

Response to Kansas State Science Standard Proposals

From Karen E. Bartelt, Ph.D.
Professor of Chemistry,
Eureka College, Eureka, IL 61530

My responses are in Arial Black, and hopefully in **red**!

1. Proposed changes to the Introduction

a. Introduction - Mission of science education

Mission Statement

Kansas science education contributes to the preparation of **all** students as lifelong learners who can use science to make *informed and* reasoned decisions that contribute to their local, state, national and international communities.

***The inclusion of the word is fine. However, the charges by the "Proponents" are specious. The "Opponents" merely seek to limit the amount of information to that which has some evidential and experimental support.

Explanation: This two-word change perhaps reflects the core of the controversy between Proponents and Opponents. Opponents seek to significantly limit the amount of scientific information provided to students about the most fundamental question humanity may address – What is the origin of life and its diversity? Where do we come from? They would narrow the scope of information to that which will not contradict the naturalistic claim that life is adequately explained by chance interactions of matter according to the laws of physics and chemistry.

***As soon as the "Proponents" come up with evidential verification, have it peer-reviewed, and present it at scientific meetings, such "scientific information" may then rightly be discussed at the high school level and below.

[snip]

Further, an indoctrination in the philosophy of Naturalism would seem to offend Constitutional principles. It causes the State of Kansas to take sides in a debate that unavoidably impacts both theistic and non-theistic religious beliefs.

Straw man. Old straw man.

The antidote to all of these scientific and Constitutional problems is to present additional relevant scientific information regarding origins,

The key phrase is "relevant scientific information." The Proponents don't have any.

[snip]

Nature of Science

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. Science does so while maintaining strict empirical standards and healthy skepticism. Scientific explanations are built on observations, hypotheses, and theories. A hypothesis is a testable statement about the natural world that can be used to build more complex inferences and explanations. A theory is a well substantiated explanation of some aspect of the natural world that can incorporate observations, inferences, and tested hypotheses.

No problem with the new wording.

[snip]

According to many scientists a core claim of evolutionary theory is that the apparent design of living systems is an illusion.⁵ Other scientists disagree. These standards neither mandate nor prohibit teaching about this scientific disagreement. However, to promote good science, good pedagogy and a curriculum that is secular, neutral and non-ideological, school districts are urged to follow the advice provided by the House and Senate Conferees in enacting the No Child Left Behind Act of 2001:

"The Conferees recognize that a quality science education should prepare students to distinguish the data and testable theories of science from religious or philosophical claims that are made in the name of science. Where topics are taught that may generate controversy (such as biological evolution), the curriculum should help students to understand the full range of scientific views that exist, why such topics may generate controversy, and how scientific discoveries can profoundly affect society."

The "full range of scientific views" surely does not mean absolutely any theory that anyone espouses (ie, we were seeded here by space aliens). The scientific views taught at this educational level should have acquired a decent amount of experimental support. Criticisms of naturalism are fine, but they should be accompanied by evidence supporting these claims. Where is the peer-reviewed literature supporting the Proponents' view?

[snip]

Methodological naturalism is scientifically problematic in origins science because it violates two key aspects of the scientific method. It philosophically limits both the formation and testing of competing hypotheses. It limits hypothesis formation by philosophically ruling out a logical, evidence-based competitor to the evolutionary hypothesis, that is, that life and its diversity are the result of a process that is at least partially guided.

No one is suggesting that the Proponents NOT go out and test their hypotheses. In fact, this has been recommended numerous times. When this has been done and there is actually some evidential support, THEN it is time to have the discussion about whether or where to include it.

Criticisms of the naturalistic hypothesis are also disallowed to ensure that the outlawed competitor does not intrude through the back door. Without any substantive competitor, evolution cannot be effectively tested or falsified, and is thereby converted into a dogma, doctrine or ideology. As such, naturalistic evolution actually ceases to fall within the realm of science.

The Proponents at one time published a journal called *Origins and Design*. This might have been the perfect vehicle for publication of evidence supporting their views. Not only was nothing of the sort ever published, but the journal seems to have ceased operation. The above statement is nothing but the typical conspiracy theory bleating.

[snip]

Methodological naturalism has also served as a science stopper in our understanding of biochemical systems. For example, for many years scientists predicted that the non-coding portions of the genome were merely evolutionary “junk” that accumulated over eons of time and were not worthy of scientific study. Scientists are now finding these portions to be functional, and some have expressed frustration that the “junk” assumption has actually held back scientific progress.⁹

The fact that scientists did not immediately (and “many years” implies it could have been a very long time – we’re talking less than 15 years here) appreciate the nature of “junk” DNA might be construed as being wedded to a paradigm. However, MN got them there, and MN got them going on a new paradigm. I fail to see how any of this makes MN a “science stopper”. A real “science stopper” would be: “It’s designed. We can’t determine any more about it.”

[snip]

c. Introduction – Teaching With Tolerance and Respect.

A teacher is an important role model for demonstrating respect, sensitivity, and civility. Science teachers should not ridicule, belittle or embarrass a student for expressing an alternative view or belief. In doing this, teachers display and demand tolerance and respect for the diverse ideas,

skills, and experiences of all students. [snip]

I agree that the last part can be stricken, but only because it is too wordy.

[snip]

d. Introduction – Unifying Concepts Patterns of Cumulative Change

“Patterns of Cumulative Change: Accumulated changes through time, some gradual and some sporadic, account for the present form and function of objects, organisms, and natural systems. The general idea is that the present arises from materials and forms of the past. An example of cumulative change is the biological theory of evolution, which explains the process of descent with modification of organisms from common ancestors. Additional examples are continental drift, which is part of plate tectonic theory, fossilization, and erosion. Patterns of cumulative change also help to describe the current structure of the universe. *Although science proposes theories to explain changes, the actual causes of many changes are currently unknown (e.g. the origin of the universe, the origin of fundamental laws, the origin of life and the genetic code, the origin of major body plans during the Cambrian explosion, etc.).*

The addition is unnecessary as this introduction refers to patterns of change, and makes no claim about the origin of these changes. There is no claim here that science does have all the answers.

The following proposals relate to 8th_Grade Standards

a. Revise the “Teacher’s Notes” to Standard 3, Benchmark 5 as indicated:

[snip]

TEACHER NOTES:

Millions of species of animals, plants and microorganisms are alive today. Animals and plants vary in body plans and internal structures. Biological evolution **theorizes that** gradual changes of characteristics of organisms over many generations, has resulted in variations among populations and species.

No problem with the change in wording, as long as theory is used in its correct scientific context, and not as a synonym for “wild hare”.

[snip]

b. Revise 8th Grade, St. 4 (Earth and space science), Benchmark 2 to add indicator

4. Tests an historical hypothesis by formulating a competing hypotheses and then describing the kinds of data (evidence) that would support one and refute the others.

4. Develops a “best current explanation” of what caused dinosaur extinction by reviewing the evidence for the asteroid theory vs. disease, volcanism and other theories. [See Carol Cleland, *Historical Science, Experimental Science and the Scientific Method*, Vol 29 No. 11, 987-990 (*Geology*, November 2001)].

This is too sophisticated for 13 year olds. It will come down to a vote not on the evidence, but on which student could verbalize something s/he knows nothing about in depth.

[snip]

Students should understand that many aspects of paleontology and earth science are historical in nature where one seeks to explain the cause of singular unobserved past events from presently existing evidence. Techniques used in science to explain the cause of past events are similar to techniques used by forensic scientists. Like detectives, historical scientists develop tentative competing hypotheses and then seek clues that will rule in one while ruling out others. In many cases historical hypotheses may not be confirmed by experiment due to unknown variables and the inability to replicate conditions in the laboratory. As new clues are developed, historical hypotheses frequently change or are discarded entirely. As a consequence, in historical sciences one generally seeks “an inference to the best current explanation,” with the understanding that the explanation may not be the “best” in the future.

I think teaching about historical science is a great idea, but the above example may be a bit sophisticated for 8th grade. One could, instead, have the students look at evidence from a crime scene, and have them propose multiple competing hypotheses, including suggesting that the crime was committed supernaturally (by ghosts or fairies, say). Have the students discuss the plausibility of the supernatural explanations vs the natural ones. I would say the same thing about 12th Grade Standard 1 and the new indicator (6)

[snip]

a. Formulates multiple hypotheses about a singular historical event such as the origin of a formation of sandstone or the cause of a fire or death.

Perfect example: The fire was caused by a careless smoker, lightning, St.Elmo, or by someone wishing it to be so. Which of these hypotheses are more likely? What criteria were used to establish the more likely hypotheses?

[snip]

1. a. Biological evolution postulates an unpredictable and unguided natural process that has no discernable direction or goal. [see NABT Statement on teaching evolution]

I have the NABT statement right here and it mentions neither the word “unguided” nor anything about direction. This is a misstatement surely meant to indicate that the NABT supports this statement. Actually, why don't you just use the NABT statements on evolution here?

b. It assumes that life arose from an unguided natural process.

Redundant. Covered in 1, which has no place in the standards anyway.

[snip]

d. patterns of diversification and extinction of organisms are documented in the fossil record. The fossil record provides evidence that simple, bacterial-like life ***may*** have existed as far back as 3.8+ billion years ago (***about the time earth first became habitable to any form of life***), ***In many cases the fossil record is not consistent with gradual, unbroken sequences postulated by biological evolution.***

The evidence from many areas (not a single piece of historical science) is consistent with bacterial life actually living 3.8 byr ago, so the “may” is not needed. The rest of the bold notation is full of wobble words (In many cases – how many?) and straw men (unbroken sequences)

[snip]

5. that evolution is a broad, unifying theoretical framework in biology.
a. Microevolution provides the context in which to ask research questions and yields valuable insights, especially in agriculture and medicine. ***Reverse engineering and end-directed thinking are sometimes used to understand the function of bio-systems and information***

I can use a wobble word, too.

[snip]

d. The view that living things in all the major kingdoms are modified descendants of a common ancestor (described in the pattern of a branching tree) has been challenged in recent years by:
i. Discrepancies in the molecular evidence

(e.g. differences in relatedness inferred from sequence studies of different proteins) previously thought to support that view.

While different proteins may lead to different dates for an event (like the split of humans and chimps from a common ancestor), this in no way negates the idea of common ancestors or branching patterns.

ii. *A fossil record that shows sudden bursts of increased complexity (the Cambrian Explosion), long periods of stasis and the absence of transitional forms rather than steady gradual increases in complexity, and*

Straw man. There are many transitional forms in the fossil record.

ii. *Studies that show animals follow different rather than identical early stages of embryological development.*

Evolution never proposed identical stages of early development (except in the 1800's maybe!), and the word "different" is vague. How different?

6. Students will be able to explain proposed scientific explanations of the origin of life as well as scientific criticisms of those explanations.

I think more than a mention of origin of life in high school is a mistake, as the students generally lack the chemical sophistication to understand most of the arguments. However, as long as the "criticisms" come from the peer-reviewed literature, this might be ok.

Presenting only one side of a controversial issue tends to indoctrinate and foster ideologies, while good science education seeks to inform. *This applies particularly where students' and/or parents' beliefs may be at odds with current scientific theories or concepts.*

But presenting an unsupported alternate view, while comforting to some parents, does not inform anyone. The supposition here is that an issue that is controversial to the general public is also controversial to 99.9% of the scientific world. Not true.

[snip]

b. Chemical evolutionary theory has encountered a number of difficulties, including:

i. A lack of empirical evidence for a "primordial soup" or a chemically hospitable pre-biotic atmosphere;

It's more lack of evidence for a particular "soup" or the exact atmosphere, not total lack of evidence.

[snip]

iii. The sudden rather than gradual emergence of organisms near the time that the earth first became habitable.

What do "sudden" and "gradual" mean? A very sophisticated student might understand why the fossil record is so poor early on in geologic time, and why "sudden" might simply mean "unpreserved". What is "habitable"? 200°C? High pressure?

[snip]

a. Science progresses by robust debate and analysis of existing theories and hypotheses, which can lead to major new scientific advances (e.g., relativity, plate tectonics, quantum theory, biological evolution).

But not debate in the legal sense, and not debate in the high school or in popular literature. Science progresses by critical analysis of well supported data.