EVOLUTION

1. **Evolution** is the process by which different kinds of living organism are believed to have developed from earlier forms during the history of the earth.

2. **Evolutionary History** - Consider a group of twelve red beetles. They live in some bushes with green leaves. Their population will grow by **sexual reproduction,** and therefore, can generate variations. Crows eat these beetles. The more beetles the crows eat, the fewer beetles are available to reproduce. Now -

   (i) **Natural Selection -** In the **first situation**, a colour **variation arises during reproduction** and one beetle that is **green in colour** instead of **red** (due to mutation). This beetle passes the colour on to its progeny. Crows cannot see green-coloured beetles on the green leaves and therefore cannot eat them. As a result, there are more and more green beetles than red ones in the beetle population. This is It results in adaptations in the beetle population to fit their environment better

   (ii) **Genetic Drift** - In a **second situation** a colour variation arises during reproduction resulting in a beetle **blue in colour instead of red**. Progeny of this beetle are blue. Crows can see blue-coloured beetles in the green leaves of the bushes as well as they can see red ones, and therefore can eat them. As population expands, there are a few blue beetles, but most are red. But at this point, **an elephant comes by, and stamps on the bushes where the beetles live. This kills most of the beetles. By chance, the few beetles that have survived are mostly blue**. The blue beetle population slowly expands again, but now, the beetles in the population are mostly blue. It was simply **a matter of accidental survival** of beetles of one colour that changed the common characteristic of the resultant population. **This is the notion of genetic drift**, which **provides diversity without any adaptations**.

   (iii) **Mutation** - Some "green genes" randomly mutated to "brown genes". But this process alone can account for the change over the gene frequency in just one generation because mutation is rare and occurs under severe conditions only.

   (iv) **Gene Flow** –(also known as *gene migration*) refers to the transfer of genes from the gene pool of one population to another. The introduction of new alleles increases **variability within a population** and **allows for new combinations of traits**.

3. **Somatic Variations**- bushes start suffering from a **plant disease**. The amount of leaf material for the beetles is reduced. The **beetles are poorly nourished** as a result. The average weight of adult beetles decreases. After a few years the plant disease is eliminated. There is a lot of leaf food. The beetles return to their original weight. If the weight of the beetle is reduced because of starvation, that **will not change the DNA of the germ cells**. Therefore, even if some generations of beetles are low in weight because of starvation, that is not an example of evolution, since the change is **not inherited over generations**.

4. **Inherited traits** are traits that are passed down from parents or ancestors. For example, hair colour, eye colour, bone structure.

5. **Acquired traits** are traits that are not passed genetically from one organism to another. These traits cannot be inherited. For example, a wrestler develops large muscles due to his training program. but this doesn't mean it'll be passed on to his offspring. Acquired traits are skills, knowledge or memory that an individual develops during his/her lifetime.

DIFFERENCE BETWEEN ACQUIRED and INHERITED TRAITS

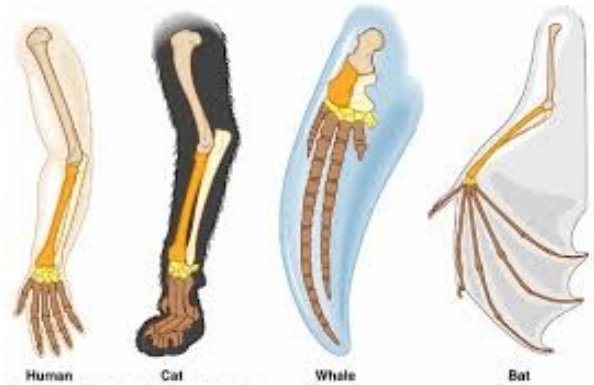
ACQUIRED TRAITS	INHERITED TRAITS
i-These are somatic variations.	i- These are genetic variations.
ii- Acquired traits develop due to the effects of environmental factors, use and disguise of organs and special (conscious) efforts.	ii- Inherited traits develop due to reshuffling of genetic material and mutations.
iii- These traits develop throughout the lifetime of an individual, and die with death of that individual.	iii- these traits are transferred (inherited) by the parents to their offspring. These don't die but are passed on to the next generation.
iv- Example- Learning of dance, music, etc. and muscular body of a wrestler.	iv- Example- Attached or free earlobe and curly hair.

6. **Speciation is the evolutionary process by which new biological species arise from existing species**. This happens when the **original group will not or cannot reproduce with the new species**. When this happens, they can be called **two independent species**. There can be a **number of ways** by which this can happen. If the DNA changes are severe enough, such as **a change in the number of chromosomes**, eventually the germ cells of the two groups cannot fuse with each other. Effectively, new species is being generated.

7. The more characteristics two species will have in common, the more closely they are related. And the more closely they are related, the more recently they will have had a common ancestor. An example will help. Classification of species is in fact a reflection of their **evolutionary relationship**.

8. A comparison on the common features shows that an evolutionary process and a pattern of relationships exist between species. As lineages evolve and split and modifications are inherited, the evolutionary paths of species diverge. This produces a branching pattern of evolutionary relationships. Such evolutionary change and relationships are represented in "family trees," or **'phylogenetic'** trees.

9. **Homologous Organs** are those organs which have the same basic structural design and developmental origin but have different functions and appearance. **Consider** the forelimb of a frog, a lizard, a bird, and a man seem to be built from the same basic design of bones but they perform different functions. Such a **homologous characteristic** helps to identify an evolutionary relationship between apparently different species. However, all similarities simply in organ shape are not necessarily because of common ancestry.



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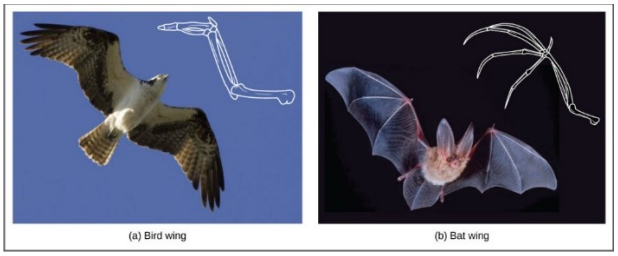
10. **Analogous Organs** are t hose organs which have different basic structural design and developmental origin but have similar appearance and perform similar functions. **For. Eg.** The wings of birds and bats look similar but have different design in their structure. Wings of bats are skin folds stretched between elongated fingers but wings of birds are covered by feathers all along the arm.



11. **Fossils** - Fossils are defined as preserved remains of a living organism that existed on earth a long time ago. Fossils are formed by the preservation of the remains of the organisms that existed in the earlier days.

12. There are **two components** to estimation the age of fossils-

    (i) **One is relative**. If we dig into the earth and start finding fossils, it is reasonable to suppose that the **fossils we find closer to the surface are more recent than the fossils we find in deeper layers**.

    (ii) The **second way** of dating fossils is **by detecting the ratios of different isotopes of the same element in the fossil material**. It is called **Radioactive dating**.

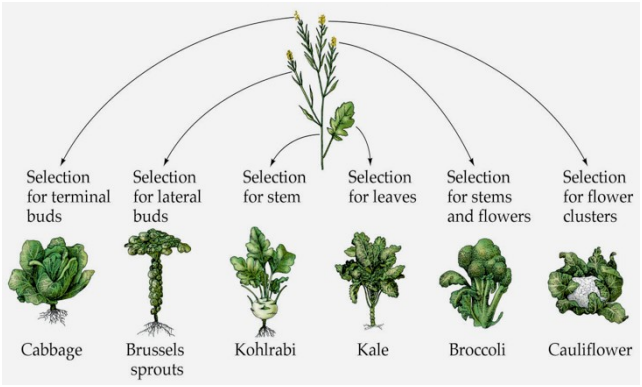
13. **Evolution by Stages** -

    (i) An intermediate stage, such as a **rudimentary eye**, can be useful to some extent. A change that is useful for one property to start with can become useful later for quite a different function.

    (ii) **Feathers**, for example, can start out as providing insulation in cold weather. But later, they might become useful for flight. Some dinosaurs had feathers, although they could not fly. Birds seem to have later adapted the feathers to flight. This means that birds are very closely related to reptiles, since dinosaurs were reptiles!

    (iii) It is true that analysis of the organ **structure in fossils** allows us to make estimates of how far back evolutionary relationships go.

14. **Artificial Selection** - The **wild cabbage** plant is a good example to study **selective breeding/artificial selection**. Humans have, over more than two thousand years, cultivated wild cabbage as a food plant, and generated different vegetables from it by selection. Some farmers wanted to select for arrested flower development, and have bred **broccoli,** or for sterile flowers, and have made the **cauliflower**. Some have selected for swollen parts, and come up with **kohlrabi**. Some have simply looked for slightly larger leaves, and come up with a leafy vegetable called **kale**.



15. **Determining the DNA** - Changes in DNA during reproduction are the basic events in evolution. Therefore, **comparing the DNA of different species** should give us a direct estimate of how much the DNA has changed during the formation of these species. This method is now used **to define evolutionary relationships**.

16. **Evolution is simply the generation of diversity** and **the shaping of the diversity by environmental selection**. The only progressive trend in evolution seems to be that **more and more complex body designs** have emerged over time.

17. The same tools for **tracing evolutionary relationships – excavating, time-dating** and **studying fossils**, as well as **determining DNA sequences** – have been used for studying human evolution.

18. Regardless of where we have lived for the past few thousand years, we all come from Africa. The earliest members of the human species, ***Homo sapiens***, can be traced there.