

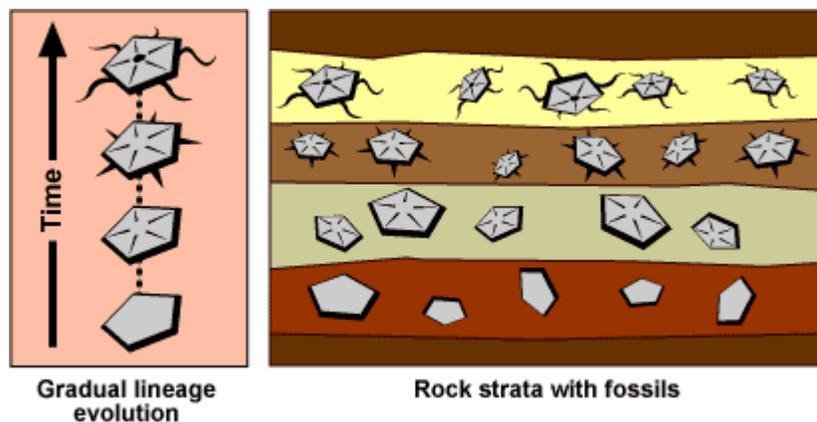
## Evidences of Evolution

**Evolution**, or change over time, is the process by which modern organisms have descended from ancient organisms. Each living species has descended, with changes, from other species over time. This principle is called “descent with modification”. According to the principle of “common descent”, all species – living and extinct- were derived from common ancestors.

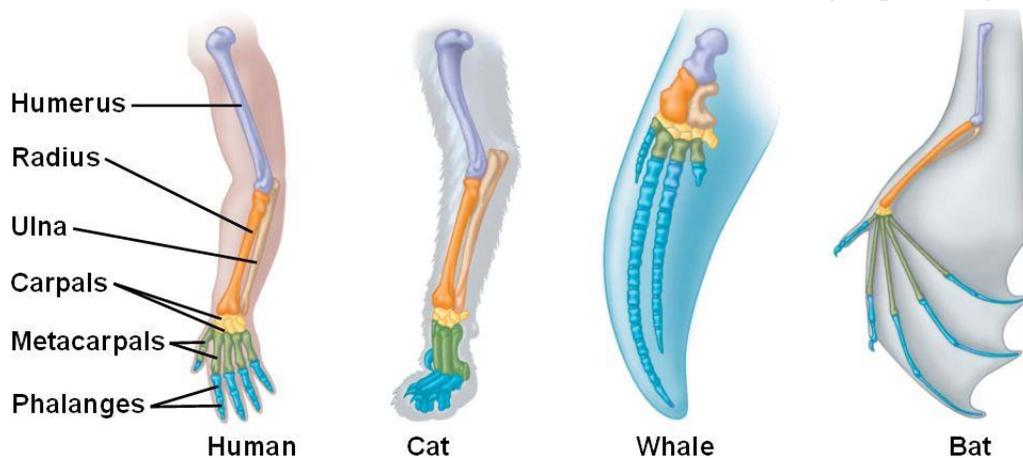
The following evidences of evolution support the principle of common descent that all organisms descended from a common ancestor.

1. **Fossil Record** -- For some organisms the record is relatively complete.

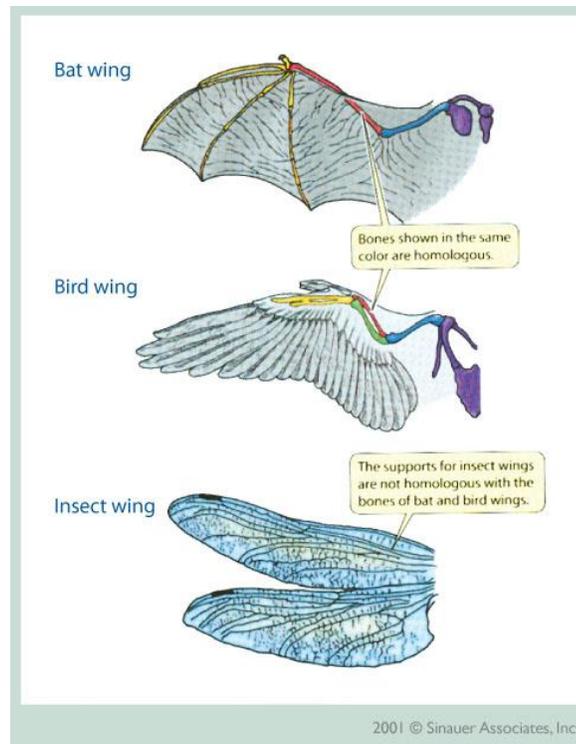
It shows changes in climate and geography over time. Soil layers near the surface are younger than deeper layers. It can be dated to show the age of fossils.



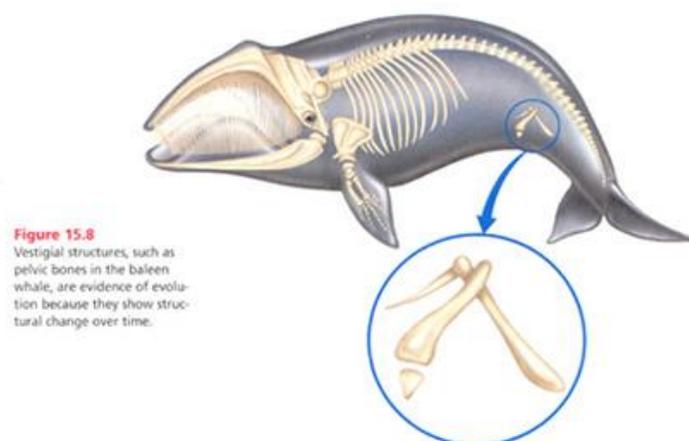
2. **Homologous Structures**— Similar bone structures in appendages of different organisms that are used for different functions. Homologous structures are inherited from a common ancestor and are formed from the same area in developing embryos.



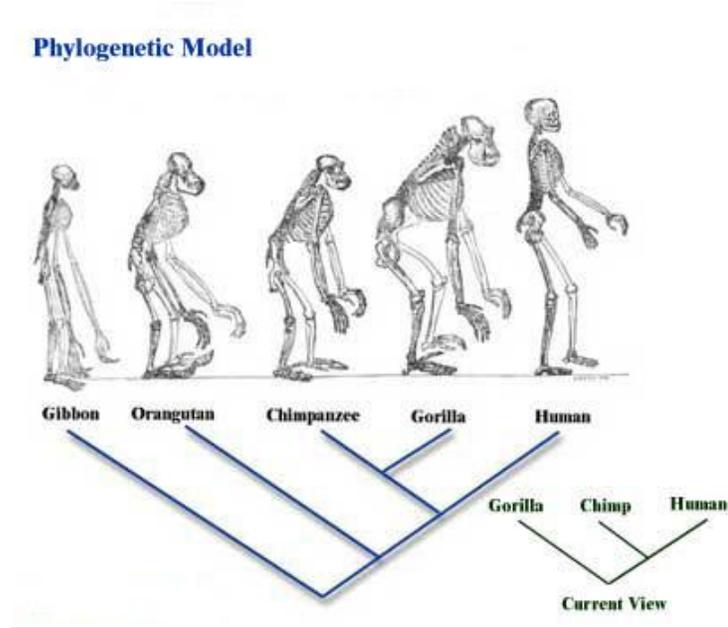
3. **Analogous Structures**—Structures that perform similar functions, but are very different in their structure and form. These organisms evolved from different ancestors but have structures that serve similar functions due to common living conditions caused by pressures of their environment.



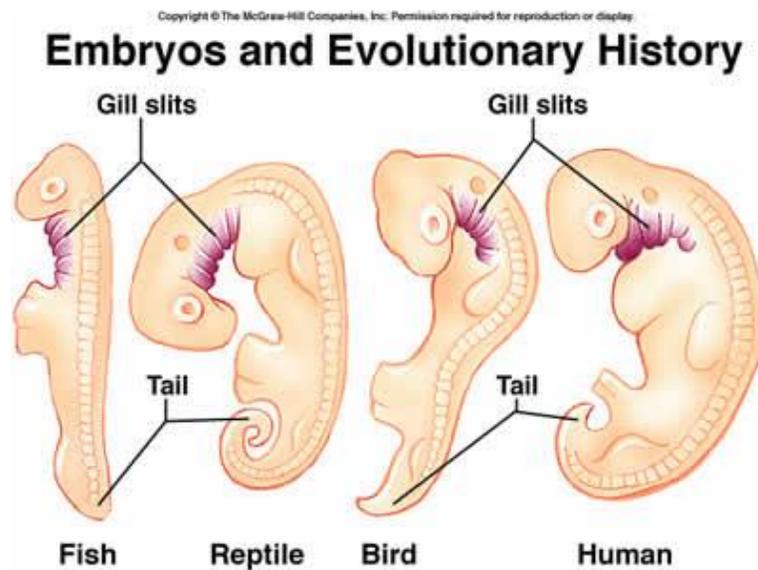
4. **Vestigial Structures (Organs)** – Structures have gradually changed through time. The organism may have the structure but it is used or they may not have the structure anymore. The remains of a structure that is no longer functional but show common ancestry.



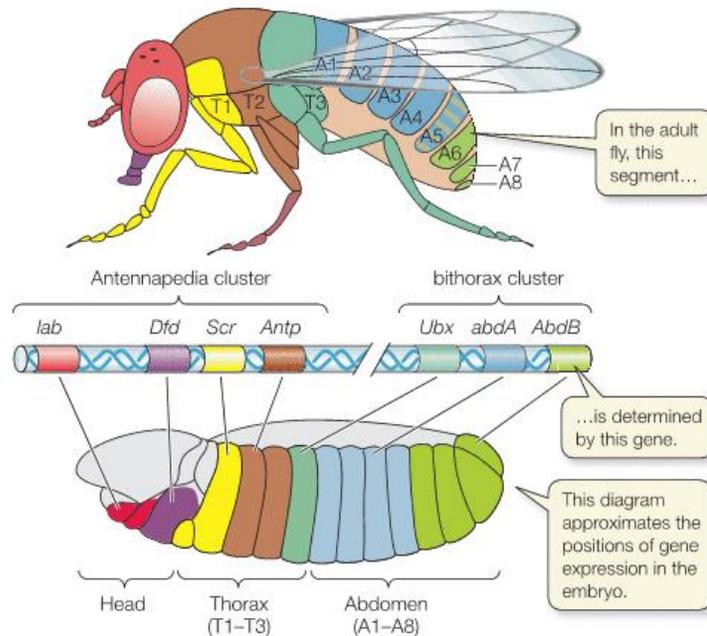
5. **Anatomical Similarities** -- Similarities in body structure suggesting the organisms are closely related because of descent from a common ancestor.



6. **Comparative Embryology - Embryological Evidence** –Embryos of very different types of vertebrates show similarities in their appearance and early development indicating a common ancestry.



7. **Developmental Homologies - HOX Genes** –Hox genes are a series of genes that control the organs and tissues that develop in various parts of an embryo. These genes are located in similar locations on similar chromosomes in different organisms. They carry the instructions for the developing cells of a new individual which cause the cells to differentiate and specialize to form tissues and organs. Hox genes also code for a common head-body-tail body plan alignment in all vertebrates.



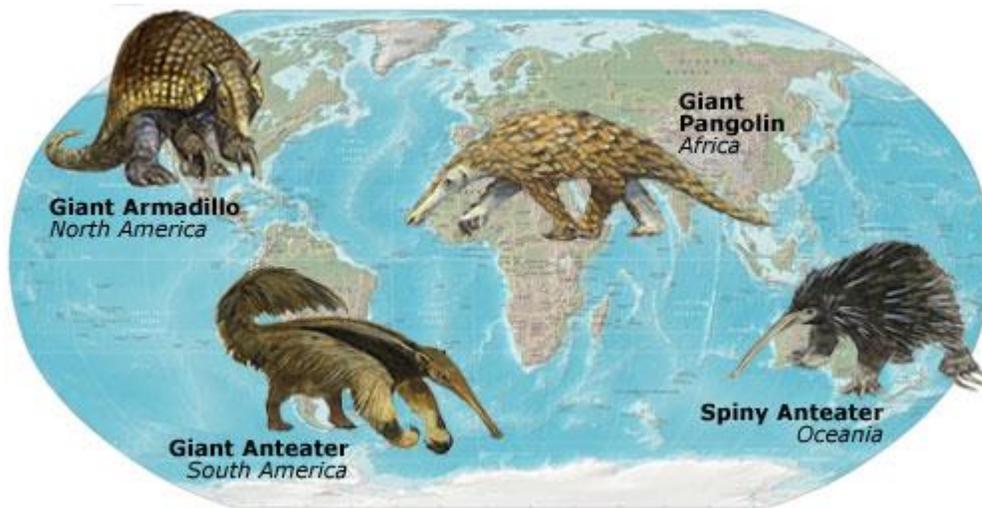
8. **Molecular Homologies - Biochemical Evidence/DNA Evidence**– All living organisms have DNA in their cells and are made of the same 20 amino acids which code for proteins. In addition, there are many similarities in some amino acid sequences that code for a particular protein, ATP is used as the energy molecule, similar enzyme functions and a high number of genes shared by all organisms in similar groups can be explained by descent from a common ancestor.

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### Amino acids reveal evolution

Cytochrome c Evolution	
Organism	Number of amino acid differences from humans
Chimpanzee	0
Rhesus monkey	1
Rabbit	9
Cow	10
Pigeon	12
Bullfrog	20
Fruit fly	24
Wheat germ	37
Yeast	42

9. **Biogeographical Evidence** -- Studying the geographic distribution of life forms on Earth shows how populations could have spread from one location to another. EX. Continents collided allowing organisms to move from one to the other then were split apart separating organisms.



10. **Current Observations** -- Modern organisms like bacteria have become resistant to antibiotics showing how adaptations occur in response to environment and mutations in bacteria and viruses make them nearly impossible to prevent or treat.