rudimentary organs, (e.g., rudimentary eye in flatworm might be useful enough to give only a fitness advantage and the structure of eye in different organisms is different indicating them to have different evolutionary origins) not by a single DNA change but created bit-by-bit over generations.
- A change that is useful for one organism can become useful later for quite a different function (e.g., Feathers might start as providing insulation in cold weather. But later, they might be useful for flight as in birds.
- Some heavy birds and reptiles also have feathers but they do not fly.
- Some very dissimilar looking structures evolve from a common ancestral design, e.g., wild cabbage was cultivated as a food plant and many different vegetables were generated by selection over last two thousand years,
- (a) Selection of very small distances between the leaves gave rise to cabbage we eat.
- (b) Selection for arrested flower development gave rise to broccoli,

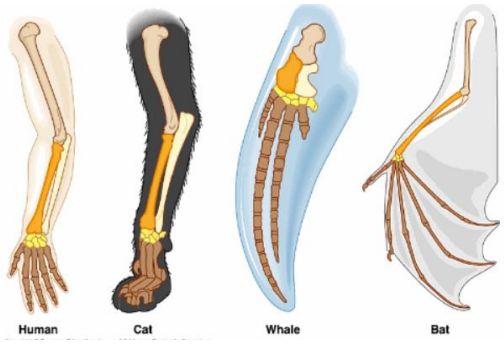
- (c) Selection for sterile flowers gave rise to cauliflower.
- (d) Selection for swollen parts gave rise to kohlrabi.
- (e) Selection for larger leaves gave rise to leafy vegetable kale.
- It suggests that, if these selections were not done then there would have been only wild cabbage.
- Evolution of wild cabbage



HOMOLOGOUS ORGANS:

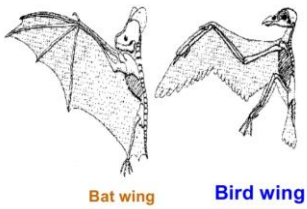
These are the organs evolved from the same ancestors but they have different functions. For example, the forelimb of a horse and the wings of a bat.

The Flippers of the whale, the human hand are other examples of homologous organs.



ANALOGOUS ORGANS:

These are the organs that arise from different ancestors but have the same function. For example, wings of bats, wings of birds, wings of insects etc.



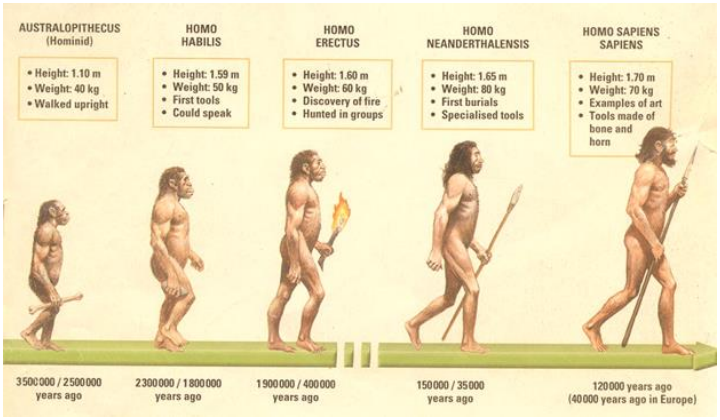
- **Paleontological (fossil) evidence** was also given for evolution. The dead remains of the organisms are known as fossils. For example, *Archaeopteryx* possesses features of both reptiles and birds. This concludes that birds have evolved from reptiles. There are two methods for finding the age of the fossils: one is carbon dating and the other is by digging. In the digging method, the deeper the fossil is, the older it is.
- **Biogenetic law** states that stages of development of an animal embryo are the same as adult animal stages.
- **Vestigial organs** are rudimentary in nature. They have lost their function through evolution. For example, appendix in humans, muscles of ears, wisdom tooth etc.

Molecular Phylogeny

It is also evidence for evolution. According to this, changes in DNA during reproduction are the basic events of evolution. Organisms that are related to each other most distantly will have greater differences in their DNA.

Human Evolution

Excavating fossils, time dating and determination of DNA sequences are used to study human evolutionary relationships. The study of human evolution indicates that all of us belong to a single species that evolved in Africa and then spread across the world in stages.



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