Chapter 7

Organic Evolution

Point to be studied:

7.1 Origin of life
7.2 Organic evolution
7.3 Evidences of organic evolution
7.4 Theories of organic evolution

Innumerable species of plants and animals exist on the Earth. At present also, discovery of new spices is going on. Man from primitive dimension strives to unravel the mystery of the origins of organism. Let's know.

- When and how did life begin?
- What were all the creatures from beginning same as they are today?

7.1 Origin of Life -

The origin of life on Earth as a result of a very slow process occurred. Initially, nitrogen and water vapour was in the Earth's atmosphere. From the reaction of extreme hot vapour and carbon build-up a hydrocarbons. By the action of nitrogen and metals, nitrite was formed. Reaction between newly formed nitrite and hot vapour produced anammonia gas. Chemical combination between hydocarbons and ammonia, Sugars and organic acids were formed. As a result of chemical reactions between amino acids and organic acids, build proteins. Three billion years ago a virus like organism developed from these early proteins. The first creatures were extremely small and like a blue-green algae. Thereafter, single-celled organism protozoan were originated. Generally, this gradual change move towards the complex organisms from simpler one.

Origin and evolution of respective complex organisms from simpler ones by changes is called organic evolution.

7.2 Organic Evolution -

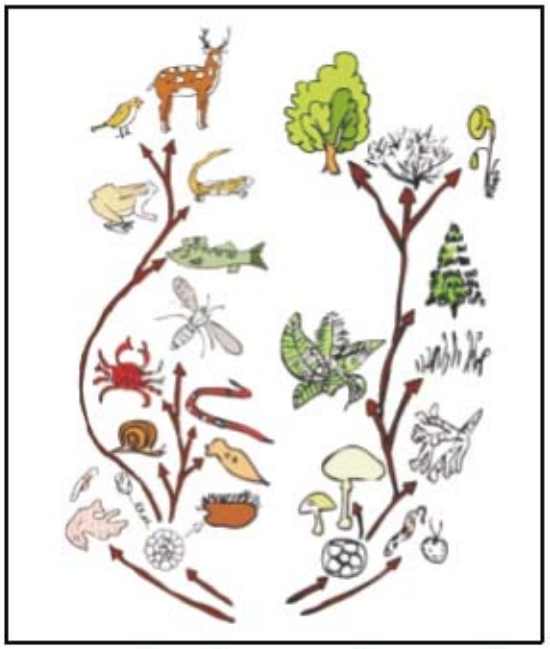

Fig 7.1: Organic Evolution

Evolution of organisms is shown in Fig 7.1. Firstly single-celled organisms were formed. Then multi cellular organisms were originated from them. Earlier, these were simple, but in gradual development became complicated. All animals were initially without a backbone. Fishes grew from them, by which amphibians were developed. From these evolved reptiles who ruled on the earth millions of years. Thereafter, some reptiles developed into birds and other in mammals. Animals from one class to another takes thousands of years to develop. Similarly, the evolution in plants also take place.

Fig 7.2: Dinosaur (Extinct animal)

7.3 Evidences of organic evolution -

Evidences from Classification: Classification of animals, from protozoa to Ecinodermata is the gradual evolution of all animals. Similarly, Pisces, Amphibia, Reptilia, Aves and Mammaliaof chordata have many similarities. Such as in these vertebral column are hollow. Animals of class Pisces developed by non-chordates. The evolution takes place from simple to complex. It is proven that all organisms evolved from a common ancestor like many branches originated from the main stem of a tree.

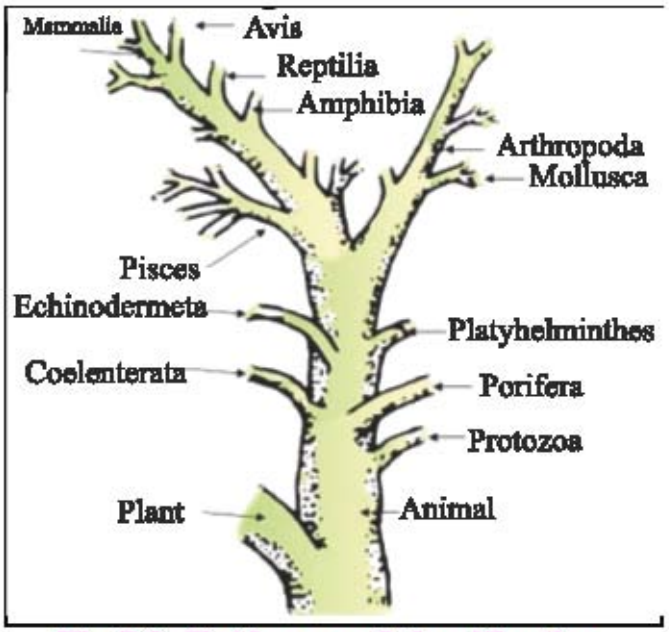

Fig 7.3: Evidences of classification

Structural Evidences:

I. Homologous Structures or Organs

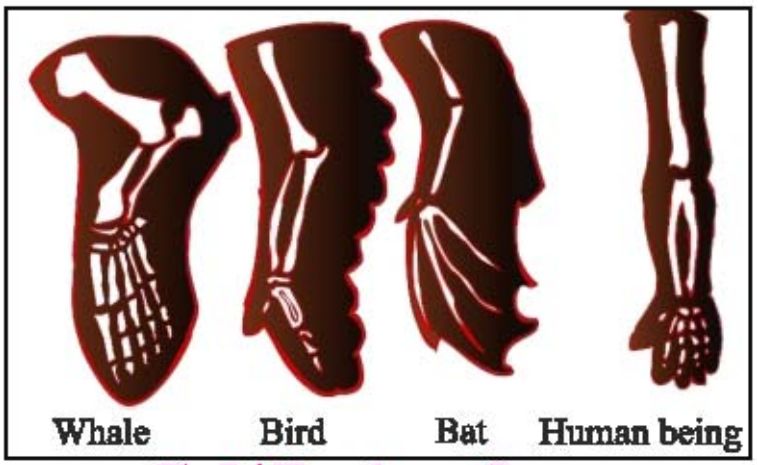

Fig 7.4 Homologous Organs

In the picture a 7.4 bird, bat, whales and humans forelimbs have been shown. There is a difference between the external structure of forelimbs of all of these due to different type of habitat and functions performed by them.

Table 7.1

Modifications and functions of forelimbs of animals

S.N.	Animal	Function	Modification of forelimb
1	Whale	Swiming	Into flipper
2	bird	Flying	Into wing
3	bat	Flying	Into wing
4	human	Grasping	Into arm

Difference between functions and external structure of forelimbs of these animals, basic structure of the skeleton and the origin of these animals is the same. Such organs are called **homologous organs.** Same origin of organs proves that ancestors of all of them were same and development gradually took place as time passed.

II. Analogous Organs :

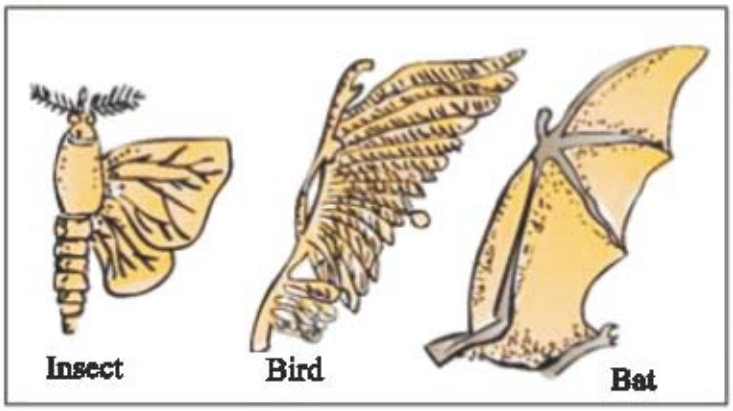

Fig 7.5: Analogous Organs

In the picture wing of insect, bird, bat are shown which help them in flying. There are differences in the structure and origin of their wings. The origin of insect wings protrudes from the walls of the body while the origin of bird and bat's wing is the modification of the forelimb. They have bones. Though the functions are similar, the origin and structure are different, such organs are called **analogous organ.** Animals with analogous organs developed in different classes in a different way.

Palaentological Evidences

Remains of dead animals and plants or their impressions found in rocks are called fossils. Fossils are found in sedimentary rocks. Some times whole body's size of an organism is found. It is a most concrete evidence of evolution.

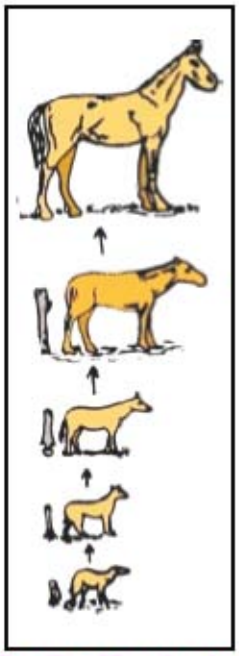

Fig 7.6 Evolution in horse

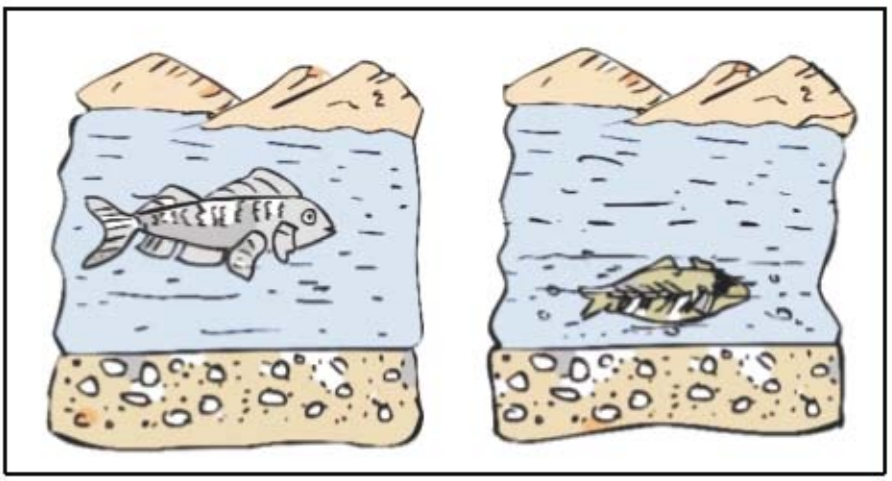

Fig 7.7 Fossils evidences

Evidences From Vestigial Organs

Some organs are found in animals, today which are present in the form of remains. But they were highly developed and functional in their ancestors. Examples are as follows -

Table 7.2 (vestigial organs of animals)

S.N.	Animal name	Vestigial organs
1	Human	muscles of ear, nictating membrane, caudal vertebrae, vermiform appendix
2	Marine bottom fish	less developed eyes
3	pythons (snake)	Vestiges of the hind limbs
4	Kiwi and Ostrich	Wings

These vestigial organs certify that in their ancestors, these organs were functional and well developed. But over time, as their utility decreases, they remained as a vestigial.

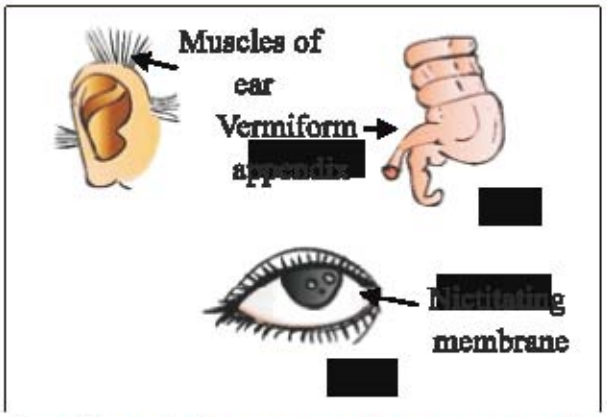

Fig 7.8 Vestigial organs in human being

Evidences From Physiology

I. Similarities in digestive system

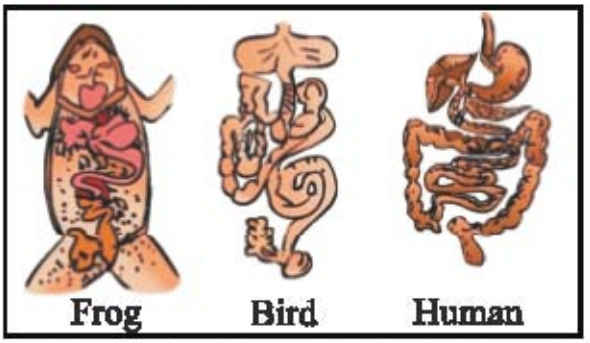

Fig 7.9: Digestive systems of different animals

In the picture 7.9 we see that digestive tract of these animals have a pharynx, stomach, small intestine. It includes liver, pancreatic, digestive glands etc. Secretion of digestive juices and their function is also same. So this proves that these animals have evolved in a certain order.

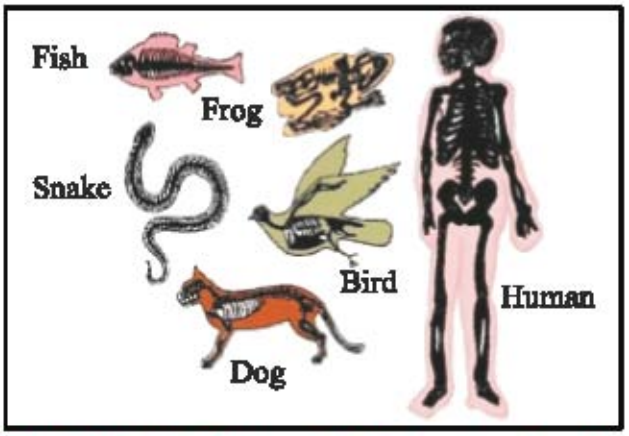

Fig 7.10: Skeleton of different animals

Generally a skeleton is found in notochord animals. They have back bone which is made up of small bones called vertebrae. The similarity in their bones of hands and leg and skeletal systems, shows that their ancestors would have been similar. Over the time some differences appear due to change in conditions.

Evidence of the complexity of the heart:

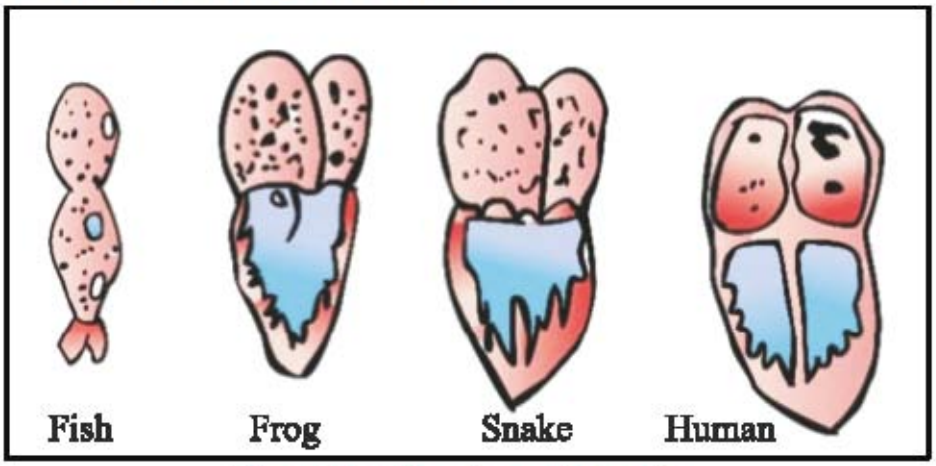

Fig 7.11: Structure of hearts

We see that heart structure of fish is the most simple but complex in man who shows an order of certain evolution.

Table 7.3- Structure of heart of animals

S.N.	Animal name	Structure of heart
1	fish	two chambers(One auricle and one ventricle)
2	frog	three chambers(two auricles and one ventricle)
3	snake	two auricles and two incompleteventricles
4	human	four chambers(two auricles and two ventricles)

II. Similarities in blood protein

Animals of different classes such as man, gorilla, monkey, fish, frogs etchave similarities in blood proteins.

Evidences from Embryology:

In multicellular animals, a unicellular zygote is formed by sexual reproduction which creates embryo by the division.

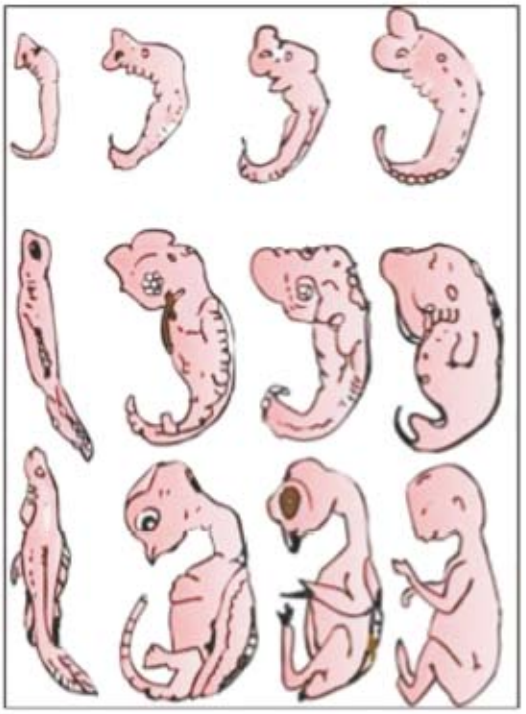

Fig 7.12: Developmental stages of different animals

When we see fish, turtle, chicken, human's embryos, early stages of them appears almost identical. This proves that the ancestor of all vertebrates resemble with fish and their development is certainly in order.

> Every organism, in its development, repeats its organic history called as Theory of Recapitulation. This theory was proposed by Jarman Scientist Haeckel.

Evidences From Connecting Link

In the classification of organisms, organisms with related properties have been placed in the same class. There are some animals which have properties of the two classes.

1. Archaeopteryx :-

This serves as connecting link between reptiles and birds. This animal had some features beak, wings, structure of legs etc were similar to aves (bird)and some characteristics beak, tail, scales on body etc were similar to reptiles.

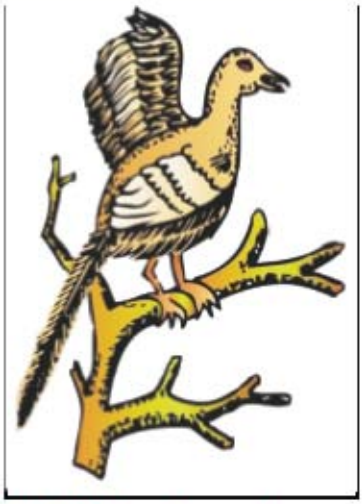

Fig 7.13Archaeopteryx

Similarly Platypus and echidna serves as connecting link between Reptilia and Mammalia classes.

Evidences from Geographical Distribution: Now a day variations are found in the geographical distribution of plants and animals. For example - Platypus, Kangaroo and eucalyptus plant is found in Australia only. Similarly Giraff is found only in Africa. According to scientists at a time the continents were connected to each other. Later on they were separated by the sea. That's why animals and plants found in one continent could not reach to another continent. Due to different circumstances structures of them are changed according to different places. The geographic distribution is therefore also certifies organic evolution.

7.4 Theories of organic evolution:

Due to the development in the living world, new species are discovered and is going on till today. To explain the order of organic evolution scientists gave different theories. Following are the theory of organic evolution -

1. Lamarck's Theory
2. Darwin's Theory
3. Mutation Theory

1. **Lamarck's Theory:** This theory was given by Jean-Baptiste Lamarck in 1809. His theory is known as theory of acquired characters.

   According to Lamarck due to changes in environment, more frequently used organ strengthened and organ that was less frequently used, disappered.

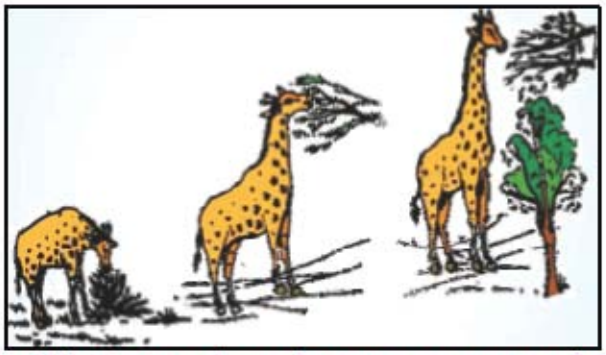

Fig 7.14 Elongation of Legs and neck of Giraffe

Giraffes are found in Africa. It has long legs and neck. It lives by eating the leaves of tall trees. According to Lamarck giraffe was not as long as their ancestor. They could easy to eat weed. Gradually due to change in environment, deserts extended and grassland perished. To get the leaves of the trees which were at height, legs and neck had to use more that's why his legs and neck became too long. These traits are inherited from generation to generation.

Snakes live in holes. Due to inconvenience legs were used less and gradually disappeared.

Some scientists denied the theory of Lamarck. They said, "if the tail of a mouse is cut generation to generation, there is no chance of birth of a mouse without tail. In the same manner girls do not take birth with a prick in the earlobe, even after girls are having it from generations.

Darwin's Theory : Charles Robert Darwin's gave a theory of natural selection for organic evolution. Different phases of Darwin's theory are as under:

1. **Production of offspring in living organisms:** Each organism does production of offsprings to maintain their race. Example elephant produces 8 offspings in her life span. It is a slow breeder. A pair of elephants began to breed regularly and engender that all offsprings are regularly breeding, in the 750 years a pair will generate approximately 1.9 million elephants and numbers of elephants will be very high. But this does not happen.
2. **The struggle for survival:** Due to over production of offsprings, the struggle for space and food for the growing number of offsprings takes place. It is the struggle of survival. This struggle occurs in between animals of own species and with other species also. Which is capable of the same shall live. Destruction due to struggle, the number of organisms will remains balanced and consistence in nature.
3. **Natural selection:** In struggle of survival only those animals live who adapt them according to nature. If they are not able to do it, then they are destroyed.

4. **Origin of the new species:** Inheritance of useful traits will continue from generation to generation and harmful traits gradually become extinct or remain as a vestigial organ. Sometimes variations increase so that after hundreds of millions of times new generation is more different from older generation and the development of a new race goes. For example, at the beginning dog, jackals and wolves, three were members of the same race but due to change in atmosphere to adapt themselves accordingly changes in their size and physical characteristics. After thousands of years dog, fox and wolf three new species was developed.

5. **Neo-Darwism Darwin** added new approaches to his old doctrine and gave a new doctrine of neo-Darwinism. According to this, the new species are originated due to gene variation into the members of the particular species. Only genetic variations are inherited and environmental characteristics ends with animal die.

6. **Mutation theory:** Hugo deries gave the theory of the mutation. When he tested some plant, found that some of the plants produced are quite different from thier species. These traits are in herited from generatio to generation. These sudden variations in inherited characters are called **mutation.** Mutations in animals can be caused by the following-

1. Change in number of genes
2. Change in gene arrangement
3. Change in gene structure.

Means of mutation: Mustard gas, Nitrous acid, Phenol, X-rays, Beta rays etc.

Birbal Sahni

Palaeobotanist who enchanted the world with interesting tidbits, Birbal Sahni was born on November 14, 1891 at Bhera village; in the Shahpur District. He is the founder of palaeobotanical research in India.

Amongst a large number of fossil plants described by him from Rajmahal Hills of Bihar, was his most remarkable discovery of a new group of fossil gymnosperms, to which he gave the name "Pentoxylae". Sahni was greatly interested in archaeology and he published a number of papers in this field. His work on the "Technique of casting coins in ancient India" set a new standard in archaeological research in India. He founded the Institute of Palaeobotany at Lucknow, which was later renamed as Birbal Sahni Institute of Palaeobotany after his death.

What Have You Learnt

1. There are constant gradual changes in living things.
2. The origin of life on earth is from the simple substances.
3. The very first single-celled organism was evolved. Thereafter, multicellular organisms evolved from unicellular organisms.
4. Organic evolution is a slow process.
5. Organic evolution has solid evidences which prove occurance of organic evolution. Classification evidence, physical structure evidence, fossil evidence, vestigial evidence, physiology evidence, embryonal evidence, connecting link evidence, geographical distribution evidence etc. are evidence of oragaic evolution.
6. According to Lamarck oragaic evolution is more or less based on the usefulness of organs.
7. Darwin's theory of natural selection is assumed as the basis of the organic evolution.
8. According to mutation theory, evolution is a sudden change in the chromosomes.

□□□

Exercises

Choose the correct option -

1. Heart of fish has -

   (a) One auricle one ventricle (b) one auricle two ventricles

   (c) Two auricles two ventricles (d) two auricle two ventricles ( )

2. Archaeopteryx is a connecting link between

   (a) Pisces and amphibian` (b) Repitiles and Aves

   (c)Aves and mammals (d) Amphibians and Repitiles ( )

3. Which Scientist gave a theory of mutation -

   (a) Lamarck (b) Darwin

   (c) Hugo de Vries (d) Mendel ( )

4. Fore limb of whale is called as -

(a) Flipper (b) arm

(c) wing (d) leg ( )

Fill in the blanks -

1. Wings of bird and bats are.....organ.
2. Vertebral Column is consists of small.....
3. Every organism, in its development, repeats it's ..... history.
4. Organic evolution is a .....and .....process.
5. Darwin gives Theory of.....

Short answer type questions -

1. Write differences between homologous and analogous organs.
2. Write a process of fossils formation.
3. Draw a structure of hearts of different animals to show sequence of organic evolution.
4. Define Lamarck's Theory of evolution with examples.
5. What is mutation?

Long answer type questions -

1. Explain enohition on the the basis of edivendences of embryology.
2. Clarify different steps of Darwin's Theory.
2. Explain a process of formation of fossils?

Activity -

1. Make a chart of organic evolution and fix in a class room.
2. Make a collage of vestigial organs.

◆◆◆