Heredity and evolution

Evolution (Chemical & Organic)

❖ SPECIATION & EVOLUTION

Speciation:

- A species is a population of organisms consisting of similar individuals which can breed together and produce fertile offspring. Species can be of plants or of animals. Wheat, paddy, sunflower, lotus, mango, neem, humans, tiger, dog and cat, etc., are all examples of various types of species. The human beings who look so different from each other in terms of size, colour and looks are said to belong to the same species (Homo sapiens) because they can interbreed to produce fertile offspring (sons and daughters). The process by which new species develop from the existing species is known as speciation.
- The important factors which could lead to the rise (or formation) of a new species are the following:

(i) Geographical isolation (Allopatric speciation e.g. Darwins finches) of a population caused by various types of barriers (such as mountain ranges, rivers and sea). The geographical isolation leads to reproductive isolation (Sympatric speciation e.g. Pig frog and Gopher frog in different habitats) due to which there is no flow of genes between separated groups of population. There can be a number of ways by which interbreeding between two beetles of two subgroups stop.

- The changes in DNA structure or number of chromosomes will make the gametes incompatible and prevent fertilization.
- The morphology of reproductive organs may change, which prevents compatibility and fertilization.
- The difference in the behaviour of male and female will also prevent mating.
- The organisms may have developed different breeding periods. groups of population. There can be a number of ways by which interbreeding between two beetles of two subgroups stop.
- The changes in DNA structure or number of chromosomes will make the gametes incompatible and prevent fertilization.

- The morphology of reproductive organs may change, which prevents compatibility and fertilization.
- The difference in the behaviour of male and female will also prevent mating.
- The organisms may have developed different breeding periods.

(ii) Genetic drift caused by drastic changes in the frequencies of particular genes by chance along.

(iii) Variations caused in individuals due to natural selection. It should be noted that geographical isolation is the major factor in the speciation of sexually reproducing animals because it interrupts the flow of genes between their isolated populations through the gametes.

(iv) Instantaneous speciation: It is a sudden development of new species.

Evolution:

(I) Evolution of eyes: The complex body organs of animals such as eyes have been created in stages over many generations. First of all rudimentary eye (basic eye) like that of flatworm (planaria) was formed. The eyes of flatworm are very simple that are actually just eye spots which can detect light. Even these rudimentary eyes have survival advantage to flatworm. Starting from this basic design, more and more complex eyes were evolved in various organisms for example insects, octopus, and invertebrates all have eyes. The structure of eyes in each of these organisms is however different which suggests their separate evolutionary origins.

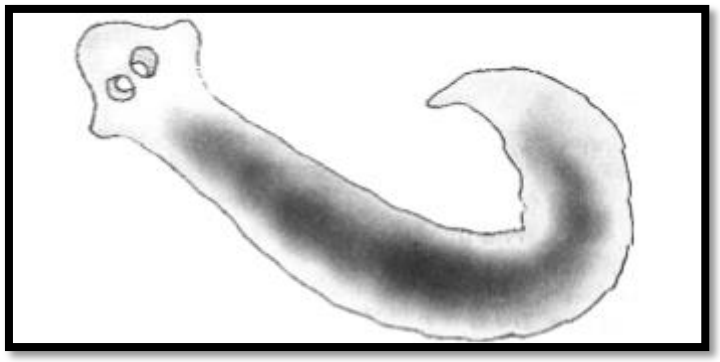

Fig.: Planaria has very simple eyes

(II) Evolution of feathers: Sometimes an evolutionary change produced in an organism for one purpose later on becomes more useful for an entirely different function. For example, birds evolved feathers as a means of providing insulation to their bodies in cold weather but later on

these feathers became more useful for the purpose of flying. Even some dinosaurs had feathers though they could not fly by using these feathers. Birds, however, adapted feathers for flying. The presence of feathers on birds tells us that the birds are very closely related to reptiles because dinosaurs (which had feathers) were reptiles.

(III) Evolution by artificial selection: Man has been taking the advantage of genetic variations for improving the qualities of domesticated plants and animals. He selects the individuals with desired characters and separates them from those which do not have such characters.

• The selected individuals are interbred. This process is termed as artificial selection.

• If it is repeated for many generations, it produces a new breed with desired characters.

(IV) Artificial Selection: By this selection process, very dissimilar looking structures may evolve from a common ancestral design.

• One of the classical examples is wild cabbage plant.

• Humans have cultivated wild cabbage as a food plant, and generated different vegetables from it by selection even more than two thousand years ago.

• The various crop plants developed from wild cabbage plants are:

- **Cabbage:** It is selected for its terminal buds, where there is a very short distance between leaves.
- **Kohlrabi:** It is selected for its swollen stem position.
- **Broccoli:** It is selected for its flowers (arrested flower development) and stem.
- **Cauliflower:** It is selected for its flower clusters (sterile flowers).

• Now, wild cabbage is the ancestor and cabbage, broccoli, cauliflower, kohlrabi and kale are all its varieties which have been obtained by evolution induced artificially by the farmers. The ordinary cabbage, broccoli, cauliflower, kohlrabi and kale look so different from their ancestor wild cabbage that if people had not seen it being done with their own eyes, they would never have believed that vegetables having such different structures can be evolved from the same ancestral vegetable plant.

Morphological evidences of evolution:

Homologous organs: -

- The term **homologous** mean the organs of different species that are related to each other through common descent, although now functionally different.

Homologous structures in different organisms are inherited from a common ancestor.

- Vertebrate forelimbs contain the same sets of bones organised in similar ways, despite their dissimilar functions. One can observe that the forearms of human, the wings of bat, the flippers of whales and the forelimbs of other vertebrate's all are formed of the same basic skeletal elements. Even they have a common structural plan. All of them contain bones named as humerus, radius, ulna, carpals, metacarpals and phalanges. Also, all the bones are derived from the same part of the body.

Analogous organs: -

The converse of homologous organs is **analogous organs**. They are similar in function but are anatomically different and unrelated. For example, the wings of birds and the wings of butterfly, both of which are used for flying, are completely different in their anatomical framework. Neither do they have similar origin nor they have evolved from the same organ in aommon ancestor. The flippers of penguin (bird) and dolphin (mammal), which perform similar functions in these aquatic animals, have originated from different structures of two different lineages.

Vestigial organs:

Those organs which have no longer function are known as vestigial organs. These organs have reduced structurally as well as functionally.

It appears that these organs were well developed in ancestors but due to their reduced or less use they became functionless.