

Evolution Unmuddled:

Fact of Evolution vs Theory of Evolution

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Unfortunately, evolution is frequently muddled, for many reasons and causes, not the least of which is its misrepresentation by anti-evolutionists.

First of all, the essence of evolution, namely the descent of species by modification from pre-existing species, is a *scientific fact*. It has been directly observed numerous times, and there is more evidence for it happening in the distant past than there is for the shape of our planet and its orbit around the Sun, so it is also an *inferred fact*. There are tons of transitional fossils, while molecular, genetic, embryological, geographic anatomical and cytological studies clearly show that life forms have not only drastically changed over time, but they have emerged from earlier forms by the gradual accumulation of new traits, and have replaced most of the earlier forms in the process. From many examples deeply studied, it has been concluded that all major groups of organisms can trace their biological origins ultimately back to common ancestry. We are all biologically connected, and this is all very well documented. Those are the facts. We call this *evolution*.

Evolution *theory*, as typically used, is actually just the abbreviated version of Darwin's "Theory of Evolution by Natural Selection." This probably should be referred to as the "Theory of Natural Selection," the *mechanism* first proposed by Charles Darwin to explain *how* evolution happens. Actually, natural selection by itself is also a fact, observed all the time in all forms of life. That this was the main (or only) mechanism for evolution has been substantially confirmed by virtually all of the studies done since Darwin. Other mechanisms are also operating, especially mechanisms of speciation that separate different populations into new species, but natural selection remains the key mechanism that explains *how* different populations can arise.

Phenomena observed and confirmed by many critical observers we call *scientific facts*. Repeatedly tested and confirmed *explanations* for those phenomena are called *scientific theories*. So, we have the fact of evolution on the one hand, and the theory of natural selection on the other (Narguizian, 2006). Hopefully, textbooks, teachers, and the press will someday realize this, and clear up the confusion.

David Morrison (2005), has a very useful idea. He proposes that we avoid the use of *theory* altogether. The word in the popular mind is typically associated with tentative or speculative notions (contrary to the scientific meaning). Anti-evolutionists play on this (and encourage its use) to convey the sense that evolution is problematic and tenuous, the image held by most Americans. This is in stark contrast to the reality of this phenomenon as understood and recognized by virtually all biologists, and sustained by every study. So Morrison makes a strong plea to *not* put evolution in the "theory" frame at all. Just refer to it matter-of-factly as "evolution." Our role as teachers is to convey, as accurately as we can, the nature and understandings of science. Rather than grappling with the popular mindset about "theory", just bypass that word, and deal with evolution as it is, an observed process, just as real as gravity, the shape of our earth and its orbit around the Sun. If anyone persists in using "theory," just explain why we shouldn't use it.

And that brings me to the need to teach the Nature of Science (NOS) right up front. Most of the objections to evolution can be traced directly to the misunderstanding (and misrepresentations) of science: its realm, its limits, its assumptions and its rules, not just one of its methods. Students must get real experiences with these elements of science, not just lecture or reading assignments. If students learn why science *cannot* use supernatural forces to explain natural phenomena, they can more readily accept why ID and “creation science” are unacceptable explanations for the science classroom. Furthermore, there would be no need to resort to the facts that “evolution is in our standards and required to be taught” or “teaching religious explanations in science has been deemed unconstitutional by the Supreme Court.” Those are convenient and true, but they sound like something else imposed on kids (and teachers): more rules and regulations to rail against. Naturally, they will be defensive about it, and feel rather helpless in the process. Why not just teach the facts of evolution and the nature of science; they can certainly stand on their own. They don’t need laws to make them true.

As pointed out above, a major part of this problem is the fact that the popular perceptions of both evolution and the nature of science are way off. A useful tool to bring this to the attention of your students is to give them pre-tests with questions selected to reveal many of those misconceptions, then go over the collective results with the class. I do this before I get into my NOS unit, and before I begin my intro to evolution unit. Then we proceed to experience what the NOS IS (as well as what it is NOT), and a little later we do the same thing with evolution.

Some have wondered how we can teach evolution without teaching genetics first. Let me remind you that there was no good understanding of genetics when Darwin wrote his *Origin of Species*. Simply by seeing how organisms fall into classification hierarchies naturally, how fossils sort out over time, seeing some examples of excellent transitional fossil sequences, some geographic evidence, and some examples of homology are sufficient to show that life does not actually fit the traditional view that each species suddenly appeared, or was created independently; life has clearly evolved. These observations beg for a different explanation, and natural selection continues to provide this beautifully.

So teach evolution by natural selection as an explanation that best fits the observations. This doesn’t necessarily mean that the Bible, Koran or other authority is wrong. It does suggest, however, that perhaps some people may have misinterpreted those sources. Science is absolutely neutral about God or any other supernatural being or force. The rules of sciences simply do not allow any such decision; God can neither be required nor denied by any scientific explanation. That has to be a matter of personal faith or belief. That’s why such factors cannot be considered in the science classroom as an equally viable explanation for any natural phenomenon.

For those of you not yet familiar with a biology course sequence that introduces the nature of science and evolution early in the course, and uses these as themes throughout the course, along with links to lessons for doing this, take a look at this on the ENSI website:

<http://www.indiana.edu/~ensiweb/teach.fs.html>. Scroll down to “The Evolution Solution.”

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References:

Morrison, David. *Reports of the NCSE*. 2005. vol.25, nos.5-6, page 40.

Narguizian, Paul. *Understanding the Nature of Science Through the Study of Biological Evolution*. NSTA Convention, Anaheim, CA., April 7, 2006.