

Evolution: it's not about belief

Belief has no part in it. Do you believe in gravity? It doesn't matter whether you do or not, gravity exists. Same with evolution. Whether you like it or not, it is a fact, plain and simple.

Modern biology doesn't make sense without evolution. It is supported by chemistry, geology, paleontology, genetics, and many other branches of science.

It's not a ladder, it's a tree!

All living organisms evolved from a common ancestor. The tree of life developed more branches as species diversified over time. Humans are not at the pinnacle of evolution, and we did not evolve from monkeys. Rather, humans and monkeys evolved from a common ancestor, which is why both species continue to exist.



"Today, the theory of evolution is an accepted fact for everyone but a fundamentalist minority, whose objections are based not on reasoning but on doctrinaire adherence to religious principles."



- James D. Watson



Tiktaalik: a "missing link" between water and land

Image courtesy of the Academy of Natural Sciences

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The Truth About Evolution



"Today the theory of evolution is about as much open to doubt as the theory that the earth goes 'round the sun."

- Richard Dawkins

What is / isn't evolution?

Evolution does not explain the beginning of life; that is called *abiogenesis*. Nor does it explain the origin of the universe; that is called *cosmogony*. Life must first start before evolution can occur.

What evolution *does* explain is the diversification of life via a process called natural selection. Every living organism produces offspring that belong to the same species as the parent, but there are always minor variations. Over many generations, these minor variations accumulate, resulting in the species gradually evolving. In time, certain traits may become more or less prevalent in a population, resulting in the species gradually diverging into multiple sub-species. To understand this, think of breeding dogs or horses for specific traits like speed, strength, or tracking ability. One 'selects' the animals with the desirable traits and breeds them. In nature, the ability to adapt and survive in a particular environment (aka "survival of the fittest") becomes the selector for desirable traits; hence the term "natural selection."

The fossil record

The fossil record is the list of all fossils that chart evolution over time. Some people think that the absence of a single fossil (a gap) disproves evolution outright. But due to the relative rarity of fossil formation, and the natural destruction of rock that holds fossils, it is unlikely that the fossil record will ever be complete. However, scientists continue to find new evidence; for example, the first chimp fossils have only been recently discovered.

Since newer sedimentary deposits are always laid on top of older ones, finding a fossil out of order (a more recent species below an older one) would disprove evolution. However such a fossil has never been found.

"It's just a theory"

In science, the word "theory" has a different meaning from its common usage. It is not a guess or speculation (in science that is called a *hypothesis*). **A theory is an idea that explains all relevant facts** (verifiable observations). Besides evolution, other scientific theories include the theory of gravity and the germ theory of disease. The way to disprove a theory is to find a single fact that contradicts it.

Evolution has been directly observed in many species, but one of the easiest examples to understand is that of bacteria, as they continue to develop antibiotic resistance and defeat the latest round of drugs.

Evolution is currently supported by over 200,000 scientific, peer-reviewed articles collected by thousands of scientists over the last century. No theory can ever be proven 100%, but until a fact is found that disproves it, it is the best scientific explanation for the diversity of living organisms on our planet.

Irreducible complexity?

Some structures, such as the human eye and ear, may seem too complex to have evolved. But as organisms become more complex, the function of some of their parts may change during the process. For example, the jaw bones of ancient reptiles evolved to become part of the human ear, and some single-celled creatures, like the single-celled *euglena*, can detect light. These examples illustrate the fact that the ability to see does evolve, and just because an organ or structure is complex doesn't mean that it couldn't have evolved from something simpler. In addition, the human eye is less acute than that of an octopus or owl – why would a designer give an octopus a better eye than it would give a human?

Micro vs. macro

When creationists talk about microevolution and macroevolution, they don't mean the same thing that evolutionary biologists do when they use the terms. Creationists believe these words describe two fundamentally different processes. As far as science is concerned, there is no magic line between microevolution and macroevolution.

While genes can vary significantly between different life forms, the basic mechanisms of evolution are all the same. Macroevolution is merely the result of a lot of microevolutions over a long period of time. There is no known mechanism that would prevent small changes (microevolution) from ultimately resulting in large changes (macroevolution), so there is no reason to differentiate them.

The age of the earth

Evolution takes an incredibly long time! A combination of scientific evidence, including DNA mutations, carbon dating and other forms of radiometric dating, and paleomagnetic dating, determine that the earth is about 4.5 billion years old, and life originated about 3.7 billion years ago. The earliest plants only appeared about 450 million years ago.

We know these estimates are reliable because each method independently gives us dates that agree with the others. From those that date more recent events, like tree-ring dating, to those that measure deep time events like potassium argon dating, each confirms and reinforces the accuracy of the data.

