Heredity and Evolution

- Chapter 9 - Biology

05.10.20 to 15.10.20

INTRODUCTION

- A recognizable feature of a human being (or any other organism) like height, complexion, shape of nose and chin, colour of eye and hair etc are called characters or traits.
- The transmission of traits from the parents to their offspring is called heredity.
- The hereditary information is present in the gametes of the parents. Thus, gametes constitute the link between one generation and the next, and pass on the maternal and paternal characters or traits to the offspring.





VABIATIONS

The differences in the characters (or traits) among the individuals of a species is called variation.

The offspring is never a true copy of the parent.

There are many kinds of variations in human species like:-

- Free and attached earlobes.
- Different complexions (Dark, Light brown, Dusky, Wheatish, Fair etc.)
- Different eye colour (Brown, Hazel, Blue, Green, Grey, Amber etc.)
- Height (tall or short)
- Chin (cleft or pointed)
- Hair colour (Black, Brown, Blonde, Red, Golden etc.)
- Hair type (curly, wavy, Straight etc.)
- Nose (Snub, Thin, Pointed etc.)



B

Detached Earlobes



Hazel eye colour



Blonde Hair



Brown Hair

Blue eye colour

2) Accumulation of variations during reproduction

When organisms reproduce, the off springs show minor variations due to inaccuracies in DNA copying. These variations are less in asexual reproduction and more in sexual reproduction. Some variations are useful variations and they help the organism to adjust to the changes in the environment. Some variations do not help

the organism to adjust to the changes in the environment. Some variations do not help die and become extinct.



3) Rules for inheritance of characters (traits) :-

- Characters are transferred through genes present in the DNA molecules in the chromosomes present in the nucleus of the cell.
- The inheritance of characters is due to the fact that both the father and mother contributes equal amount of genetic material to the child. So for each trait there are two factors one from the father and one from the mother.
- Gregor Johann Mendel conducted experiments with garden pea plants and determined the rules for the inheritance of traits.





IMPORTANT TERMS

Chromosome : It is a thread-like structure in the nucleus of a cell formed of DNA which carries the genes.

Gene : It is a unit of DNA on chromosome which governs the synthesis of one protein that controls a specific characteristic of an organism. Genes are actually units of heredity which transfer characteristics from parents to their offsprings during reproduction.

Dominant Gene : The gene which decides the appearance of an organism even in the presence of an alternative contrasting gene is known as a dominant gene. It is represented by a capital letter.

□ Recessive gene : The gene which can decide the appearance of an organism only in the presence of another identical gene is called a recessive gene. It is represented by the corresponding small letter.

Genotype : It is the description of genes present in an organism.

Phenotype : It is the characteristic which is visible in an organism.

First Filial Generation or F1 Generation : When two parents cross to produce offsprings, their offspring is called First Filial generation or F1 generation.

Second Filial Generation or F2 Generation : When the first generation offsprings cross among themselves to produce second generation offsprings, then this offspring is called Second Filial Generation or F2 Generation.

MENDEL'S EXPERIMENTS

Gregor Mendel was the first scientist to make a systematic study of patterns of inheritance which involved the transfer of characteristics from parents to progeny.

Mendel chose pea plants for studying inheritance because pea plants had a number of clear cut differences which were easy to tell apart. For ex : tall and dwarf pea plants. Some pea plants produced round yellow seeds while others produced wrinkled green seeds etc.

Another reason for choosing pea plants was that they were self pollinating. Also, Mendel chose pea plants because many generations of pea plants can be produced in a comparatively short time span and their study is much simpler than that of animals.





Traits that Mendel observed



Mendel was the first scientist to make a systematic study of patterns of inheritance which involved the transfer of characters from parents to their offsprings.

Mendel chose pea plant (Pisum sativum) for studying inheritance due to following reasons.

- i. Pea plants have variations for many traits. Tall and dwarf plant, green and yellow seeds, round and wrinkled seeds etc.
- ii. Pea plants are self pollinating as well as cross pollinting.
- iii. Pea plants have short life span.
- Iv. They can be grown easily.

First generation (F1 generation):- When two parents cross to produce their offsprings then the offsprings are called F1 generation.

Second generation (F2 generation):- When the F1 generation plants cross among themselves to produce offsprings then the offsprings are called F2 generation.

a) When plants having one pair of character (Eg:- tall and short plant) was crossed (Monohybrid cross) :-Mendel selected pea plants having one pair of character - a tall pea plant and a short pea plant. He selected pure tall (TT) and pure short (tt) pea plants and cross pollinated them. He obtained all tall plants (Tt) in the first generation (F1). When the first generation plants were self pollinated, he obtained tall and dwarf plants in the ratio 3:1 in the second generation. (F2) The ratio of pure tall (TT), hybrid tall (Tt) and pure dwarf (tt) was in the ratio 1:2:1 The trait that is expressed in the F1 generation is called the dominant trait and the trait that is suppressed in the F1 is called the recessive trait.



LAW OF SEGREGATION

Mendel's first law of inheritance or **the Law of Segregation** : The characteristics (or trait) of an organism are determined by internal "factors" which occur in pairs. Only one such factor can be present in a single gamete.

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b) When plants having two pairs of characters (Eg:- shape and colour of seeds) were crossed (Dihybrid cross) :-

Mendel selected pea plants having two pairs of characters $\hat{a} \in \hat{a}$ shape and colour of seed. He selected plants having round yellow seeds (RRYY) and wrinkled green seeds (rryy) and cross pollinated them. He obtained all plants with round yellow seeds (RrYy) in the F1 generation. When these plants were self pollinated in the F2 generation out of 16 plants, 9 had round yellow (RrYy), 3 had round green (Rryy), 3 had wrinkled yellow (rrYy) and 1 had wrinkled green (rryy) seed. In the ratio 9:3:3:1.





LAW OF INDEPENDENT ASSORTMENT

Mendel's second law of inheritance or Law of Independent Assortment states that In the inheritance of more than one pair of traits in a cross simultaneously, the factors responsible for each pair of traits are distributed independently to the gametes.



4) Sex determination in human beings :-

Human beings have 23 pairs of chromosomes in the nucleus of the cell. Out of this two chromosomes are sex chromosomes X and Y. The female has two X chromosomes (XX) and male has one X and one Y chromosome (XY). The sperms and eggs have one set of sex chromosomes. Some sperms have X chromosome and some have Y chromosome. All eggs have X chromosome, If a sperm having X chromosome fuses with an egg having chromosome the child will be a girl. If a sperm having Y chromosome fuses with an egg having X chromosome the child will be a boy.



BLOOR GBOUPS

A person has one of the four blood groups: A, B, O, AB.
A and B are co-dominant genes whereas O is a recessive gene.
The genes for blood groups are denoted by: IA (A in superscript), IB etc.
If the genotype is IA IA or IA IO, then the blood group is A.
If the genotype is IB IB or IB IO, then the blood group is B.
If the genotype is IO IO, then the blood group is O.

5. Variations may or may not help organisms to survive :-

a) Some variations help organisms to survive :-Eg :- There are some beetles living in green bushes. They increase their numbers by reproduction. Crows can easily see the red beetles and they are eaten by the crows. During reproduction due to some variation some green beetles are produced instead of red beetles. The green beetles are not visible to crows and are not eaten by them. Then gradually the population of the red beetles decreases and the population of the green beetles increases. This variation has helped the organisms to survive.

b) Some variations do not help organisms to survive :-

Eg :- During sexual reproduction a colour variation occurs in red beetles and some blue beetles are produced instead of red beetles. Both the red and blue beetles are visible to crows and are eaten by them. Then the population of both red and blue beetles decreases. This variation has not helped the organisms to survive c) Aquired traits cannot be passed from one generation to the next Eg :- If the population of beetles increases and plants are affected by diseases, then the food available for the beetles decreases and their body weight also decreases. If after a few years the availability of food increases then the body weight of the beetles als increases. This acquired trait cannot be passed from one generation to the next

- 6. Speciation :- (Formation of new species from existing species)
- The formation of new species from existing species is mainly due to one or more of the following factors. They are :- Accumulation of variations, Physical barriers, Genetic drift, Natural selection and migration.
- i) Accumulation of variations :- The differences between the individuals of the same species is called variations. The accumulation of variations over several generations produce her species.
- ii) Physical barriers :- Populations may get separated by physical barriers like mountains, rivers, lakes etc. These isolated groups produce variations which can produce new species.

iii) Genetic drift :- Natural calamities or introduction of new members of the same species in an area can produce changes in the gene pool of the population and new variations are produced which can produce new species. iv) Natural selection :- Only those individuals of a species which have useful variations and can adapt to the changes in the environment survive and the others die. These organisms can produce variations and new species. v) Migration :- Some individuals of a species may migrate to new geographical area and adjust to the changes in the environment there

7. Evolution :-

The gradual changes taking place in living organisms giving rise to new organisms due to changes in their genetic composition is called evolution.

8a. Inherited traits :-

Inherited traits are traits in an organism due to changes in the genetic composition and it can be passed from one generation to the next and it results in evolution.

b. Acquired traits :-

Acquired traits are traits which are acquired by an organism / during its lifetime and it cannot be passed from one generation to the next and it does not result in evolution.

9. Evidences of evolution :-

There are a number of common features in different organisms which provide evidence to show evolutionary relationship. The main evidences of evolution are from the study of :-

Homologous organs, Analogous organs and Fossils.

a) Homologous organs :- are organs which are similar in structure but different in functions.

Eg :- The fore limbs of amphibians, reptiles, birds, and mammals have similar structures but different functions. Frog (amphibian) uses its fore limb to raise the front of the body. Lizard (reptile) uses its fore limb for walking and running. Birds fore limbs are modified as wings for flying. Mammals use the fore limbs for grasping, walking, running, swimming, flying etc. This shows evolutionary relationship.





b) Analogous organs :- are organs which are different in structures but similar in functions.
Eg :- The wings of butterfly, bird and bat have different structures but similar functions. This shows evolutionary relationship.



c) Fossils :- are the remains of organisms which lived long ago. From the study of fossils we can know their structures and the time period in which they lived. The fossils of complex and recent organisms are found closer to the surface of the earth and the fossils of simpler organisms are found deeper inside the earth. The age of fossils can be determined by Radio Carbon Dating. The study of fossils show evolution of simpler forms into complex, forms and their evolutionary relationship.





Tree trunk fossil

Fish fossil (Knightia)







10. Evolution by stages :-

- Complex organisms and its organs developed from simpler organisms gradually over generations.
- i) Evolution of eyes :- The eyes of planaria are just eye spots to detect light. It developed gradually into a complex organ in higher animals.
- ii) Evolution of feathers :- Feathers were first developed in dinosaurs and used for protection from cold. Later birds used them for flying.



iii) Evolution by artificial selection :- Humans cultivated wild cabbage for over 2000 years and produced different vegetables from it by artificial selection. Eg :- Cabbage - by selecting short distance between the leaves. Cauliflower - by selecting sterile flowers. Kale - by selecting large leaves Kholrabi - by selecting the swollen stem Broccoli - by arresting flower growth











11. Evolution should not be equated with progress :-Evolution has not resulted in progress. Evolution has resulted in the formation of several complex species from simpler species due to variations, genetic drift and natural selection. This does not mean that one species gets eliminated when new species are formed or that the new species are better than the older species. Species get eliminated only if they are not able to adapt to the changes in the environment. Several species which could adapt to the changes in the environment still continue to survive for example bacteria.

Human beings have not evolved from chimpanzees. They had a common ancestor from which they evolved separately. Human beings are not the pinnacle of evolution but they are only one species among the several evolving species.

12. Human evolution :- (Homo sapiens)

There is a great diversity among human beings in their form and features around the world. Human beings evolved in Africa. Some of them stayed there and others migrated to different parts of the world. Then due to genetic variations and the environmental changes in different geographical regions they developed changes in their forms and features.



LUCY Nearly all experts agree Lucy was just a 3 foot tall chimpanzee.



HEIDELBERG MAN Built from a jawbone that was conceded by many to be guite human.



an extinct pig.



PILTDOWN NEBRASKA MAN MAN Scientifically built up The jawbone turned from one tooth, later found to be the tooth of out to belong to a modern ape.

PEKING MAN Supposedly 500,000 years old, but all evidence has

disappeared.



At the Int'l Congress of Zoology (1958) Dr. A.J.E. Cave said his examination showed that this famous skeleton found in France over 50 years ago is that of an old man who suffered from arthritis.

Dates way back to 1970. This species has been found in the region just north of Australia.

established fossils is at least equal in physique and brain capacity to modern man... so what's the difference?

This genius thinks we came from a monkey.

Professing themselves to be wise they became fools." (Romans 1:22)

