Evidence for Evolution Notes:

Evidence that supports the theory of evolution is usually grouped into four main areas, such as

1. Biochemical—DNA analysis
2. Comparative anatomy—morphology, homologous structures, and embryology
3. Observable events
4. Fossil record

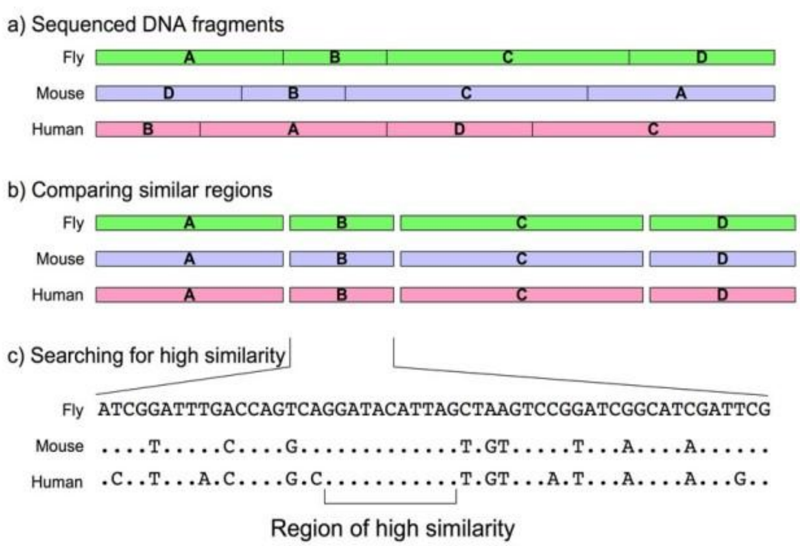
1. Biochemical—Cells, DNA analysis

   All living organisms are made up of the same basic structures—cells. Many cells are similar in that they contain many of the same organelles and carry out many of the same chemical and biological processes.

   The resistance of organisms, such as bacteria to antibiotics and pesticides, shows that organisms can change, modify, probably by mutation from one generation to the next, in order to survive. That resistance, however, makes it more difficult for medicines and pesticides to be effective in killing the bacteria and so treating the diseases they cause.

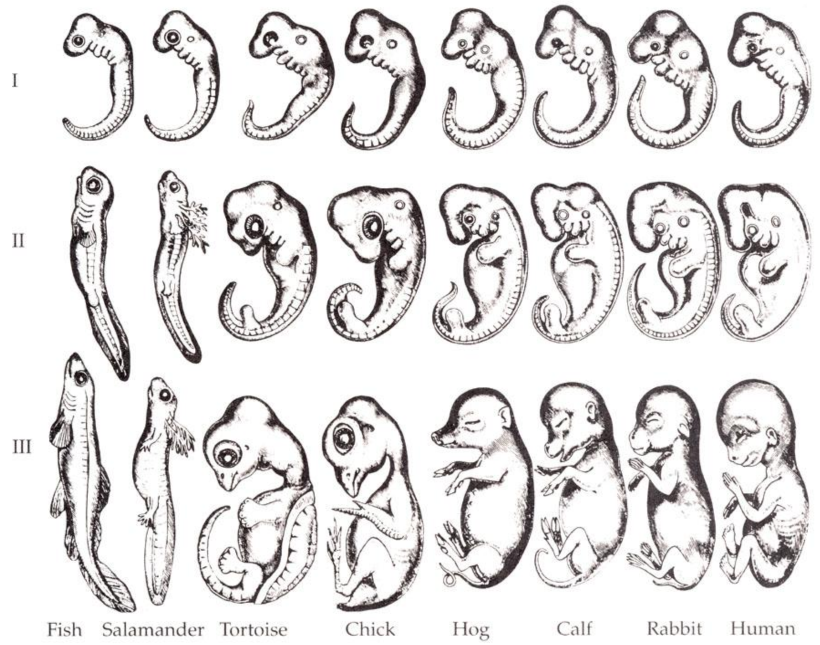
   Another point of evidence is found in DNA's structure and function. Many of the amino acid sequences that create proteins are similar which may be due to a common ancestor. Others are more varied and may not share such a close relationship, or may show more variation in how the proteins are formed. Over time, the genes are thought to have changed very little as they have passed from parent to offspring. The genetic code is almost universal where every organism uses the same building blocks for DNA.

   But as DNA analysis continues to change and become more able to determine slight differences in DNA, more questions are being raised about the strength of the evidence. (This follows the scientific method where scientists have to verify others results or be honest or skeptical when data shows unpopular or contrary information.)

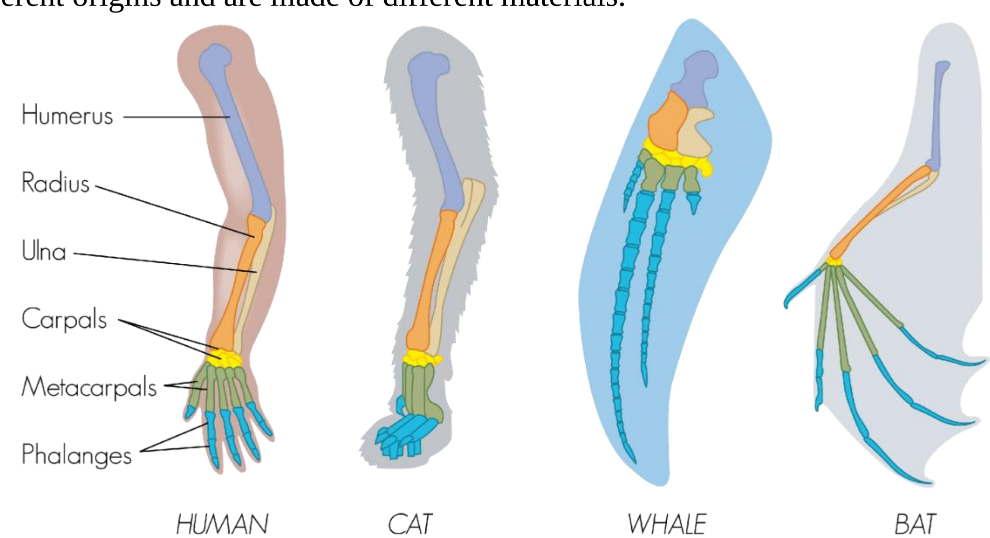


2. Morphology

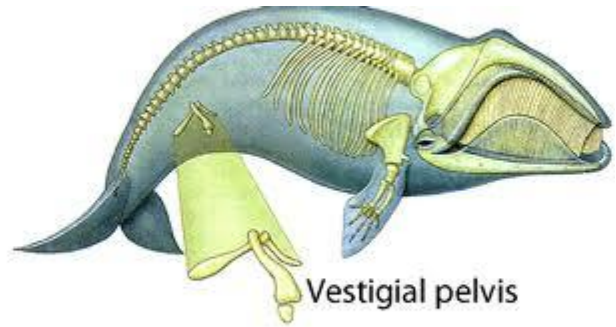
A. Embryology—the study of developing embryos. Comparing the embryos of some developing embryos show some similarities such as gill slits, segmented backbones, C-shaped bodies, and tails. This may mean they had a common ancestor at one time. The first row shows the embryos (first period of time after fertilization) of several different organsisms. The second row shows the fetuses (period of time until organs are formed to birth) and how they are showing more differences than before. Finally, the third row is the newborn organsism. They are now extrememly different from one another. These early similarities may show that developmental processes are constatn through the evolution of animals. The similarities show that previous structures may have needed to be adapted to new uses.



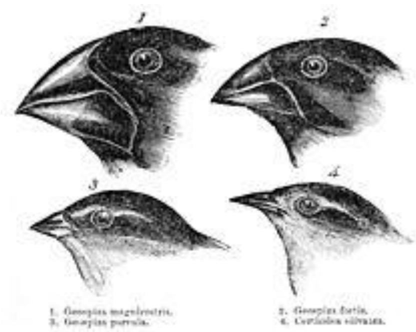
B. Comparative anatomy is the science of comparing the physical features of organisms. Homologous structures that are thought to have the same evolution and origins, but do not have the same function. They are composed of the same types of bones. They look different but in evolutionary tems they show how a basic structure has been modified through natural selection to meet the needs of the organisms.ie whale flipper, human arm, cat leg, bat wing. Analogous structures are present in two different organisms that have the same function but came from a different evolutionary origin and so are strucutrally different. For example, the wing of a bird and of a mosquito are both used for flying but come from different origins and are made of different materials.



C. Vestiges are structures found in an organism that are reduced in size and does not have any apparent current use, but may have a function in another species or had in an ancestor organism. The human appendix is an example, as is a whale pelvis. The appendix is a small pouch where the large and small in testines join. Similar structures in herbivores is used as storage.



3. Observable events are evolutionary events that are currently or have occurred in modern times. One example is the Peppered moth in England which changed from a lighter form to a darker form due to the environmental changes brought on by the Industrial Revolution. Also, Darwins finches on the Galapagos Islands are still showing changes over time since Darwin first saw them and took samples of them. Some scientists believe their changes are cyclical.

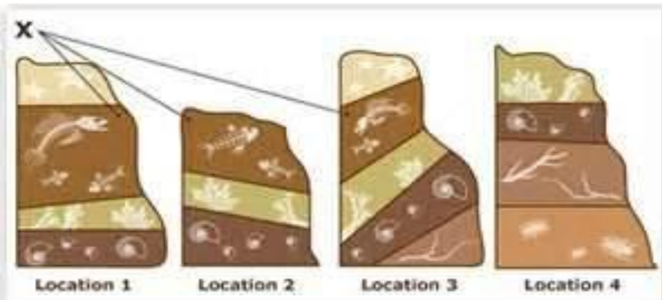


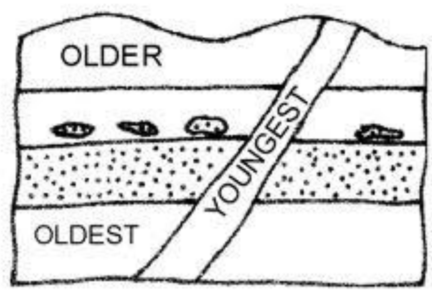
4. The fossil record has been discovered through the sciences of geology and paleontology. Fossils are the remains or traces of an organism from long ago. Remains include items such as bones, teeth, or a shell. Traces could include a burrow, footprint, or imprint. An extremely small number of organisms from the past have been preserved as fossils. Fossils can be molds, casts, or even whole organisms preserved in ice, tar, sap.

Type of fossil	Description
Hard parts of organisms	Bones, teeth, and shells are not as easily decomposed as many other parts of a living organism and can remain intact in certain environmental conditions for many years
Petrification	The bones of animals and the cellulose within plants and trees can sometimes be replaced with minerals that preserve the shape of these structures ie the petrified forest in the US southwest
Imprints	Tracks, tunnels, footprints and leaf prints can be left in soft mud by ancient organisms that eventually harden into rock ie dinosaur footprints found in southern Arkansas
Amber	Small organisms, such as insects, that once roamed the earth can sometimes be trapped in the sticky resin of evergreen trees and be sealed off from the decomposing agents of the environment
Casts and molds	Sometimes rock forms around the structure of an organism, and when the organism decays, a mold of the organism remains in the rock
Freezing	The preserved bodies of some prehistoric organisms have been uncovered in very cold parts of the world i.e. more commonly found in Europe
Tar	Tar pits form when crude oil seeps to the surface through fissures in the Earth's crust; the light fraction of the oil evaporates, leaving behind the heavy tar, or asphalt, in sticky pools. Animals fall into the tar pits and are preserved by the tar i.e. La Brea tar pits near L.A.

Most fossils will be found in sedimentary rocks. These rocks are formed as the organism is buried under layers and more layers of sediment that are then pressed down and harden into rock over long periods of time. The oldest fossils will be found in the lower layers since they were deposited first and are eventually covered up. Comparing fossils from different layers shows how life has changed and that there are increased numbers of life forms. The layers are called strata. Scientists can determine the age of fossils in two ways: relative dating and radioactive dating.

Index fossil





Relative dating is when the fossils found deepest under the surface or the lowest layer are considered the oldest with those closer to the surface are younger or from a more recent time. Relative dating does not give an exact age to a fossil but can be used to determine a range of time.This can be done by comparing the fossil to an index fossil, which is a fossil of an organism that lived over a wide are but only for a short time. Also, a relative age can be found by determining the radioactive date of rocks or ash above or below the fossil. Radioactive dating is done by measuring the amount of a radioactive isotope found in the rock. Some chemicals have unstable forms called radioactive isotopes. They break down to a more stable form is a predictable amount of time called a half-life. The half-life means the amount of time needed for half of the newly formed radioactive isotope to break down to the stable isotope form. The half-life is not affected by physical forces or other chemicals. So if the half-life is known then the age of the fossils can be determined by measurung the amount of the radioactive isotope to the amount of stable isotope.

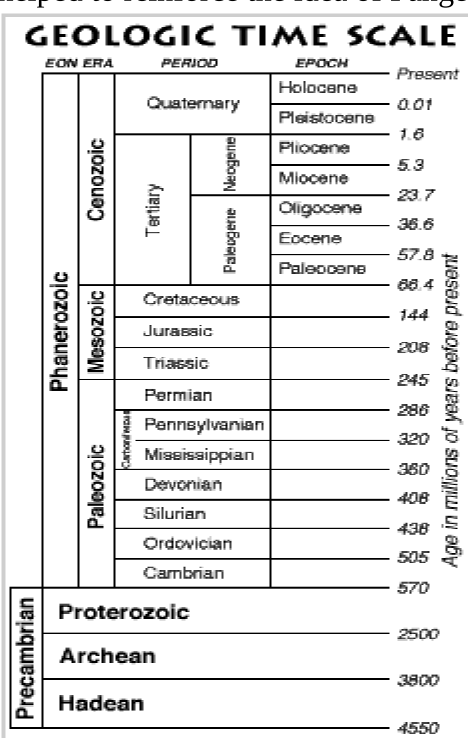
Some commonly used radioactive isotopes are in the following table:

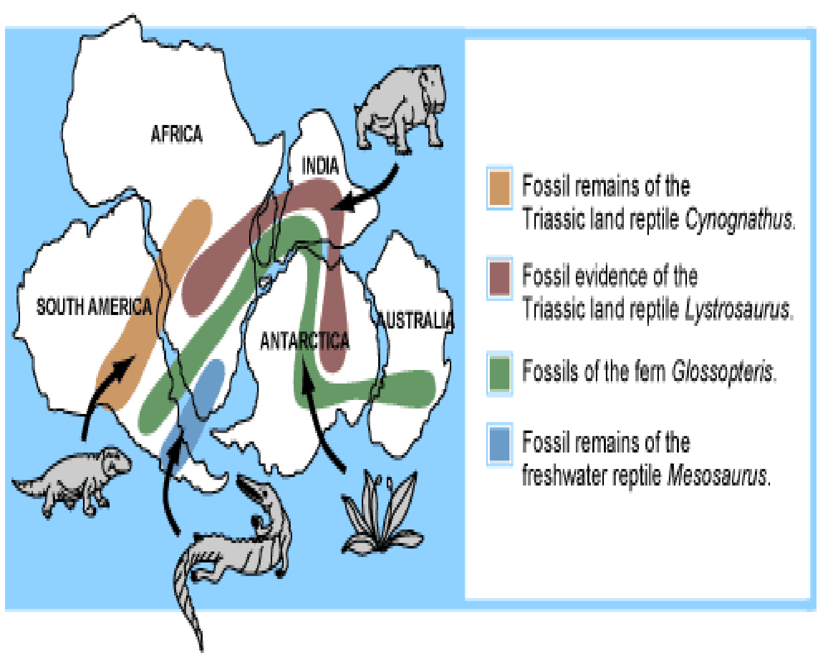
Isotope	Half-life	Isotope	Half-life
Uranium-238	4.5 billion years	Plutonium-239	24,300 years
Potassium-40	1.26 billion years	Carbon-14	5,730 years

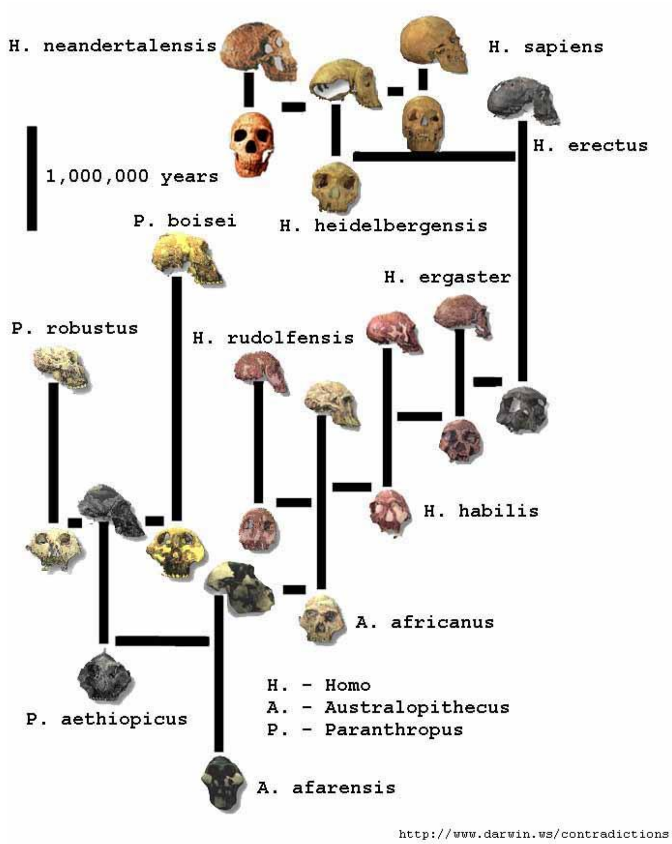
Carbon-14 is taken into living organisms as part of their food source. The carbon-14 isotope is best for dating organic fossils that are more recent since the half-life is short. Using carbon-14 on more recent fossils instead of very old fossils allows the age to be determine more accurately. Radioactive dating can be difficult since the actual amount of the radioactive isotope can be difficult to determine.

Dating the fossils has been used to create a geologic time scale or timeline which is used to show how organisms have changed over time, and when mass extinction events have occurred. The time scale is broken up into different size chunks of time called eons, then smaller eras, then smaller periods, then epochs.

The geographic distribution of fossils found around the world has been documented too and has helped to reinforce the idea of Pangea and the theory of continental drift.






H. neandertalensis
H. sapiens
H. erectus
1,000,000 years
P. boisei
H. heidelbergensis
H. ergaster
P. robustus
H. rudolfensis
H. habilis
A. africanus
H. - Homo
A. - Australopithecus
P. - Paranthropus
P. aethiopicus
A. afarensis
http://www.darwin.ws/contradictions