

Evidences of Organic evolution

There are many evidences to support the organic evolution of living organisms on the earth. They are following:

1. **Evidence from Morphology and Comparative Anatomy**
 2. **Evidence from Paleontology**
 3. **Evidence from Embryology**
 4. **Evidence from Biochemistry**
 5. **Evidence from Genetics**
1. **Evidence from Morphology and Comparative Anatomy**
 - A. **Evidence from morphology**

All the organisms of same taxonomic group have similar morphological features. This similarity provides the evidence of common ancestry of these organisms. For example, all the animals under cat family like tiger, leopard, wild cat etc. look similar in their appearance.

B. Evidence from Comparative Anatomy

The anatomical features like homologous organs, analogous organs, vestigial organs, connecting links and atavism etc. provide the evidence of organic evolution.

i. Evidence from Homologous organs

Those organs which are similar in embryonic origin and internal structural pattern but different in function and appearance are called homologous organs. For example; fore limbs of different mammals like arms of man, flipper of whale, wings of bat and forelimbs of horse etc. are different in their appearances and functions but have the same sets of bones, muscles and similar arrangement of blood vessels and nerve fibers etc. Thus, this evidence supports the occurrence of divergent evolution. The animals having homologous organs were originated from a common ancestor but modified differently to adjust in different environments during course of evolution.

ii. Evidence from Analogous organs

Those organs which are functionally similar but different in internal structure and embryonic origin are called Analogous organs. For example, the wings of insect and birds, eyes of squid and fish etc. are similar in their function but they are different in origin and basic internal structural pattern. This evidence supports the occurrence of convergent evolution. Different unrelated organisms live in similar environment developed similar functional structures during course of evolution which increased the chance of survival and reproductive potential in that environment.

iii. Evidence from Vestigial organ

Those organs which are functionless and incompletely developed in present generation but may be fully developed and functional in their ancestors are called rudimentary or vestigial organs. Due to the environmental changes and change in habit of animals during course of evolution, number of organs are degenerated and functionless which were well developed and functional in their ancestors. Thus, this evidence supports in favor of common ancestry. There are about ninety vestigial organs in human body like; nictitating membrane, canine teeth, coccyx vertebrae, set of caudal muscles, auricular muscles, wisdom teeth and vermiform appendix etc. For examples;

- Vermiform appendix - Vermiform appendix present in caecum of large intestine of mammals. It is well developed in herbivorous and helps in digestion of cellulose but in carnivorous, it is completely absent. In human it is greatly reduced and functionless. This may be due to change in dietary habit of man during course of evolution, vermiform appendix became disused and it remained as vestigial form. This provide evidence that modern man was evolved from herbivorous ancestor.
- Nictitating membrane- It occurs as a movable third eyelid in vertebrate animals and spreads over the eye for cleaning and protection. But in human, it is found as a small, un-stretchable fold like structure in the inner angle of each eye and is called as **plica semilunaris**. That may be because of its the function is replaced by the upper eyelid and it becomes functionless in course of evolution.

iv. Evidence from Connecting links

Intermediate group of organisms which possess the characteristic of two different classes or phylum called connecting link. The connecting links present in nature support that the evolution of the complex organisms take place from the simple organism and evolution from one form to another was not occurred suddenly but through the intermediate groups like connecting link. For examples;

- Virus is connecting link between non-living and living form.
- *Peripatus* is connecting link between annelidan and arthropodan.
- *Neopilina* is connecting link between annelidan and Mollusca.
- Prototherian like platypus, spiny anteater etc. are connecting link between reptile and mammal.
- The connecting between the reptile and bird is *Archeopteryx* which was existed in Jurassic period.

Note: "**Birds are glorified reptile**". Explain this statement. Or *Archeopteryx* supports a connecting link between reptiles and birds, how?

The connecting between the reptile and bird is *Archeopteryx* which was existed in Jurassic period. It possessed the characters of both reptile and bird like,

S.N.	Reptilian characters	Avian characters
1.	Body and hind limbs covered with scales	It looks alike the terrestrial bird of sized about a crow
2.	Bones were non-pneumatic types	Body covered by flight feathers
3.	Jaws bear homodont types of teeth	Jaws modified into beak
4.	Tail long and tapering like typical dinosaur	Tail bears elongated tail feathers which were arranged in two lateral rows
5.	Wings bear three clawed digits	Fore limbs modified into wings with three digits
6.	Sternum poorly developed and without keel	Hind limbs had 4 toes, 3 forward and 1 back ward.

The fossil of *Archeopteryx* showed that birds were evolved from reptilian ancestor through the intermediate group. Birds are better developed in their organization to adjust in aerial mode of life than their ancestor. Thus, **Birds are glorified reptiles.**

v. Evidence from Atavism

Sudden appearance of some ancestral characters in some individual which are completely disappeared or presence in vestigial form is called atavism. For examples in human, presence of large canine, thick hair on the body, presence of more pair of nipples in thorax and presence of short tail etc. The reappearance of all such features indicates relation of human and remote far ancestor which had these features and favor the evolution from common ancestor.

2. Evidence from Paleontology

Paleontology is branch of science that deals with study of fossils. Fossils are "Any form of preserved remains thought to be derived from a living organism". Like, trace, impression and cast of organisms or entire organism that lived in past on the earth. During formation of fossils, soft parts of death organisms disintegrated and hard parts of their body were settled at the bottom and buried by sand or mud particles that formed the sedimentary rock. Thus, the dead bodies of organisms preserved in rock as the fossils and this process continued along with formation of the new strata or layers of sedimentary rock. The older fossils preserved at lower most strata of the sedimentary rock, while new fossils preserved at upper strata of rock. The studied of fossils revealed that fossils found in upper most layers of sedimentary rock are complex and diverse form of organisms. while the fossils found in lower most stratum were most simple and primitive form of organisms. Thus, this evidence supports that complex and diverse forms of organisms were developed from pre-existing simple form of organisms on due course of time which may be favored by constantly changing environment. For example,

Evolution of Horse (*Equus*)

The fossil record of horse showed that the evolution of modern-day horse (*Equus*) started during the Eocene epoch some 60 million years ago. The earliest fossil of ancestor of horse was *Eohippus* found in North America. To adjust the new environment, they changed their morphological structure for attaining speed in open grass land and getting the food along with gradual increased in size. In this evolutionary process, most dominant intermediate stages from each geological period are *Mesohippus*, *Merychippus*, *Pliohippus* to *Equus*.

S.N.	<i>Eohippus</i>	<i>Mesohippus</i>	<i>Merychippus</i>	<i>Pliohippus</i>	<i>Equus</i>
1.	It was lived about 60 million years ago in Eocene epoch.	It was evolved from <i>Eohippus</i> about 40 million years ago in Oligocene epoch.	It was evolved from the <i>Mesohippus</i> about 25 million years ago during Miocene epoch.	It was evolved from <i>Merychippus</i> about 11 million years ago in Pliocene epoch.	It was evolved from <i>Pliohippus</i> about one million years ago in Pleistocene epoch.
2.	It was about the size of fox with 28 cm height.	It was about 60 cm in height.	It was about 100 cm in height.	It was about 108 cm in height.	It is about 150 to 160 cm in height.
3.	It had short head and neck.	It had somewhat elongated muzzle.	It had long neck	It had long muzzle along with elongated jaws and diastema	It has long muzzle with elongated jaws and diastema and increased the mobility of neck
4.	The teeth had short crown, adapted for grinding soft vegetation.	Canine teeth were lost. Molar teeth had low crown.	Molar teeth had long crown, suited for chewing the grass.	Molar teeth had long and ridged crown having cement for grazing.	Molar teeth are long crown and complex enameled ridges which are suitable for grazing.
5.	Limbs were short and fore limbs had four digits and hind	They had only three functional digits in each limb. The	Each limb had three digits but middle digit was longer and	They had long legs with reduced and splint like second	Only third digit persists in each limb while second and fourth

	limbs had three digits. The third digit was longer than other and all the digits touched the ground.	middle digit was longer than other and all the digits touched the ground.	only touched the ground.	and fourth digits.	digits become splint and hidden beneath the skin. Legs are long and only hoof touch the ground for swift running.
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Note: What changes were occurred in the evolution of modern horse?

The important changes in evolution of modern horse are following;

- Increase in size and length of limbs and feet
- Reduction of lateral digits
- Increase in length and thickness of the third digit
- Metacarpals and metatarsals are fused
- Straightening and stiffening of the back
- Better development of brain and sense organs
- Increase in width of incisor teeth
- Replacement of premolar by molar
- Increase in tooth length
- Increase in crown height of molars
- Increase lateral support of teeth by cement
- Increase of mobility of neck]

Note: Determination of the Age of fossil or rock

Radioactive dating method is usually used for estimation of age of fossils or rock. The radioactive substances are present in rock and they emitted electron from their outer rings to form some stable non-radioactive isotopes in a specific period of time. By calculating the amount of non-radioactive isotopes or substances in rock, age of rock can be estimated. There are two methods usually used to estimate the age of fossils. They are,

- i. **Uranium-Lead technique or Radioactive clock technique**
- ii. **Carbon dating method**

Note: Types of fossils

S.N.	Types of fossils	Formation process	Examples
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