

# What is Evolution?

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Most non-scientists seem to be quite confused about precise definitions of biological evolution. Such confusion is due in large part to the inability of scientists to communicate effectively to the general public and also to confusion among scientists themselves about how to define such an important term. When discussing evolution it is important to distinguish between the existence of evolution and various theories about the mechanism of evolution. And when referring to the existence of evolution it is important to have a clear definition in mind. What exactly do biologists mean when they say that they have observed evolution or that humans and chimps have evolved from a common ancestor?

One of the most respected evolutionary biologists has defined biological evolution as follows: "In the broadest sense, evolution is merely change, and so is all-pervasive; galaxies, languages, and political systems all evolve. Biological evolution ... is change in the properties of populations of organisms that transcend the lifetime of a single individual. The ontogeny of an individual is not considered evolution; individual organisms do not evolve. The changes in populations that are considered evolutionary are those that are inheritable via the genetic material from one generation to the next. Biological evolution may be slight or substantial; it embraces everything from slight changes in the proportion of different alleles within a population (such as those determining blood types) to the successive alterations that led from the earliest protoorganism to snails, bees, giraffes, and dandelions." (Douglas J. Futuyma in *Evolutionary Biology*, Sinauer Associates 1986).

It is important to note that biological evolution refers to populations and not to individuals and that the changes must be passed on to the next generation. In practice this means that, evolution is a process that results in heritable changes in a population spread over many generations.

This is a good working scientific definition of evolution; one that can be used to distinguish between evolution and similar changes that are not evolution. Another common short definition of evolution can be found in many textbooks:

"In fact, evolution can be precisely defined as any change in the frequency of alleles within a gene pool from one generation to the next."

- Helena Curtis and N. Sue Barnes, *Biology*, 5th ed. 1989 Worth Publishers, p.974

One can quibble about the accuracy of such a definition (and we have often quibbled on these newsgroups) but it also conveys the essence of what evolution really is. When biologists say that they have observed evolution, they mean that they have detected a change in the frequency of genes in a population. (Often the genetic change is inferred from phenotypic changes that are heritable.) When biologists say that humans and chimps have evolved from a common ancestor they mean that there have been successive heritable changes in the two separated populations since they became isolated.

Unfortunately the common definitions of evolution outside of the scientific community are different. For example, in the Oxford Concise Science Dictionary we find the following definition:

"evolution: The gradual process by which the present diversity of plant and animal life arose from the earliest and most primitive organisms, which is believed to have been continuing for the past 3000 million years."

This is inexcusable for a dictionary of science. Not only does this definition exclude prokaryotes, protozoa, and fungi, but it specifically includes a term "gradual process" which should not be part of the definition.

More importantly the definition seems to refer more to the history of evolution than to evolution itself. Using this definition it is possible to debate whether evolution is still occurring, but the definition provides no easy way of distinguishing evolution from other processes. For example, is the increase in height among Caucasians over the past several hundred years an example of evolution? Are the color changes in the peppered moth population examples of evolution? This is not a scientific definition.

Standard dictionaries are even worse.

"evolution: ...the doctrine according to which higher forms of life have gradually arisen out of lower.." - Chambers

"evolution: ...the development of a species, organism, or organ from its original or primitive state to its present or specialized state; phylogeny or ontogeny" - Webster's

These definitions are simply wrong. Unfortunately it is common for non-scientists to enter into a discussion about evolution with such a definition in mind. This often leads to fruitless debate since the experts are thinking about evolution from a different perspective. When someone claims that they don't believe in evolution they cannot be referring to an acceptable scientific definition of evolution because that would be denying something which is easy to demonstrate. It would be like saying that they don't believe in gravity!

Recently I read a statement from a creationist who claimed that scientists are being dishonest when they talk about evolution. This person believed that evolution was being misrepresented to the public. The real problem is that the public, and creationists, do not understand what evolution is all about. This person's definition of evolution was very different from the common scientific definition and as a consequence he was unable to understand what evolutionary biology really meant. This is the same person who claimed that one could not "believe" in evolution and still be religious! But once we realize that evolution is simply "a process that results in heritable changes in a population spread over many generations" it seems a little silly to pretend that this excludes religion!

Scientists such as myself must share the blame for the lack of public understanding of science. We need to work harder to convey the correct information. Sometimes we don't succeed very well but that does not mean that we are dishonest. On the other hand, the general public, and creationists in particular, need to also work a little harder in order to understand science. Reading a textbook would help.

<http://www.talkorigins.org/faqs/evolution-definition.html>