

A Radical Redefinition of science

In 1999 the Kansas Board of Education took the remarkable step of removing evolution from its academic standards in science. Educators and scientists alike criticized this controversial move, and in early 2001 the Board reversed itself and adopted a new curriculum that has won praise and admiration around the country.

Kansas is again in the process of reviewing science standards, and some time this year the Board will act on a new set of science standards based on the recommendations of its Science Writing Committee. The current committee has produced an excellent set of standards, which, if adopted and professionally implemented, will make Kansas a leader in science education. However, an eight member minority of the committee has produced a dissenting report that the Board may also consider in revising the standards.

Unlike the situation in 1999, the authors of the minority report may have hoped to escape scrutiny by leaving evolution in the curriculum — but what their changes would actually do to Kansas' science standards is far more radical and much more dangerous. Changes proposed by the eight dissenters would redefine science itself to include non-natural (*supernatural*) explanations for natural phenomena. They would prevent teachers from telling students that belief systems such as astrology, paganism, and wiccan healing are outside the realm of science, and they would misinform students on a variety of topics, most of which are related to evolutionary biology.

The goals of the eight dissenters are clear. They plan to use the classroom to undermine evolution in a manner that clears the way for supernatural explanations regarding the origins of species. This would allow them to redefine religious beliefs as scientific ones, misleading students as to the nature of science, and entangling science classrooms throughout Kansas in an endless and unproductive battle between the multiple religious interpretations of origins that characterize our pluralistic society.

In 1999, their target was more modest — the removal of just one topic, evolution, from the state science curriculum. This time, the scope of their intentions is much broader. It is an outright attack upon all of science, and every discipline, from physics to astronomy to geology, is at risk. So is the future of science education in Kansas.

Citing “Naturalism” to misrepresent Science

The most striking aspect of the eight member minority report is its fixation with “naturalism.” This word and its variations appear no less than 23 times in their report, and forms the basis for every one of their recommendations. Their report defines naturalism as a “philosophy [that] allows only “natural” or mechanistic material causes for the origin and diversity of life.” This philosophy, they affirm, would “limit the amount of scientific information provided to students” about the origin and diversity of life. Naturalism, in their view, must be done away with because it restricts student inquiry. Simply stated, Kansas students must be told that natural science is *not* restricted to natural explanations.

To fully understand the radical nature of this proposal, look at the definition of science proposed by the majority of the Standards Writing Committee. Science, they wrote, is *“the human activity of seeking natural explanations for what we observe in the world around us. These explanations are based on observations, experiments, and logical arguments that adhere to strict empirical standards and a healthy skeptical perspective.”* It would be hard to improve on this well-written definition. Science does indeed seek natural explanations for natural events, and this is why science works. We see natural events (like a tsunami in the Indian Ocean) and we seek natural explanations (sudden movements of tectonic plates on the ocean floor). In fact, the golden age of science — the age in which we live today — has been made possible by this very process of reasoned inquiry into the workings of nature.

The minority report, however, disagrees. It would change the definition of science to read *“Science is a systematic method of continuing investigation, that uses observation, hypothesis testing, measurement, experimentation, logical argument and theory building to lead to more adequate explanations of natural phenomena.”* See the important difference? “Natural explanations” has been replaced with “adequate explanations” and the word “natural” has been deleted. Why one would want to change the description of how science works by deleting the word “natural” from “natural explanations?” The answer is straightforward — even though the minority didn’t seem to have the courage to state it plainly. They seek to turn science on its head by telling students that non-natural (*supernatural*) explanations are a legitimate part of science.

Why does this matter? Imagine an earth science class discussing tsunamis and applying “non-natural” explanations to the tragedy under the new guidelines. Plate tectonics are now just one of the explanations on the blackboard. They are joined by “non-naturalistic” ones like bad global karma, divine punishment for the sins of Indonesia, or evil spirits disturbed by ethnic warfare in Sri Lanka.

Think that’s an exaggeration? The original guidelines would have advised teachers to treat such non-scientific suggestions gently: *“If a student should raise a question in a natural science class that the teacher determines to be outside the domain of science class, the teacher should treat the question with respect. The teacher should explain why the question is outside the domain of natural sciences and encourage the student to discuss the question further with his or her family and other appropriate sources.”* Sounds like good advice, doesn’t it? Not to the group of eight. They deleted both of those sentences in their revision, making it clear that *nothing* is out of bounds with respect to non-natural explanations in science.

I can’t wait to see how exciting health class will be when wiccan healing is brought in as one of the “scientific” topics for discussion — and the teacher *cannot* gently tell her students that witchcraft isn’t science. According to the eight dissenters, *“The parameters defining “the domain of science” are ambiguous and scientifically controversial, and thus teachers cannot be expected to be able to accurately identify such questions.”* Science teachers in Kansas are required to be “highly qualified,” but those qualifications apparently do not extend to knowing what science itself might be. At least not according to the group of eight.

The real target of the dissenting eight may be evolutionary biology, but when one science is placed under attack, no science is safe. Subverting the teaching of natural science by forcing it

to accept non-natural explanations will place every science at risk, at least in the classrooms of Kansas. The group of eight, if they have their way, will open the science classroom to pyramid power, mystical healing, astrology, ancient astronauts, and Raelian analysis. Not only are such non-natural explanations specifically allowed, but teachers are told that they aren't bright enough to rule them outside the domain of science. Education in the Midway State will be in for some interesting times if the minority has its way.

False Claims about “Historical Science”

The minority report's re-writing of science continues with an effort to tell students that “historical sciences” are fundamentally different from experimental sciences because they concern events that happened in the past. The recommendations of the eight tell students that historical sciences require investigators to construct competing hypotheses and test them against each other. At first glance, their description of how science works is perfectly reasonable. Students are told that they must test “*an historical hypothesis by formulating a competing hypotheses and then describing the kinds of data (evidence) that would support one and refute the others (p. 8).*”

What's wrong with this passage is not what it says about historical sciences, but its radical suggestion that “experimental sciences” don't work the same way. In fact, the formulation and testing of alternate hypotheses is exactly how all sciences work. For example, experimentalists in high-energy physics routinely work by formulating alternate hypotheses based on string theory and other descriptions of subatomic behavior. They then seek to construct experiments designed to produce data that might support one and refute others. Cell biologists do the same when they try to determine the function and composition of various cell organelles — they form competing hypotheses, and then try to determine what sort of data would support one or the other¹. The notion that the use of competing hypotheses is unique to “historical science” is simply wrong.

Why do the eight dissenters wish to mislead students by telling them that historical sciences follow different rules than experimental science? They explain this in a deliberately veiled way on pages 9 and 10 of their document. In their view, historical science requires that *all* “competing hypotheses” must be examined. They write “*the failure to rule out (or to even seek to rule out) a competing historical hypothesis leaves the favored hypothesis as nothing more than a speculation or a ‘dreaded just-so story.’*” While it's only reasonable to include all competing hypotheses in any scientific study, the reason they set historical science aside and give it special emphasis is clear. In line with their criticisms of “naturalism” in the earlier pages of the document, the competing hypotheses they wish to include are *supernatural* ones.

Supernatural hypotheses are not accepted in science, of course, because they cannot be tested. This does not mean that they are not true, only that they are not scientific. Science is necessarily

¹ An example of this can be found in a current controversy over the nature of the Golgi apparatus. See E. Check's article “Cell Biology: Will the real Golgi Please Stand up?” in *Nature* **416**, 780 - 781 (25 April 2002) for background. The notion that “experimental science” relies on direct observation and experiment, and need not form competing hypotheses to test is not correct. As this article shows, competing hypotheses are used in experimental sciences as well.

silent on the issue of the supernatural, not because it rejects the supernatural, but because supernatural phenomena exist outside the realm of science. By pretending that “historical” sciences differ in a fundamental way from experimental sciences, the authors of these revisions wish to suggest that untestable explanations that rely on supernatural forces are a legitimate part of science and the scientific method.

The misleading style of argument employed by the eight authors of the document is evidence on page 10. They use a quotation from my book (*“Finding Darwin’s God”*) in support of their view that historical sciences are fundamentally different from experimental sciences. In reality, the passage they quote actually argues precisely the opposite point, maintaining that so-called historical sciences are fully scientific, because the forensic techniques they use are based on experimental procedures and data analysis. They then state flatly that “Miller and Cleland” would agree with their insistence on including all “competing hypotheses” in such analyses. In reality any scientist, myself included, would object to including supernatural hypotheses in such competition, since such hypotheses would be untestable by the methods of science.

Mixing Science and Philosophy

One of the most radical and dangerous elements of the revisions proposed by the eight dissenters is the way in which they link evolution with a particular set of distinctly non-scientific philosophical views. The standards produced by the writing committee avoid this failing, by explicitly stating that science is limited to natural explanations of natural phenomena. Science, as understood by most scientists and by the majority of the standards writing committee, cannot make statements about the meaning and purpose of life.

The eight authors of the dissenting document disagree, and throughout their document attempt to misrepresent evolutionary biology as a philosophical construct that does indeed make statement about the meaning and purpose of life. They state that evolutionary biology claims “life is adequately explained by chance interactions of matter according to the laws of physics and chemistry (p.2).” In reality, no such claim exists. Science does not claim that life is “adequately explained,” and if it did, it would be time to call a halt to scientific research (since all questions about life would already have been answered!). Nor does evolution rely on “chance interactions” of matter. Natural selection, for example, does not rely on chance interactions, but rather is driven by non-random ecological, population, and environmental pressures that can be tested, studied, and analyzed.

The eight dissenting members worry that teaching evolution as suggested by the majority of the committee “*will necessarily have the effect of causing students to reach an uninformed, but ‘reasoned’ decision that they, and all other human beings, are merely natural occurrences, accidents of nature that lack intrinsic purpose.*” In reality, nothing in the standards suggested by the writing committee would cause students to reach such a conclusion. Ironically, only the statements suggested by the eight dissenting members would actually produce such a misconception: “1. a. *Biological evolution postulates an unpredictable and unguided natural process that has no discernable direction or goal. (p. 14).*” It is clear that the eight authors of the minority report strive so mightily to mislead students as to the meaning of evolutionary theory in order to “balance” their own distortions with a non-naturalistic (*supernatural*) story of origins

that lies entirely outside the realm of science.

This is a very poor way to produce standards that pretend to teach students about science.

Multiple Misstatements of Scientific Fact

In addition to its radical redefinition of science and its philosophical distortions, the eight member minority report contains a large number of scientific errors and misstatements of fact. Here are a few of the more serious examples:

- Page 13 of the revisions proposed by the eight dissenting members states that students should be told that “*The order of the nucleotide sequences within the gene is not dictated by any known chemical or physical law.*” They cite James Watson’s book *The Double Helix* to support this claim, but they seem to misunderstand the whole point of Watson’s statement. Watson’s observation that the order of nucleotide sequences is variable is a direct and necessary consequence of the fact that DNA carries information. That fact, of course, is stated in many places in the guidelines. Adding that these sequences are not dictated by any physical law is misleading and unnecessary, since no textbook, no curriculum, and no scientist has *ever* suggested otherwise since the discovery of the double helical structure of DNA in 1953.
- On Page 13 the eight members add “*changes in allelic frequency (genetic drift)*” to the list of mechanisms by which natural selection operates. This is incorrect, since changes produced by genetic drift are not subject to selection.
- Page 15 of the revisions introduces the terms “microevolution” and “macroevolution.” It also defines macroevolution as speciation, but then states flatly that macroevolution has not been observed and is based on historical inference. In fact, speciation has indeed been observed directly (see, for one example, Linn *et al*, 2004, “Postzygotic isolating factor in sympatric speciation in *Rhagoletis* flies: Reduced response of hybrids to parental host-fruit odors,” *Proceedings of the National Academy of Sciences*, 101: 17753-17758). Therefore, the artificial distinction between micro- and macro-evolution should be dropped, or the section should be rewritten to state that macroevolution has been observed repeatedly in nature.
- Page 15 of the suggested revisions misleads students by stating “*In many cases the fossil record is not consistent with gradual, unbroken sequences postulated by biological evolution.*” In reality, evolutionary theory encompasses both gradual and non-gradual (punctuated) change. Also, the fossil record contains scores of examples of exactly the sort of lineages expected for evolutionary change, and the proposed revision misleads students by concealing this fact from them.
- Page 16 makes the incorrect claim that fossil record lacks “transitional forms.” This statement has been repeatedly rebutted by scientific evidence. As the National Academy of Sciences noted in 1999², “nearly all fossils can be regarded as intermediates in some sense; they are life forms that come between the forms that preceded them and those that followed.”

² Science and Creationism, page 14. National Academy Press, 1999

• Page 16 makes another incorrect claim: “*Studies that show animals follow different rather than identical early stages of embryological development.*” This claim is based on the work of embryologist Michael K. Richardson, who found significant differences between early embryonic development and widely-copied drawings used in many biology textbooks. Textbooks have long been corrected to reflect Richardson’s observations. However, Richardson himself points out that “*All vertebrates develop a similar body plan (consisting of notochord, body segments, pharyngeal pouches, and so forth). This shared developmental program reflects shared evolutionary history*” (Richardson *et al.* *Science*, 280: 983. [1998]). Telling students that vertebrate embryos differ in ways that they in fact do not is misleading.

• Page 17 tells students that “chemical evolutionary theory” has been challenged by “The sudden rather than gradual emergence of organisms near the time that the earth first became habitable.” In reality, the sequence of appearances of living organisms is one of the most powerful lines of evidence in favor of evolutionary theory. The first organisms to appear in the fossil record are not complex multicellular forms, but smaller, simpler prokaryotes. For nearly 2 billion years, prokaryotic single-celled organisms dominate the fossil record. Eukaryotic cells appear first about a billion years ago, and colonial organisms arise in the Edicaran, as much as 300 million years later. Telling students that organisms appear “suddenly” implies otherwise, and serves no educational or scientific purpose.

Summary

The recommendations of the eight dissenting members of the Standards Writing Committee are intended to undermine the teaching of evolution and to support the introduction of non-scientific explanations of origins into the science classroom. The radical redefinition of science in these recommendations would bring supernatural explanations into the classroom under the guise of science, and would distort the meaning of science itself. They would serve only to confuse students, demoralize teachers, and to bring needless religious conflicts into the teaching of science in Kansas.

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