

One side can be wrong

Accepting 'intelligent design' in science classrooms would have disastrous consequences, warn Richard Dawkins and Jerry Coyne

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It sounds so reasonable, doesn't it? Such a modest proposal. Why not teach "both sides" and let the children decide for themselves? As President Bush said, "You're asking me whether or not people ought to be exposed to different ideas, the answer is yes." At first hearing, everything about the phrase "both sides" warms the hearts of educators like ourselves.

One of us spent years as an Oxford tutor and it was his habit to choose controversial topics for the students' weekly essays. They were required to go to the library, read about both sides of an argument, give a fair account of both, and then come to a balanced judgment in their essay. The call for balance, by the way, was always tempered by the maxim, "When two opposite points of view are expressed with equal intensity, the truth does not necessarily lie exactly half way between. It is possible for one side simply to be wrong."

As teachers, both of us have found that asking our students to analyse controversies is of enormous value to their education. What is wrong, then, with teaching both sides of the alleged controversy between evolution and creationism or "intelligent design" (ID)? And, by the way, don't be fooled by the disingenuous euphemism. There is nothing new about ID. It is simply creationism camouflaged with a new name to slip (with some success, thanks to loads of tax-free money and slick public-relations professionals) under the radar of the US Constitution's mandate for separation between church and state.

Why, then, would two lifelong educators and passionate advocates of the "both sides" style of teaching join with essentially all biologists in making an exception of the alleged controversy between creation and evolution? What is wrong with the apparently sweet reasonableness of "it is only fair to teach both sides"? The answer is simple. This is not a scientific controversy at all. And it is a time-wasting distraction because evolutionary science, perhaps more than any other major science, is bountifully endowed with genuine controversy.

Among the controversies that students of evolution commonly face, these are genuinely challenging and of great educational value: neutralism versus selectionism in molecular evolution; adaptationism; group selection; punctuated equilibrium; cladism; "evo-devo"; the "Cambrian Explosion"; mass extinctions; interspecies competition; sympatric speciation; sexual selection; the evolution of sex itself; evolutionary psychology; Darwinian medicine and so on. The point is that all these controversies, and many more, provide fodder for fascinating and lively argument, not just in essays but for student discussions late at night.

Intelligent design is not an argument of the same character as these controversies. It is not a scientific argument at all, but a religious one. It might be worth discussing in a class on the history of ideas, in a philosophy class on popular logical fallacies, or in a comparative religion class on origin myths from around the world. But it no more belongs in a biology class than alchemy belongs in a chemistry class, phlogiston in a physics class or the stork theory in a sex education class. In those cases, the demand for equal time for "both theories" would be ludicrous. Similarly, in a class on 20th-century European history, who would demand equal time for the theory that the Holocaust never happened?

So, why are we so sure that intelligent design is not a real scientific theory, worthy of "both sides" treatment? Isn't that just our personal opinion? It is an opinion shared by the vast majority of professional biologists, but of course science does not proceed by majority vote among scientists. Why isn't creationism (or its incarnation as intelligent design) just another scientific controversy, as worthy of scientific debate as the dozen essay topics we listed above? Here's why.

If ID really were a scientific theory, positive evidence for it, gathered through research, would fill peer-reviewed scientific journals. This doesn't happen. It isn't that editors refuse to publish ID research. There simply isn't any ID research to publish. Its advocates bypass normal scientific due process by appealing directly to the non-scientific public and - with great shrewdness - to the government officials they elect.

The argument the ID advocates put, such as it is, is always of the same character. Never do they offer positive evidence in favour of intelligent design. All we ever get is a list of alleged deficiencies in evolution. We are told of "gaps" in the fossil record. Or organs are stated, by fiat and without supporting evidence, to be "irreducibly complex": too complex to have evolved by natural selection.

In all cases there is a hidden (actually they scarcely even bother to hide it) "default" assumption that if Theory A has some difficulty in explaining Phenomenon X, we must automatically prefer Theory B without even asking whether Theory B (creationism in this case) is any better at explaining it. Note how unbalanced this is, and how it gives the lie to the apparent reasonableness of "let's teach both sides". One side is required to produce evidence, every step of the way. The other side is never required to produce one iota of evidence, but is deemed to have won automatically, the moment the first side encounters a difficulty - the sort of difficulty that all sciences encounter every day, and go to work to solve, with relish.

What, after all, is a gap in the fossil record? It is simply the absence of a fossil which would otherwise have documented a particular evolutionary transition. The gap means that we lack a complete cinematic record of every step in the evolutionary process. But how incredibly presumptuous to demand a complete record, given that only a minuscule proportion of deaths result in a fossil anyway.

The equivalent evidential demand of creationism would be a complete cinematic record of God's behaviour on the day that he went to work on, say, the mammalian ear bones or the bacterial flagellum - the small, hair-like organ that propels mobile bacteria. Not even the most ardent advocate of intelligent design claims that any such divine videotape will ever become available.

Biologists, on the other hand, can confidently claim the equivalent "cinematic" sequence of fossils for a very large number of evolutionary transitions. Not all, but very many, including our own descent from the bipedal ape *Australopithecus*. And - far more telling - not a single authentic fossil has ever been found in the "wrong" place in the evolutionary sequence. Such an anachronistic fossil, if one were ever unearthed, would blow evolution out of the water.

As the great biologist J B S Haldane growled, when asked what might disprove evolution: "Fossil rabbits in the pre-Cambrian." Evolution, like all good theories, makes itself vulnerable to disproof. Needless to say, it has always come through with flying colours.

Similarly, the claim that something - say the bacterial flagellum - is too complex to have evolved by natural selection is alleged, by a lamentably common but false syllogism, to support the "rival" intelligent design theory by default. This kind of default reasoning leaves completely open the possibility that, if the bacterial flagellum is too complex to have evolved, it might also be too complex to have been created. And indeed, a moment's thought shows that any God capable of creating a bacterial flagellum (to say nothing of a universe) would have to be a far more complex,

and therefore statistically improbable, entity than the bacterial flagellum (or universe) itself - even more in need of an explanation than the object he is alleged to have created.

If complex organisms demand an explanation, so does a complex designer. And it's no solution to raise the theologian's plea that God (or the Intelligent Designer) is simply immune to the normal demands of scientific explanation. To do so would be to shoot yourself in the foot. You cannot have it both ways. Either ID belongs in the science classroom, in which case it must submit to the discipline required of a scientific hypothesis. Or it does not, in which case get it out of the science classroom and send it back into the church, where it belongs.

In fact, the bacterial flagellum is certainly not too complex to have evolved, nor is any other living structure that has ever been carefully studied. Biologists have located plausible series of intermediates, using ingredients to be found elsewhere in living systems. But even if some particular case were found for which biologists could offer no ready explanation, the important point is that the "default" logic of the creationists remains thoroughly rotten.

There is no evidence in favour of intelligent design: only alleged gaps in the completeness of the evolutionary account, coupled with the "default" fallacy we have identified. And, while it is inevitably true that there are incompletenesses in evolutionary science, the positive evidence for the fact of evolution is truly massive, made up of hundreds of thousands of mutually corroborating observations. These come from areas such as geology, paleontology, comparative anatomy, physiology, biochemistry, ethology, biogeography, embryology and - increasingly nowadays - molecular genetics.

The weight of the evidence has become so heavy that opposition to the fact of evolution is laughable to all who are acquainted with even a fraction of the published data. Evolution is a fact: as much a fact as plate tectonics or the heliocentric solar system.

Why, finally, does it matter whether these issues are discussed in science classes? There is a case for saying that it doesn't - that biologists shouldn't get so hot under the collar. Perhaps we should just accept the popular demand that we teach ID as well as evolution in science classes. It would, after all, take only about 10 minutes to exhaust the case for ID, then we could get back to teaching real science and genuine controversy.

Tempting as this is, a serious worry remains. The seductive "let's teach the controversy" language still conveys the false, and highly pernicious, idea that there really are two sides. This would distract students from the genuinely important and interesting controversies that enliven evolutionary discourse. Worse, it would hand creationism the only victory it realistically aspires to. Without needing to make a single good point in any argument, it would have won the right for a form of supernaturalism to be recognised as an authentic part of science. And that would be the end of science education in America.

Arguments worth having ...

The "Cambrian Explosion"

Although the fossil record shows that the first multicellular animals lived about 640m years ago, the diversity of species was low until about 530m years ago. At that time there was a sudden explosion of many diverse marine species, including the first appearance of molluscs, arthropods, echinoderms and vertebrates. "Sudden" here is used in the geological sense; the "explosion" occurred over a period of 10m to 30m years, which is, after all, comparable to the time taken to evolve most of the great radiations of mammals. This rapid diversification raises fascinating questions; explanations include the evolution of organisms with hard parts (which aid

fossilisation), the evolutionary "discovery" of eyes, and the development of new genes that allowed parts of organisms to evolve independently.

The evolutionary basis of human behaviour

The field of evolutionary psychology (once called "sociobiology") maintains that many universal traits of human behaviour (especially sexual behaviour), as well as differences between individuals and between ethnic groups, have a genetic basis. These traits and differences are said to have evolved in our ancestors via natural selection. There is much controversy about these claims, largely because it is hard to reconstruct the evolutionary forces that acted on our ancestors, and it is unethical to do genetic experiments on modern humans.

Sexual versus natural selection

Although evolutionists agree that adaptations invariably result from natural selection, there are many traits, such as the elaborate plumage of male birds and size differences between the sexes in many species, that are better explained by "sexual selection": selection based on members of one sex (usually females) preferring to mate with members of the other sex that show certain desirable traits. Evolutionists debate how many features of animals have resulted from sexual as opposed to natural selection; some, like Darwin himself, feel that many physical features differentiating human "races" resulted from sexual selection.

The target of natural selection

Evolutionists agree that natural selection usually acts on genes in organisms - individuals carrying genes that give them a reproductive or survival advantage over others will leave more descendants, gradually changing the genetic composition of a species. This is called "individual selection". But some evolutionists have proposed that selection can act at higher levels as well: on populations (group selection), or even on species themselves (species selection). The relative importance of individual versus these higher order forms of selection is a topic of lively debate.

Natural selection versus genetic drift

Natural selection is a process that leads to the replacement of one gene by another in a predictable way. But there is also a "random" evolutionary process called genetic drift, which is the genetic equivalent of coin-tossing. Genetic drift leads to unpredictable changes in the frequencies of genes that don't make much difference to the adaptation of their carriers, and can cause evolution by changing the genetic composition of populations. Many features of DNA are said to have evolved by genetic drift. Evolutionary geneticists disagree about the importance of selection versus drift in explaining features of organisms and their DNA. All evolutionists agree that genetic drift can't explain adaptive evolution. But not all evolution is adaptive.

Further reading

www.talkorigins.org/faqs/comdesc

Website explaining evolution in user-friendly fashion

Climbing Mount Improbable

Richard Dawkin (illustrations by Lalla Ward), Penguin 1997

Evolution versus Creationism

Eugenie C Scott, Greenwood Press, 2004

· Richard Dawkins is Charles Simonyi professor of the public understanding of science at Oxford University, and Jerry Coyne is a professor in the department of ecology and evolution at the University of Chicago

Richard Dawkins book 'The Ancestor's Tale: A Pilgrimage to the Dawn of Life' is published by Phoenix in paperback today priced £9.99.