

Preparatory Materials for Speakers at the 21 January 2009 Texas SBOE Meeting

by Steven Newton, NCSE

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Registering

If you plan to testify, you should register early in the morning on Friday, 16 January 2009. According to the TEA website, the registration process is:

Speakers may register between the hours of 8:00 a.m. and 5:00 p.m. (Central Time) on the Friday and Monday preceding the board meeting with the appropriate agency office either by telephone, by facsimile, or in person at the William B. Travis (WBT) State Office Building, 1701 N. Congress, Austin, Texas 78701:

(A) Committee of the Full Board - Office of the State Board of Education, WBT Room 2-190, 512-463-9007, fax: 512-936-4319;

http://ritter.tea.state.tx.us/sboe/op_rules.html#publictestimony

Usually, registration also occurs on the Monday before the meeting; however, Monday the 19th is MLK Day.

On Wednesday, 21 January 2009, there are only four hours scheduled (8 am to noon) for public testimony, so it is at this point uncertain whether everyone who signs up will have the opportunity to testify. The six expert TEKS reviewers are scheduled to speak in the afternoon.

Talking Points

Here are some ideas for speakers planning to testify at the 21 Jan meeting.

Ask the Board to:

- approve the final, third draft of 5 January 2009 without changes

Why to Approve the Final Draft:

- standards written by experts in specific scientific fields
 - respect the time and effort they spent writing this draft
 - respect their expertise and judgment
- removes “strengths & weaknesses” language
 - students may still ask questions and challenge teachers
- the draft uses a definition of science involving “testable explanations and predictions of natural phenomena”
 - from the very respected National Academy of Sciences

Links:

- the third TEKS draft of 5 Jan 09
http://www.tea.state.tx.us/teks/Sci_TEKS_9-12_Clean_010509.pdf
- NAS booklet Science, Evolution, and Creationism, from which the definition of science is drawn (free as .pdf with registration)
http://www.nap.edu/catalog.php?record_id=11876#toc

Issues Likely to Come Up

Note on Ken Mercer

Many of the questions posed to pro-evolution speakers at the 19 Nov 08 Texas SBOE meeting came from creationist Ken Mercer. He is one of the most vocal members of the board. Armed with a wealth of pseudoscience, he led the challenges to pro-evolution speakers during the 19 Nov 08 meeting. If you are questioned following your testimony, it is most likely to come from Ken Mercer.

Mercer was elected to the board in 2006. He actually holds a bachelor's degree in biology from the University of Texas at Austin, and is a former member of the Texas House of Representatives. He once said that the "most discriminated people in this country are not blacks or Hispanics, or any other groups of color or race," but instead, "any Christian American who would dare stand up for the protection of their family!"



Questioning Science and Strengths & Weaknesses (Leo, Mercer)

Consider this exchange between Terri Leo and Richard Neavel from the 19 Nov 08 meeting [I produced all the transcripts by hand while listening to a recording, so there may be errors ☺]:

Terri Leo: You made several references to the Discovery Institute. Was it the Discovery Institute that discovered that the Piltdown Man was false? Was it the Discovery Institute that discovered that Haeckel's embryos was bogus [sic]? And was it the Discovery Institute in the 1950s—they weren't even around—that decided that Haeckel's Tree of Life, which was extremely racist, was finally removed from the textbooks? Was that Discovery Institute?

Richard Neavel: No, it was not.

TL: So that's science that was discovered—

RN: By scientists.

TL: By science. Correct. And so I'm saying... you're attributing or wrapping this all up into one as if the scientists who were skeptical of evolution back then, and of those pieces, that supposedly prove evolutionary theory ... um, that somehow that's okay and that relevant, but scientists that are with the Discovery Institute, that are skeptical, are not relevant? ...

RN: Well, yes, I would say that. I would agree with that completely. And the reason that the scientists—or so-called scientists—that are in the Discovery Institute are not relevant, that their problems with evolution are not relevant, is that they don't offer any real evidence about any real weaknesses, any scientific weaknesses, of evolution. What they is they offer a number of instances which they contend are weaknesses of evolution, but those things that they propose have nothing to do with the whole theory of evolution.

TL: But they would say that you have contentions on the strengths of evolutionary theory. I mean, what's the ... Why do you consider only one side of science, but you don't consider the other? Those are scientists that have done research and have credible scientific weaknesses.

RN: No, ma'am. Those so-called scientists at the Discovery Institute are not published in any peer-reviewed literature, which implies that they have not done any real research. Ma'am, I can back that up.

TL: Thank you...

In this exchange, Richard Neavel did an excellent job of countering Leo's attack. The main points of this exchange can be summarized as:

- Leo posited that in the past, scientists were more able than today to criticize the theory of evolution
- Leo suggests the 'scientists' of the Discovery Institute are now the only group still practicing scientific skepticism
- Neavel challenged the idea that there are true scientists at the Discovery Institute
 - A way to emphasize this point would be:
 - having a PhD alone does not make one a scientist
 - any more than having a degree in Art makes one an artist
 - practicing scientists are typically employed by accredited universities, government agencies, or private firms
 - the DI is none of these
 - publication of research in peer-reviewed journals is an important indicator of whether one is a practicing scientist
 - to date, there has only been *one* publication in a peer-reviewed journal of an article promoting intelligent design
 - the article bypassed normal peer-review
 - the article was immediately withdrawn
 - the article was written by Stephen Meyer, who has a PhD not in a scientific field, but in History and Philosophy of Science
 - Meyer, S. *Proceedings of the Biological Society of Washington* [117(2):213-239] August 2004

Consider this statement from Terri Leo to Joe Bernal during the 19 Nov 08 meeting:

Terri Leo: We're talking about scientific weaknesses and scientific strengths. We're not talking about religious weaknesses. The thing that I'm concerned about is federal law basically says you can't pull out evolution and teach it separately. But that's what we would be doing if we removed that language [strengths & weaknesses]. We apply scientific strengths and scientific weaknesses to all theories, not just to the theory of evolution.

So it's people who are militant Darwinists that want to pull out [audience reaction]... sorry! [sarcastic] ... but, I mean they want to pull out that language and teach evolution separately from how we teach all other theories. To me, that's part of science, and the critical thinking part of science, is to teach theories and to look at all the evidence.

Most of the scientific discoveries have been taken place by that very scientist who questioned something that was once thought fact. I just think that you're pulling out and you're asking the board to actually be in violation of federal law. When you pull out evolution to treat it separately than how we treat all other theories.

Terri Leo has it completely backwards:

- she never identifies the “federal law” to which she is referring
- she may be confusing “federal law” with Supreme Court rulings such as:
 - *Everson v. Board of Education* (1947), which ruled that the government cannot favor one religion over another
 - *Lemon v. Kurtzman* (1971), which ruled that the 1st Amendment Establishment Clause requires secular purposes for government actions
 - *Edwards v. Aguillard* (1987), which ruled that creationism is religious, and therefore teaching creationism is an Establishment Clause problem
 - the federal *Kitzmiller v. Dover* (2005) ruled that intelligent design is equivalent to creationism
- Leo's assumption here may be that evolution constitutes a religious belief
- rather than treating evolution “how we treat all other theories,” Leo is in favor singling out evolution for criticism
 - in practice, the “strengths and weaknesses” language is applied only to evolution
 - no one talks about the “weaknesses” of the theory of gravity, quantum mechanics, Avogadro's number, the Ideal Gas Law, etc.

Consider this question between Barbara Cargill and Max Brodsky during the 19 Nov 08 meeting:

Barbara Cargill: Can you give me specific examples of when the current language that has been in place for so long about strengths and weaknesses has brought religion into the classroom, or any of your coworkers, specifically? ...

This is a point they are likely to make again. Some things to consider:

- students/parents may feel uncomfortable challenging a creationist teacher who is describing inaccurate “weaknesses” of evolution
 - the teacher operates from a position of great power over the student
 - students also feel peer-pressure not to stand out in classes
 - it is easier for students to just swallow their pride and allow the teacher to say whatever he or she wishes
- removing “strengths and weaknesses” is really about protecting the rights of students
 - creationist “weaknesses” of evolution are inherently religious
 - the mainstream scientific community does not acknowledge that such “weaknesses” even exist
 - “weaknesses” are only pushed by the religious community
 - students should not feel distracted from their studies by the interjection of religion into the classroom
 - parents should not be put in the situation where the only way they can protect their children from religious proselytizing is to sue

Consider this question between Ken Mercer and Steven Schafersman during the 19 Nov 08 meeting:

Ken Mercer: Are you actually saying that students have no business discussing or critiquing scientific theories? You really believe that?

Steven Schafersman: Mr. Mercer, high school students—the great majority of them, anyway—don’t have the expertise to do that in a scientific context. So when you say ‘critique the weaknesses,’ I don’t know what that means. That is not scientific language. You see, in science we investigate, analyze, do research, test hypotheses, and the critiques are done in the literature and among scientists. Now, students can ask questions, and certainly teachers can answer them honestly, but to make it a formal proposition that students should be allowed to critique theories is just wrong. It’s not scientific.

KM: But what about academic freedom, classroom freedom? The right to raise your hand and question?

SS: They have that right to do that.

Mercer is here confusing academic freedom at the university level with students being able to questions in classes. Mercer also confuses “critique” with asking questions. Steve S.’s excellent response cuts to the heart of this.

- no one is suggesting student should not be allowed to ask questions
- in most classes, teachers *love* to have students ask questions
- participation is part of the grade in some classes

- removing false “weaknesses” in no way affects the ability of students to question their teachers



Piltdown Man (Mercer, Leo)

Ken Mercer is obsessed with Piltdown Man. He questioned a number of testifiers about Piltdown during the 19 November meeting, and once even brought it up after learning that Piltdown had been mentioned while he was briefly out of the room getting coffee.

Piltdown man was a fraudulent fossil. Creationists try to use Piltdown cast doubt upon *all* fossils. This is quite a stretch in reasoning.

Basic Facts:

- in 1912, a mandible (jawbone) and partial skull were reported by Charles Dawson and Arthur Woodward from in a gravel pit near Piltdown, England
 - the mandible appeared ape-like
 - the skull fragment appeared like a modern human
- these fragments were interpreted as *Eoanthropus dawsoni*, a ½ million year-old human-ape transitional fossil
 - considered a “missing link”
- re-examination in 1953 demonstrated that the mandible and skull were not from the same individual
 - mandible = orangutan
 - skull = recently-deceased human
 - teeth = chimpanzee
- the identity of the hoaxer has never been definitively established

Points to Counter Mercer:

- Piltdown was a fraud exposed *by scientists*
 - anthropologist Kenneth Oakley was key in exposing the fraud
 - though 41 years late, eventually science corrected this error
 - ideally, science would correct itself quicker
 - as a result of the embarrassment of Piltdown, scientists are more cautious and skeptical, making future Piltdowns less likely
 - the confusion caused by Piltdown actually harmed science because it appeared just as scientists were beginning to understand the true fossil record
 - many papers and countless hours were squandered on this fraud
 - some scientists were skeptical of Piltdown from the beginning
- one fraudulent fossil does not invalidate all other fossils
 - one corrupt governor does not mean that the governors of all 50 states are corrupt

- by today's standards of collection, Dawson's techniques would have never passed muster in a peer-reviewed journal
 - o the skull fragments were collected not by Dawson, but by workmen who had initially failed to recognize them as possibly human and had broken them apart with shovels
 - o the position of the layer containing the fossils was not well-established
- many other examples of transitional fossils show the evolution of man
 - o the exposure of Piltdown did not require changing scientists' views on human evolution
 - o Piltdown never fit with the picture of evolution from other fossils

<http://www.toarchive.org/indexcc/CC/CC001.html>



Archaeoraptor & National Geographic (Mercer)

from 19 Nov 08 SBOE meeting:

Ken Mercer: Most recently National Geographic ... the famous T-raptor [sic] called uh... archaeo... I forget what it was called, but it was a T-raptor bird, a feathered dinosaur—

Richard Neavel: Archaeopteryx?

KM: Archaeoraptor ... it wasn't any institute, it was National Geographic had to put a retraction there. The scientist from China admitted he had put things together, had put bird feet together, put somebody else's feet, lizard feet with a tail, whatever else ... and that's what I'm talking about.

Every example we've talked about has nothing to do with religion. We got questions, we got questions. We got problems here. Can we ask these things? And if you're ever told, 'No, you can't ask questions, that that's not good science,' I'm not sure... we're trying to draw the line. In those three examples, and there are many, many more, where someone had the guts to stand up and say, 'You know what? I don't care where the research money, the fellowship money is. I have a problem with this and I want to ask a question about this.'

RN: Mr. Mercer...

KM: That's my only concern... academic freedom.

Basic Facts:

In the November 1999 issue of *National Geographic*, an article by Christopher Sloan titled "Feathers for T. Rex?" described a fossil of feathered dinosaur, generically called

Archaeoraptor, and later determined to be a composite fossil. Creationists claim Archaeoraptor was invented to promote the idea of transitional fossils

- this fossil was a composite of several other fossils; the fossil itself was illegally smuggled out of China
- Christopher Sloan, who described Archaeoraptor as a “missing link,” was a *NG* art editor, not a paleontologist
- both *Nature* and *Science* rejected papers on this fossil because of its obvious assembly from different animals
- *National Geographic* retracted the article in February 2000

Response:

- the scientific community was not fooled by “Archaeoraptor”
 - the peer-review screenings at *Nature* and *Science* detected this fraud
 - this is how good science should function
- no one was ever prevented from “asking a question” about Archaeoraptor
 - in fact, the questions that were asked exposed the fraud
- this case never involved questions of academic freedom
- *National Geographic* is not a peer-reviewed scientific journal, and hence not the proper venue for publishing a description of a new fossil find
- the author Christopher Sloan was writing as a journalist, not a professional paleontologist
- Sloan’s description of this fossil as a missing link between birds and dinosaurs was simply his opinion and had no scientific standing
- therefore, Archaeoraptor is not an example of scientists inventing a fraud to promote the idea of transitional fossils
 - it is an example of why scientific peer-review is necessary

Sloan, C.P., and Mazzatenta, O.L. “Feathers for T. Rex?” *National Geographic*, v. November 1999.

Zhou, Zhonghe, Clarke, Julia A., Zhang, Fucheng. "Archaeoraptor's better half." *Nature* Vol. 420. 21 November 2002. pp. 285.



Polystrate fossils (Lowe)

Definition

The word polystrate derives from stratum, or layer. Combined with the prefix poly, this becomes polystrate, meaning many layers. The term polystrate does not appear in standard geology textbooks.

Creationists use the term polystrate to imply that something is wrong with the standard geologic model of sediment deposition. They see in polystrate fossils evidence for very rapid deposition from a catastrophic event—specifically, Noah’s Flood.

Here is how polystrate fossils were addressed in a creationist magazine [from *Creation Ex Nihilo* (Anonymous, 1988. “Polystratic Fossils.” 10(2): 25]:

“Do you know what ‘polystratic’ fossils are? They are fossils which pass through many different rock layers, and they prove that those layers were formed very quickly. In many part of the world, usually in coal seams, there are upright tree trunks, some as long as 50 feet. Can you imagine a tree standing there for thousands or millions of years as the sand and mud piled up slowly around it? Of course not! The tree would have rotted away long before it was completely buried.

“About 10 years ago, in a quarry in California, USA, one of the largest fossils ever found was discovered. It was a baleen whale about 80 feet long—and it was standing on its tail! A dead whale could never balance on its tail for thousands of years, waiting to be buried gradually in the mud. It must have happened very quickly.”

Trees

One example of a “fossil forest” comes from a coal mine in Illinois. According to DiMichele (2007), this “forest was abruptly drowned when fault movement dropped a segment of coastal mire below sea level.”

(http://www.livescience.com/strangenews/070423_fossil_forest.html)

This picture shows an upright tree trunk in sediment, with a metal retaining plate on the bottom, viewed from underneath in a mine:





from <http://www.mnh.si.edu/highlight/riola/>

This is probably what Gail Lowe has in mind when she's talking about polystrate fossil trees.

There is, however, nothing unusual about such fossils, nor does their preservation require extraordinary conditions (such as rapid postdiluvial burial).



from <http://www.mnh.si.edu/highlight/riola/>

This reconstruction of the swampy conditions in Illinois shows a rich diversity of life and productivity. Materials falling into the swampy waters may be buried in oxygen-deprived

sediments, which inhibit their decay. These oxygen-poor conditions are a factor in the excellent preservation of fossil plant materials.

Humans are likewise subject to extreme preservation in organic-rich, oxygen-deprived sediments. The phenomenon of “bog people”—bodies preserved in exquisite detail—is widely known.

The fact that “polystrate” trees stand perpendicular to sediment layers does not present a problem and does not require a great length of time for burial.

Here is a picture I took in 2007 at Mammoth Hot Springs, Yellowstone, of two trees recently enveloped in rapidly-depositing travertine.



You can find this picture at: <http://www.blackquartz.com/yellowstone.html>

Note that fine branches to the left suggest these not much time has passed since these trees were subsumed and killed by the advancing rock. The travertine at Mammoth may in a short time completely cover these trees, leaving them standing perpendicular to the layers of travertine.

These trees would then be completely buried *in situ*, becoming “polystrate” fossils, without the requirement of extraordinary conditions, such as rapid burial during Noah’s Flood.

Summary

“Polystrate” fossils are seen by creationists as evidence of rapid, catastrophic burial during Noah’s Flood. However, the processes that produce such fossils are common and require to special circumstances.

When confronted by a board member about such fossils, a counter might be:

Lowe: ...well, what about polystrate trees in coal mines? How does your ‘science’ explain those?

Speaker: Mrs. Lowe, since this non-standard term ‘polystrate’ is usually associated with by creationists in the context of a Noachian flood, are you implying by your question that the best explanation is a literal, world-wide deluge?

If such an explanation were true, this would mean that virtually every thing discovered by science would have to be false. Are you justified in making such a claim based upon fossil trees whose positions and deposition require no extraordinary conditions, and whose formation can be observed happening in the world today?

DiMichele, et al., 2007. “Ecological gradients within a Pennsylvanian mire forest.” *Geology*, v. 35, n. 5, May 2007. P. 415-418.



The Lompoc whale (Lowe)

During the 19 November 2008 Board of Education meeting, board member Gail Lowe brought up the “Lompoc whale” as an example of a “polystrate” fossil, meaning a fossil cutting across more than one rock layer.

In this exchange, Gail Lowe challenged geologist Richard Neavel:

Lowe: Mr. Neavel, are you familiar with polystrate fossils? ... If one fossil were found that were through up to 20 feet of multi-strata, how would that square with your theory that that strata was [sic] laid out over millions of years?... I would like to know how the theory of a gradually accumulated geologic column can explain how a baleen whale could be discovered in Lompoc, California, through 20 feet of varying geologic strata, that covered millions of years? ...

Neavel: Is your question about how it can be found throughout the 20 feet? ...

Lowe: No, it’s standing up, it’s not laying flat.

Lowe's "whale on its tail" example is considered false even by many creationists. Here is the real story of this fossil.

Background:

Lompoc, California, is located near the Pacific coast between San Luis Obispo and Santa Barbara. The fossil was found in the Miguelito Mine, in diatomite of the mid-Miocene Monterey Formation. Diatomite is a light-colored, low-density sedimentary rock. Like many rock strata in California, these layers were displaced from their original horizontal position by tectonic movement associated with the San Andreas Fault.

In April 1976, workers at the Miguelito Mine observed bones exposed by their excavations. The Natural History Museum of Los Angeles County was contacted, and a team led by Dr. Lawrence Barnes unearthed the fossil. Twenty-four pieces, including the head and right flipper, were removed and encased in protective plaster. Because only the head was exposed, the vertebrate were not removed. Based upon measurements of the skull and flipper, the whale was between 81-87 feet in length. The flipper was taken back to the Natural History Museum. The larger pieces of plaster, including the skull and jawbones, were transported to the edge of the mine, where they remain today.

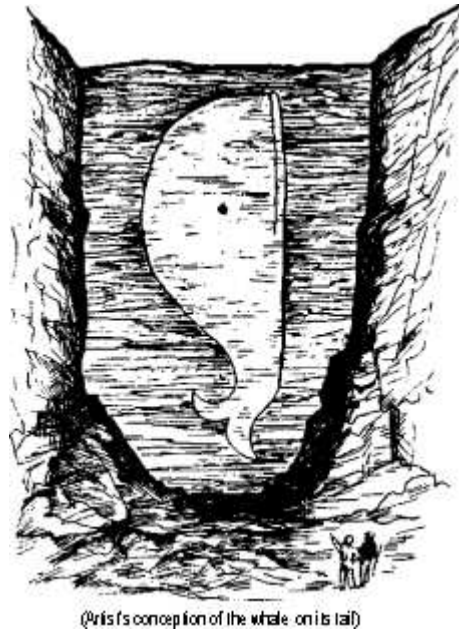
Creationist Description:

Subsequent to its discovery, the Lompoc whale was described in three articles in *Chemical and Engineering News* (Jueneman, 1976; Russel, 1976; Olney, 1977). It should be noted that *Chemical and Engineering News* is not a peer-reviewed journal of paleontology, and these reporters did not specify the position of the fossil in the manner professional paleontologists would.

The Lompoc whale then took on a life of its own. In Paul Ackerman's 1986 creationist book *It's a Young World After All*, Ackerman cites the whale in chapter 9, "Back Down to Earth." Citing Jueneman (1976), Ackerman described the whale this way:

"At a diatomaceous-earth quarry in Lompoc, California, a remarkable discovery was made during mining operations in 1976. Workers of the Dicalite Division of Grefco Corporation uncovered the fossil skeleton of a baleen whale. The whale fossil is standing on end in the quarry and is being exposed gradually as the diatomite is mined. Estimates are that the fossil is about eighty feet long."

The diagram in Ackerman's book showed the whale in this orientation:

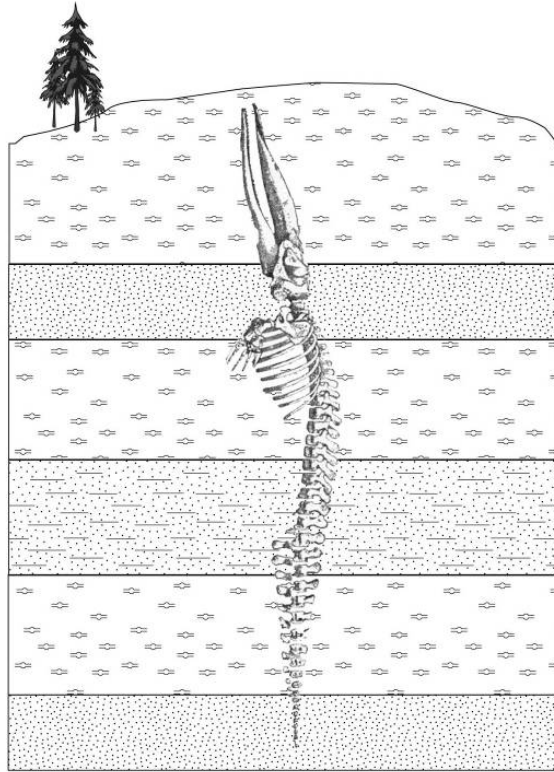


This drawing seems to show the unrealistically-drawn whale oriented 90° to the horizontal bedding planes. Such a perpendicular alignment would indeed be unusual.

However, this was not how the Lompoc whale was preserved. This fossil was oriented parallel to the tilted strata. It died, fell flat to the ocean bottom, and became entombed in diatomaceous ooze. After this ooze solidified and was raised from the sea floor by tectonics, these rock strata were tilted approximately 60° from horizontal.

The Real Orientation:

This is how creationists such as Gail Lowe and Paul Ackerman envision the Lompoc whale:



However, the creationist Andrew Snelling, who visited the Miguelito Mine and examined the excavation site, admits this was not the orientation of the Lompoc whale.

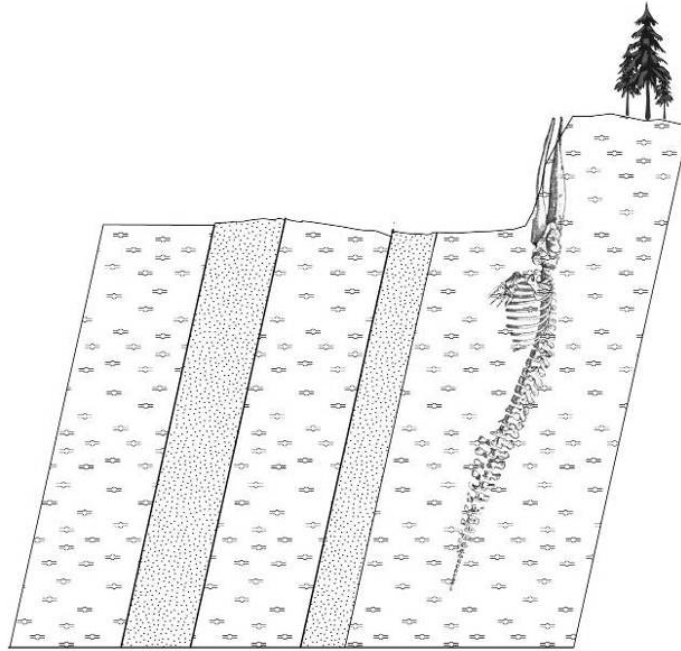
Snelling writes:

“...the fossilized baleen whale found there in diatomite was not buried while ‘standing on its tail,’ but is tilted because the enclosing diatomite unit is tilted.”

Snelling continues:

“...upon death its body came to rest on the sea floor on its back...”

This is how the Lompoc whale was really oriented:



This orientation is entirely consistent with normal whale fossil deposition. Upon death, whale carcasses have been observed to rest flat on the ocean floor. These “whale falls” become a rich food source for temporary communities of organisms.

According to the creationist CreationWiki:

(http://creationwiki.org/A_fossil_whale_was_found_vertically_through_several_strata):

“The fact that the fossil was parallel to the strata was not in the original article, which was published in *Chemical and Engineering News*. The fossil was not completely uncovered at that time and the orientation of the strata was probably not yet known. Unfortunately, before the orientation of the strata was discovered the story got a life of its own. This problem has caused it to fall out of favor with most creationists.”

How to Counter this Claim in the Future:

Gail Lowe, or other board members, may bring up the Lompoc whale in the future. Anyone testifying during the January meeting can expect that if issues of geology or fossils are raised, Lowe may repeat her question.

Therefore, a way to prepare is to keep in mind these points:

- the fossil was oriented parallel, not perpendicular, to the rock layers
- a creationist who examined the site agrees that orientation was parallel

Sample Exchange:

Gail Lowe: Are you familiar with the polystrate fossil of a baleen whale that was found in Lompoc, California?

Speaker: Yes, Mrs. Lowe, I am quite familiar with this fossil.

The whale was oriented parallel, not perpendicular, to its strata—lying flat, not “standing on its tail.” The layers themselves were tilted by tectonics, and the fossil moved along with them. The fossil does not cut across layers.

If you doubt this, I can provide you with a reference to a paper by the creationist Andrew Snelling. Dr. Snelling actually examined the site where the fossil was removed and concluded that it “was not buried while ‘standing on its tail,’ but was tilted because the enclosing diatomite unit is tilted.”

If you need further confirmation, I can refer to you Dr. Lawrence Barnes of the Natural History Museum of Los Angeles County. I can give you his phone number. He actually dug the fossil out of the ground, so he can tell you its exact orientation—parallel, not perpendicular, to tilted strata.

Links:

<http://www.toarchive.org/faqs/polystrate/trees.html>

<http://www.toarchive.org/faqs/polystrate/whale.html>

<http://www.science-frontiers.com/sf104/sf104p11.htm>

<http://www.physforum.com/index.php?showtopic=2763&st=165>

<http://www.rcgroups.com/forums/showthread.php?t=271269&page=29>

http://www.nhm.org/research/vertebrate_paleontology/

Dr. Lawrence Barnes, lbarnes@nhm.org, (213) 763-3329

References:

Ackerman, P. D., 1986. *It's a Young World After All*, Grand Rapids, MI: Baker Book House, pp. 81-83. (available at <http://www.creationism.org/ackerman/index.htm>)

Frederic B. Jueneman, "Workers Find Whale in Diatomaceous Earth Quarry," *Chemical and Engineering News* 54 (October 11, 1976): 40.

Olney III, Harvey O. 1977. A Whale of a Tale. *Chemical and Engineering News*. 55(12)

Russel, K. M. 1976. Workers Find Whale in Diatomaceous Earth Quarry. *Chemical and Engineering News*. 54(41):48. (October 4, 1976 issue).

Snelling, A.A., 1995. "The Whale Fossil in Diatomite, Lompoc, California." *Creation Ex Nihilo Technical Journal*, vol 9, no. 2, p. 244-258.



Macroevolution not observed (Mercer)

One common creationist claim is the distinction between “micro” and “macro” evolution.

- microevolution = small changes
 - e.g., changes in dog breeds within the timeframe of recorded history
- macroevolution = species-level changes
 - e.g., fish becoming tetrapods

During the 19 Nov 08 SBOE meeting, Ken Mercer said this:

“My background is a degree in Biology and things I was taught, and now I’m finding out there are things... Do I believe in understanding microevolution? Sure, everyone understands that. But the cases of macroevolution, the jumping between species, which I talked about earlier in the Piltdown Man, and now Haeckel’s drawings, those are weaknesses people found...”

Creationists like to claim that while microevolution has been observed and is acceptable to them, macroevolution has never been observed.

If you encounter such a statement, here is a strategy to use:

- Definition of species
 - creationists can define species in a way that prevents there ever being enough change to recognize species-level evolution
 - a general definition of species, from Campbell’s *Biology*:
 - “The biological species concept defines a species as a population or group of populations whose members have the potential to interbreed with one another in nature to produce viable, fertile offspring, but who cannot successfully interbreed with members of other species. In other words, a biological species is the largest unit of population in which genetic exchange is possible, and that is genetically isolation for other such populations.”
 - the ability to interbreed is therefore a key to species definition
- False distinction
 - where specifically is the dividing line between micro and macro?
 - why should the processes involved in microevolution—which some creationists admit are happening—not also be true at the macro scale?
- Examples of Recent Macroevolution
 - despite creationist claims to the contrary, there are numerous examples of recently-diverged new species—in other words, macroevolution
 - cichlid fish in Lakes Malawi and Victoria have diverged into hundreds of species

- mDNA analysis shows that the diverse cichlids in Lake Victoria, Africa, all derive from a common ancestor about 200,000 years ago
 - o in the London Underground, a new mosquito speciated from *Culex pipiens*
 - o adjacent salamanders in California's Central Valley do not breed
 - now divided into two subspecies
 - o <http://www.talkorigins.org/indexcc/CB/CB910.html>
- Examples of Past Macroevolution
 - numerous fossils record the transition between species
 - o *Tiktaalik rosea* shows the transition between fish and tetrapods
 - 385 million years ago: only fish
 - 375 million years ago: *Tiktaalik*
 - 365 million years ago: amphibians
 - o Whales
 - the fossil lineage from Pakicetus to Ambulocetus to Basilosaurus shows a clear transition from land-based, to mixed land/water, to full water adaptation
 - o Humans
 - from the Australopithecines, to *Homo habilis*, *Homo erectus*, and *Homo sapiens*, there is a clear record of transitional fossils and species-level changes in the human lineage



Eminent scientists reject evolution (Mercer, Dunbar)

This claim makes reference to the “Dissent from Darwin” list promulgated by the creationist Discovery Institute, and posted at <http://www.dissentfromdarwin.org/>.

The Dissent from Darwin signers have subscribed to this statement:

“We are skeptical of claims for the ability of random mutation and natural selection to account for the complexity of life. Careful examination of the evidence for Darwinian theory should be encouraged.”

One might argue that of course scientists are skeptical of claims, since skepticism—rather than faith—is a foundation of scientific thinking. One might also say that of course scientists agree evidence should be carefully examined—what scientist would be against careful examination of evidence?

- The phrasing of this statement, therefore, obscures its true intent.
- The statement does not clearly say that evolution is wrong, or that creationism is correct.

- o It probably would have garnered fewer signatories if it were written in honest language
- Yet the Discovery Institute uses this list to make exactly these claims

The August 2008 Dissent from Darwin (DfD) list tallies 753 names, with degrees and university affiliations. Of the 753 signers, 52 are not currently practicing in their fields, leaving 701 signers.

These signers are tallied in a deceptive fashion. The DfD list is inconsistent in its usage of the institutions associated with the signers. In some cases, the university listed is where they work. In other cases, it is where the signers obtained their degrees. The DfD does not specify which is which, and apparently uses the institution of the greatest academic prestige, rather than the one which best describes what the dissenter does for a living.

- The creationist Jonathan Wells, for example, earned a PhD in Molecular and Cell Biology from UC Berkeley.
 - o The DfD list associates him with UC Berkeley
 - o This gives the inaccurate impression that Berkeley employs Dr. Wells as a professor of Molecular and Cell Biology
 - o This obfuscation is intentional; for many of the other signers of the DfD list, the university listing is their place of employment
 - o In fact, Wells works for the creationist Discovery Institute.

Many signers have degrees in fields that do not necessarily involve training in evolution:

- physics and astrophysics, chemistry, philosophy, military science, mathematics, education, computer science, engineering
- fully 15% of the signers are engineers

In the most generous grouping of signers with degrees in biology and biology-related fields (e.g., epidemiology, genetics), the DfD list has 172 signers, making up 24.5% of the total list.

- the NSF tallied that in 1999 there were 955,300 biological scientists in the US
- the 172 therefore represent 0.018% of practicing biological scientists in the US

Some signers did not fully realize what they were signing, and might not have signed the list had the Discovery Institute been forthcoming about how the list would be used.

Examples of this are:

- Robert C. Davidson, nephrologist
- Stanley N. Salthe, biologist

In summary, the Dissent from Darwin list does not support the claim that eminent scientists reject evolution because:

- the wording of the statement does not clearly reject evolution
 - o rather, it mentions skepticism and critical thinking common to scientific thinking
- the majority of the signers have PhDs in fields unrelated to evolution

- those signers with PhDs in relevant biological fields constitute much less than 1% of the population of practicing biological sciences



Haeckel's embryos (Mercer)

Creationists love to cite the drawings of Ernst Haeckel as proof that scientists fabricate data to fit preconceived notions. Most creationists draw this example from Jonathan Wells' book *Icons of Evolution*.

In 1874, Haeckel made several drawings showing the embryonic stages of a pig, a human, a turtle, and others animals. In their earliest stages, Haeckel portrayed them as very similar.

- these drawings were made about 15 years *after* publication Darwin's *Origin*
- therefore, not an influence on Darwin
 - Darwin used embryonic evidence from Karl Ernst von Baer, who did not agree with Haeckel's recapitulation idea
 - Darwin wrote about von Baer: "Hardly any point gave me so much satisfaction when I was at work on the *Origin* as the explanation of the wide difference in many classes between embryo and the adult animal, and of the close resemblance of the embryos within the same class."

Haeckel had an idea, which he called the Biogenic Law. The Biogenic Law can be stated, in somewhat obfuscating terms, as "ontogeny recapitulates phylogeny."

- ontogeny is the development of an individual; phylogeny is the development of an entire species
 - the idea is that the embryonic development of an individuals mirrors the development of its species
- Haeckel proposed that one could observe the past development of a species—whether it had a tail, gills, fins—in the developing embryos of an individual of that species.
- Haeckel made his drawing to emphasize these similarities

Haeckel's drawings were wrong.

- scientists now understand that his drawings are inaccurate in many respects
- the great biologist PZ Myers believes Haeckel "willfully over-interpreted the data to prop up a false thesis."
- modern embryology uses photographs and actual specimens of embryos
 - modern scientists do not rely on hand drawings from 1874

Haeckel's drawings have remained in textbooks too long

- but this is not a failing of evolutionary theory

- rather, a failing of science editors at publishing houses
- the movie *Flock of Dodos* has a funny scene where the filmmaker confronts a creationist claiming that Haeckel drawings are used in modern textbooks, and they go through a stack of the creationist's textbooks without finding a Haeckel drawing
- the most recent publication using Haeckel's drawings was Raven & Johnson's 2002 textbook *Biology* (6th edition, 0073031208, p. 1229).
 - this single diagram appeared to have been modeled by a graphic artist after a Haeckel drawing
 - the page on which this drawing occurs also warns students:
 - "...the biogenic law is not literally true when stated in this way because embryonic stages are not reflections of *adult* ancestors. Instead, the embryonic stages of a particular vertebrate often reflect the *embryonic* stages of that vertebrate's ancestors. Thus, the pharyngeal slits of a mammalian embryo are not like the gill slits its ancestors had *when they were adults*. Rather they are like the pharyngeal slits its ancestors had *when they were embryos*."
 - explaining what is *wrong* about Haeckel's theory and drawings is an acceptable use of a discredited illustration
 - Jonathan Wells, in *Icons of Evolution*, also reproduced Haeckel drawings in order to criticize them
 - if science textbooks are to be criticized for showing Haeckel, then Wells should also be criticized for showing Haeckel

Haeckel Links

- <http://ncseweb.org/creationism/analysis/icon-4-haeckels-embryos>
- http://scienceblogs.com/pharyngula/2006/01/textbooks_and_haeckel_again.php
- <http://darwin.bc.asu.edu/pub/pickett.pdf>
- http://scienceblogs.com/pharyngula/2007/02/wells_false_accusation_against.php
- <http://www.toarchive.org/indexcc/CB/CB701.html>



Creationist TEKS Reviewers

Note: The outside “experts” invited by the SBOE to review the TEKS are writing about the first TEKS draft of 15 September 2008. The current TEKS draft is the third version of this.

The six reviewers will each speak to the SBOE on the afternoon of the meeting on 21 January. It is unclear if they have all re-reviewed the new TEKS draft currently under consideration, or will comment on the first draft.

These notes are meant to anticipate the points they might make during their testimony.

Charles Garner

Dr. Charles Garner was one of six outside reviewers selected by the Texas State Board of Education to critique the proposed Texas Essential Knowledge and Skills (TEKS) standards.

Bio:

- PhD, chemistry
- currently Associate Professor of Chemistry at Baylor University
- research focus is synthesis of chiral organic molecules

Garner’s review breaks down into six main subjects:

1. Increased “Strength & Weaknesses”
2. Historical vs. Experimental Sciences
3. Environmental Systems is Political Activism, Not Science
4. “Dogmatism”
5. Origin-Of-Life & Miller Experiment
6. Other issues

1. Garner Recommends Increased “Strengths & Weaknesses” Language

Garner wants to apply S&W broadly:

- “I recommend that this ‘strengths & weaknesses’ standard be implemented across the board for all grade levels and not left off certain grade levels.”

Garner sees removal of the S&W language as a plot:

- “I think they hope that by eliminating criticism of evolutionary theory, they will eventually produce a public far more accepting of the theory and in agreement with their own world view.”

Garner thinks there will be negative consequences to eliminating the S&W language:

- “By removing the ‘strengths and weaknesses’ language, they will produce a public that does not understand how science works, blindly accepts authoritative scientific claims of faith, not evidence, and is incapable of independent thought or individual scientific decision-making.”
- “Some have said that including requirements that students learn the ‘strengths and weaknesses’ of scientific theories would bring religion or pseudoscience into the classroom. I have been able to find no evidence of this, and I believe such statements are the result of undue paranoia...”

According to Garner, “limitations” language is an acceptable replacement to S&W. In the second TEKS draft, the phrase “strengths and limitations” appeared.

- “I recommend rewording to read: ‘...including analysis of the limitations and assumptions inherent in the evidence.’ An alternative to ‘limitations and assumptions’ would be ‘strengths and weaknesses.’”

Garner engages in hyperbole, implying that the only thing that has allowed “independent thought or individual scientific decision-making” is language in school standards about alleged weaknesses.

2. Garner Divides Science into Historical and Experimental, and Views Historical Sciences as Much Weaker

Garner believes the controversy over S&W language is:

- “driven by a certain vocal and ardent supporters from the historical sciences, particularly biologists and geologists, who are frustrated that the general public tends not to be accepting of the grand picture of ‘evolution’...”

On these historical sciences:

- “Certain fields of science, particularly astronomy, geology and biology, try to explain the ancient history of the universe and planet ... what is gathered is necessarily circumstantial evidence rather than direct observation of proposed events.”
- “The new TEKS draft mentions in several places that scientific theories must be testable, yet how ‘testable’ are historical events?”
- “Not all scientific theories are truly ‘testable,’ especially when dealing with events in the distant past. However, chemistry deals almost entirely with laboratory-based phenomena in the present.”

Some points to keep in mind here are:

- historical sciences are like forensic sciences. They use laboratory-based evidence from controlled experiments to interpret events after the fact; they use direct observation and testing in the laboratory to understand processes that occurred in the past.

- if the methodology of historical sciences were circumstantial and not truly scientific because of the lack of direct observation, then crime scene investigators would never be able to determine things such as proximity to gunshots, blood spatter patterns, time of death, etc. Such findings are, however, scientific and considered good enough to stand as evidence in courts of law.
- Garner seems to fundamentally misunderstand the methods and practices of astronomy, geology, and biology
- Garner fails to recognize that testing in historical sciences is commonplace; tests using direct laboratory observation are made by reproducing conditions and applying these results to interpretations of past events. Garner seems not to realize that if he were to look into geology and biology laboratories around the country, he would see researchers doing the same sorts of procedures, using the same types of equipment, as the chemists in his laboratory.
- testing in historical sciences is no different than a chemist analyzing an aliquot of an old, unknown solution whose preparation he or she did not directly observe; the chemist has confidence that the tests he or she can perform in the laboratory today are not “circumstantial” and can determine the unknown solution’s identity

3. Garner views Environmental Systems as Political Activism, Not Science

In his review Garner takes issue with the Environmental Systems TEKS:

- “a shallow exercise in political activism for or against certain environmental causes”
- “it is important that this course is taught as a science course and NOT as an introduction to political activism. Environmental issues are very important, but an objective approach is necessary to avoid highly politicized fads”

Garner is referring to the September draft for grades 9-12 TEKS standard 112.44 Environmental Systems (ES). The ES standards include innocuous requirements that students “demonstrate safe practices during field and laboratory investigations” and “organize, analyze, evaluate, make inferences, and predict trends from data” and “identify native plants and animals.”

I suspect what Garner finds offensive about the ES TEKS are these parts:

- (8)(d): “... weather conditions including El Niño and La Niña oscillations and their impact on global warming, icecap and glacial melting, and changes in ocean surface temperatures.”
- (9)(a): “identify causes and types of air, soil and water pollution including chlorofluorocarbons, carbon dioxide, runoff, thermal variations, heavy metals and nuclear waste”
- (9)(b): “describe the effect of pollution on global warming, glacial/ice cap melting, greenhouse effect, ozone layer, and aquatic viability”
- (9)(f): “analyze local, state and national legislation and international treaties/protocols including, Texas automobile emissions regulations, National

Park Service Act, Clean Air Act, Clean Water Act, Endangered Species Act, and Kyoto Protocol”

Garner seems to think the science behind the El Niño Southern Oscillation, chlorofluorocarbons, and mercury pollution is merely a “politicized fad.” He may also believe that the National Parks Service Act is too restrictive for mining and logging.

Garner should be reminded that there is no longer any serious debate among earth scientists about the reality of global warming. The 2007 IPCC report and Oreskes (2004) are good references for this. If Garner denies global warming, the ozone hole, and the dangers of heavy metal pollution, then he puts himself among a tiny fraction of extremist fringe thinkers.

<http://www.sciencemag.org/cgi/content/full/306/5702/1686> - affiliation

4. “Dogmatism”

Garner takes issues with some of the TEKS for what he terms “dogmatism.” For example, he says [*italics mine*]:

- “the tone of the presentation regarding evolutionary biology has become far too *dogmatic* in places.”
- “the word ‘identify’ is *dogmatic*—it implies that the evidence of natural selection is always well documented.”
- “The debate is not about religion at all, but about whether we will teach evolution and other scientific theories in a scientific fashion by letting students learn about both the strengths and the weaknesses, or if we will teach such subjects as *dogmatic* fact that can’t be scientifically questioned.”
- “I found an almost continual aggressive, *dogmatic* tone to much of the ESS [Earth and Space Science] standards ... concepts are presented to students as if they were established fact (see, for example, (5), (6) and (6A) below), rather than scientific hypotheses. In my opinion, those who wrote the proposed ESS standards have an agenda that, in places, borders on indoctrination.”
- writing about the formation of the solar system: “While this may be the view held by most cosmologists, the statement is overly *dogmatic*.”
- commenting about the evolution of the Earth’s atmosphere: “Though they may reflect the scientific community’s current best models based upon sparse evidence, these topics are highly speculative and should be worded much less *dogmatically*. The statements make it sound like these proposals are established fact!”

Garner offers no objective basis for how to distinguish between what he considers fact and what he considers dogma. If the subject is chiral organic compounds (Dr. Garner’s research field), then presumably he describes this as scientific fact. If the subject is cosmology, then that is called dogma. Even “the scientific community’s current best” is not good enough for Garner.

Garner disrespects the expertise of the authors of standards such as ESS. He presumes to be a better judge of disciplines such as ecology, astrophysics, and atmospheric chemistry than those who have devoted their lives to studying these fields.

5. Origin of Life & Miller Experiment

Garner claims:

- “Nowhere in science is critical thinking more appropriate than when discussing controversial claims about the origin of living things.”

This begs the question, “Why?” Why should origin of life (OOL) be singled as the single-most important area for critical thinking? (By “critical,” Garner may mean criticism rather than balanced judgment of evidence.)

The origin of life is a moot point; life happened. Evolution is concerned with what happened after the origin of life, while the ultimate beginning is a perennial concern of religion. One could argue that the origin of life is of less scientific importance than oncology and cardiology because so many people face end of life issues from cancer and heart attacks. Why does Garner think OOL ranks as the field most deserving of critical analysis?

Garner does not explain his reasoning. However, Garner feels this is very important and therefore devotes more time on OOL than any other single subject in his review.

Garner asks:

- “How could any evidence possibly refute the ‘scientific’ hypothesis that ‘life arose from chemical mixtures’? Conceivably, chemistry might be discovered by which the statement might be proven true, but it could never be proven false.”

Completely wrong. The production of organic molecules by inorganic processes is entirely falsifiable. Add the compounds that best represent the atmosphere of the early Earth, add some electricity, and you either (a) create complex organic compounds, or (b) do not. As Miller and so many after him have shown, this setup produces complex organic compounds under a variety of circumstances. It works. This experiment is falsifiable and scientific. To Garner’s chagrin, Miller-type experiments easily produce the building blocks of life, and a recent re-analysis of some of Miller’s original samples showed that even more were created than Miller recognized (Johnson et al., 2008).

Organic molecules in the early Earth could also have been formed by non-Miller processes. In a paper published in *Nature Geoscience* on 7 December 2008 (subsequent to Garner’s review), Furukawa et al. demonstrated that in recreations of chondritic meteorite strikes in a primitive ocean, the shock of meteorite impacts can create complex organic molecules.

Complex organic molecules, including amino acids, have been discovered in meteorites and in the deep recesses of space. The universe is literally teeming with the bricks needed to construct the house of life.

Garner writes:

- Because the proteins that are essential to life are long polymers of amino acids, the products of Miller-Urey type experiments are often hailed as ‘the building blocks of life’ ... The presentation leaves the impression that, while there are still questions to be answered, good evidence exists to suggest a chemical origin of life.

This statement begs the question: If the origin of life was not chemical, then what alternative does that leave? The idea that something other than natural, abiotic, chemical processes was involved in the origin of life implies religion.

Garner believes:

- “The more one knows about the molecular complexity of cells and the inability of organic compounds to self-organize as required, the less likely one is to believe that a chemical origin of life is possible.”

The ability of both organic compounds to self-organize has been well documented (Gavezzotti, 1998; Kunitake, 1999; Yang, 2007).

6. Other Issues

Garner cites Wikipedia as a reference for:

- the definition of evolutionary adaptation
- the Nebular Disk model

Perhaps Garner does not realize how easy it is to alter Wikipedia to suit one’s needs. Just prior to the January meeting, someone could change the definition of adaptation to “Charles Garner is a creationist” as a way of demonstrating the ephemeral nature of Wikipedia entries.

Garner comments:

- “Given the very large numbers of biology majors in college and intense competition for employment afterwards, students need to know what career opportunities and challenges there are in biology.”

Education is not vocational training. Students will be ill-served if standards for rapidly-changing career fields are codified for a decade using the soon-to-be-obsolete standards of today.

Garner criticizes the “purported forces outside of nature” language in the TEKS:

- “It seems to me that the Big Bang was ‘outside of nature’ and it is considered to have been scientifically tested.”

It is unclear why Garner thinks the Big Bang would be a non-natural event. As in his commentary on the origin of life, Garner makes an implicitly religious statement.

On Galápagos finches;

- “In the case of bird beaks, the adaptation might be appropriately well documented, especially in the case of bird beaks of the Galápagos finches. But students should realize that this example represents meager evolutionary change, and it has been documented that the bird beaks returned to their normal sizes after the end of a drought. Thus, this is ‘oscillating selection,’ and these sorts of examples don’t imply a great creative power of natural selection.”

This is a complete misreading of the Galápagos evidence for major changes in response to drought cycles. This evidence comes from a meticulous long-term study conducted by Peter and Rosemary Grant, and which was so well discussed in Weiner’s book *The Beak of the Finch*.

Summary

Charles Garner is a creationist. He has signed the Dissent from Darwin list. In a guest column for the Waco Tribune, Garner criticized what he termed a “naturalistic Darwinistic worldview.”¹ According to an article in the Dallas Observer, Garner “prays with students when they come to him with problems and criticizes evolutionary theory in class.”²

Garner’s review of the TEKS standards show:

- 1) his disrespect for other scientific disciplines,
- 2) his misunderstanding of key scientific facts,
- 3) his anti-environmental stance, and
- 4) his anti-evolution agenda.

¹ Garner, Charles. “It’s not religion; it’s sound, skeptical science.” The Waco Tribune, 19 November 2008. <http://www.wacotrib.com/opin/content/news/opinion/stories/2008/11/19/11192008wacgarner.html>

² Kern, Lauren. “Monkey Business.” *Dallas Observer*, 11 January 2001. http://www.arn.org/docs/dembski/wd_dallasobserver0101.htm

Stephen Meyer

Dr. Stephen Meyer, a senior fellow and vice president of the creationist Discovery Institute, was one of six outside reviewers selected by the Texas State Board of Education to critique the proposed Texas Essential Knowledge and Skills (TEKS) standards.

Bio:

- BS degrees in Physics, Geology
- PhD in History and Philosophy of Science
 - it should be noted that among the 6 reviewers of the science TEKS, only Meyer lacks a PhD in a scientific field
 - he might be a better fit for evaluating the history TEKS
- co-author of creationist book *Explore Evolution*
- currently employed by the Discovery Institute; no university affiliation

Meyer's review breaks down into ten sections.

1. "Alternative Explanations"
2. "Purported Forces."
3. New Evidence
4. Critical Thinking
5. Strengths & Weaknesses
6. Other Curriculum Changes
7. History & Social Impact
8. Definition of Evolution
9. Genetic Code
10. Origin of Life

1. "Alternative Explanations"

Meyer opens by criticizing the definition of science used in the TEKS.

The TEKS definition that "science is a way of learning about the natural world" is incomplete to Meyer because this fails to address what he terms "alternative explanations."

Meyer recommends adding to the TEKS science definition "wherever it appears" language to the effect that students should learn about assumptions, critical and logical thinking, and alternative explanations. Meyer takes this language from a 1996 National Science Education Standard model produced by the National Academy of Sciences.

In the NSES document,³ however, the usage of "alternative explanations" is quite different than Meyer's meaning. As a creationist, Meyer wishes to introduce

³ available at <http://www.nap.edu/catalog/4962.html>

pseudoscientific “alternatives” as a way of undermining science education. NSES discusses alternative explanations as a method of problem solving.

For example, pages 124-125 of the NSES report give the example of “Willie the Hamster.” A very young student notices that a plant watering can has run dry, even though he remembers filling it in a previous class. Rather than simply telling the class this is because of evaporation, the teacher encourages the students to entertain “alternative explanations” for the cause of the disappearing water. A student suggests that the class hamster, Willie, is sneaking out of his cage at night to drink the water. The teacher then asks the class to consider ways to test whether Willie actually is escaping his cage, such as putting his cage in the middle of sand that would record his footsteps. Alternate ideas are entertained as a way to stimulate children’s curiosity.

Meyer therefore uses the phrase “alternative explanations” without the substance and context of its meaning by NSES. Meyer does not specify an example of an alternative that he would require in the standards, but judging by his previous writings, a reasonable example might include that whenever evolution is part of the curriculum, an “alternate” theory should be proffered that God designed everything instead.

2. “Purported Forces.”

Meyer objects to this language from the TEKS standards:

“If scientific explanations are based on purported forces that are outside of nature, scientists have no way of testing those explanations.”⁴

Meyer disagrees:

“By using the word ‘purported’ to describe forces outside of nature, this language seems to deny (or even ridicule) the idea that there are forces outside of nature. Surely, this is not an issue the TEKS for science should comment on, one way or another.”

Science posits that there are no forces outside of nature. Science cannot be neutral on this issue. The history of science is a long comment denying that forces outside of nature exist, and proving that this is the case again and again. There is simply zero scientific evidence for forces outside of the natural world.

Scientific experiments do not rely on “magic” in order to explain their results. Magic—as magicians Penn & Teller and James Randi hasten to point out—does not exist.

Since Meyer’s usage of a National Academy of Sciences book in the previous section suggests he accepts the validity of the NAS’s work, here is what the NAS says on this issue:

⁴ Drafts of the TEKS science standards are available at <http://www.tea.state.tx.us/teks/scienceTEKS.html>

“If explanations are based on purported forces that are outside of nature, scientists have no way of either confirming or disproving those explanations. Any scientific explanation has to be *testable* — there must be possible observational consequences that could support the idea *but also ones that could refute it*. [italics original]”⁵

3. New Evidence

Meyer takes issue with TEKS Biology standard (b)(5), which says:

“Many scientific theories are so well established that no new evidence is likely to alter them substantially...”

Meyer argues this unfairly excludes potential new evidence that might alter prevailing scientific views.

The TEKS standard language comes, in part, from the NAS book *Science, Evolution, and Creationism*. The full quote is revealing:

“Many scientific theories are so well established that no new evidence is likely to alter them substantially. For example, no new evidence will demonstrate that the Earth does not orbit around the Sun (heliocentric theory), or that living things are not made of cells (cell theory), that matter is not composed of atoms, or that the surface of the Earth is not divided into solid plates that have moved over geological timescales (the theory of plate tectonics).”⁶

If Meyer has “new evidence” proving the Sun is not the center of solar system, new evidence that life is composed of something other than cells, or that plate tectonics is a myth, then let him present this evidence to a peer-reviewed scientific journal. Otherwise, the NAS statement stands: some scientific theories are so well-proven that scientists need waste time and effort continuing to argue about them.

Meyer recommends that this statement be added to the TEKS:

“The history of science shows that the prevailing consensus among scientists may turn out to be correct, but it may also turn out to be incorrect, and so even prevailing scientific theories should be open to continuing refinement, evaluation, and refutation.”

⁵ National Academy of Sciences and Institute of Medicine (2008). *Science, Evolution, and Creationism*. Washington, D.C.: The National Academies Press. Available at http://www.nap.edu/catalog.php?record_id=11876

⁶ *Science, Evolution, and Creationism*, p. 11.

It is absurd to instruct children that what they are learning is scientifically correct—with the caveat that at some undetermined point in the future, as yet undetermined evidence may prove what they’re learning to be incorrect. Such language creates confusion rather than education.

If Meyer thinks this language should apply to science curriculum, why not to other required subjects, such as history? The prevailing consensus view of historians is that Lincoln was president during the Civil War. This is what children are taught. But by Meyer’s reasoning, they should also be told that at some point in the future historians may discover that Lincoln was not, in fact, president during the Civil War. After all, no one now living was alive during Lincoln’s presidency, so how can we know for sure? One cannot absolutely prove that some form of new evidence will not be found. Shouldn’t children therefore be taught “both sides”?

4. Critical Thinking

Meyer uses the term “critical thinking” in a non-standard way. Normally, critical thinking involves learning the basics of a subject, evaluating different arguments without prejudice, and judging whether or not sufficient evidence exists to come to a conclusion. This is not what Meyer means.

Meyer writes:

“Simply presenting students with current scientific conclusions by rote without having them examine the reasoning and assumptions that underlie those conclusions disserves students by presenting them with a false view of the way scientists work...”

“Science education that does not encourage students to evaluate competing scientific arguments is not teaching students about the way science actually operates.”

Meyer misses the first step of learning the basics of a subject. He would have students jump to the very end—the conclusion—without knowing the basics of the topic.

Sometimes these basics are best learned by rote. Children successfully use rote memorization to learn multiplication tables, for example. There is no need to have children learn about the assumptions of mathematical theories before they learn the product of 3 multiplied by 7.

Meyer is so adamant about having students learn about and critically analyze imagined scientific controversies that what he proposes here is like having students skip learning multiplication tables, and instead jump directly into critiques of advanced mathematics, such as topology and number theory. This is pedagogical nonsense.

5. Strengths & Weaknesses

The history of “strengths and weaknesses” language in Texas standards has a long history. The “3A” process skill in current TEKS draft reads:

“(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their *strengths and weaknesses* using scientific evidence and information; [italics mine]”

Meyer correctly understands that the phrase “strengths and weaknesses” is a subject of much controversy to scientists, and that pro-evolution groups seek to amend this language. Meyer writes:

“I recognize there has been a campaign to strip the ‘strengths and weaknesses’ language from the new version of the TEKS, *even though that language has been included in the Texas science standards for many years* [italics original].”

The fact “strengths and weaknesses” language has been used in the past is a weak justification its continued existence. The fact is, Process Skill 3A is an open invitation to unwarranted, unscientific criticism of theories such as evolution.

No scientific theory is free from examination and criticism by other scientists, in forums such as peer-reviewed papers and scientific conferences. These are the proper places to debate the merits of scientific ideas. Examination of the strengths and weaknesses of scientific ideas occurs continuously in the pages of peer-reviewed journals. Evolution, like plate tectonics or Einsteinian physics or germ theory, has survived thorough testing by an onslaught of substantive, expert criticism.

However, what Meyer proposes is to bypass this system, to make an end-run around scientific experts in order to present untested, half-baked pseudoscientific ideas to children who are poorly-prepared to understand they are being lied to. What Meyer proposes is to recruit young children to believe they know better than scientists, Nobel laureates included, who have studied their disciplines their entire careers. How children are expected to identify “strengths and weaknesses” that the collective brainpower of the scientific community has missed is a mystery.

Meyer writes:

“The goal of opponents of the ‘strengths and weaknesses’ language seems to be the singling out of Darwinian evolution to shield it from the normal process of scientific inquiry and scrutiny.”

The theory of evolution does not need special shielding from the normal processes of scientific skepticism; it has been challenged, and has survived numerous tests.

6. Other Curriculum Changes

Meyer believes that the gospel of “strengths and weaknesses” should be spread to topics other than evolution:

“It is not enough to have a general standard calling for the examination of strengths and weaknesses of scientific explanations. The critical thinking approach needs to be applied to topics and issues throughout the curriculum.”

The other parts of the curriculum Meyer has in mind are environmental.

Meyer recommends changing TEKS standards of Environmental Systems by inserting the phrase “analyze strengths and weaknesses” to:

- global warming
- the greenhouse effect
- effects of recreational activities
- emissions regulation
- Kyoto Protocol
- the Endangered Species Act

For the Earth and Space Sciences TEKS standards, Meyer would insert “analyze strengths and weaknesses” language into discussions of:

- the evolution of Earth’s atmosphere
- theories about the origin of oceans (volcanic outgassing & water-bearing comets)
- tectonic activity
- fossil types
- atmospheric CO₂ concentrations

Meyer also takes umbrage of the Astronomy TEKS standards. He recommends inserting “analyze strengths and weaknesses” language into topics such as:

- the fate of the universe
- dark matter & dark energy
- the Big Bang

This list mixes well-established scientific theories with less-tested ideas. It is hard to delineate the strengths of weaknesses about dark matter and dark energy when scientists know so little about these conjectured substances. Indeed, the scientific understanding of dark matter and dark energy is so new and untested that it is possible it may turn out that there are no such things as dark matter and dark energy.

On the other hand, what are the strengths and weaknesses of plate tectonics that Meyer would have children learn? What are the strengths and weaknesses of the CO₂ concentration rise documented by Charles Keeling? Meyer does not specify what he thinks these strengths and weaknesses are.

7. History & Social Impact

Meyer not only tries to sweep environmental sciences and astronomy into his sweeping attack on science, but he goes on to make a striking statement:

“...the draft standards do not clearly require students to learn about the cultural factors that influenced the development of modern science.”

When a student in physics learns that force equals mass times acceleration, it is hard to know where to insert the “cultural factor” into this equation. When a chemistry student learns that pressure times volume equals the number of moles of gas times the universal gas constant times the absolute temperature, it hard to say where “society” fits. When a calculus student learns that the first derivative yields velocity, while the second derivative gives acceleration, where does Meyer propose to insert “culture”?

There are perhaps some legitimate reasons to spend time talking about the societal impact of science. The proper place for such discussions, however, is in a social studies course.

As any science teacher could have told Stephen Meyer if he had asked, there is simply no time in a science classroom to waste on cultural issues. There is not even enough time to cover the required scientific topics, much less some other discipline in which science teachers have no formal training.

8. Definition of Evolution

Meyer makes the remarkable assertion that, “There are actually multiple meanings of evolution,” and goes on to recommend that the TEKS Biology section (c)(7) be changed to say that students should:

“know and distinguish between the different meanings of the term evolution, including change over time, universal common ancestry, and natural selection acting on random variations; and understand that evolutionary biology is primarily an historical science.”

Meyer posits these abstract distinctions as a way of dividing and conquering evolution. In reality, change over time is not contrary to natural selection, which are in turn not separate from universal common ancestry. Meyer would codify such distinctions as a way of rejecting evolution by attacking its components.

Meyer also throws out the red herring of “historical science” to suggest that this undermines evolution. In fact, we might just as well say “forensic” in place of “historical” to reflect the fact that piecing together past events is not necessarily less accurate than directly observing experiments.

Stephen Jay Gould explained this best when he wrote in *Wonderful Life*:

“Many large domains of nature—cosmology, geology, and evolution among them—must be studied with the tools of history...

“Nature’s laws are defined by their invariance in space and time. The techniques of controlled experiment, and reduction of natural complexity to a set of general causes, presuppose that all times can be treated alike and adequately simulated in a laboratory. Cambrian quartz is like modern quartz—tetrahedra of silicon and oxygen bound together at all corners. Determine the properties of modern quartz under controlled conditions in a laboratory, and you can interpret the beach sands of the Cambrian Potsdam Sandstone.”⁷

9. Genetic Code

Meyer want to change Standard (c)(6)(B), which states students should “recognize that the genetic code is common to all organisms.” Meyer asserts, “This is not entirely accurate.”

Meyer instead proposes changing (c)(6)(B) to read that students should:

“recognize that the genetic code is similar in most organisms but that there are variations in the genetic code. Analyze whether the evidence supports or challenges the theory of universal common ancestry.”

Of course there are “variations” in the genetic code. Without variations, every organism would be identical to every other. Meyer then lobs a radical *non sequitur* by saying that this variation challenges universal common ancestry.

A more robust (c)(6)(B) might point out the remarkable genetic similarity among eukaryotes as diverse as fungi, ferns, and people. A better standard might explain the greater than 98% match between chimpanzee and human DNA. A real discussion of the genetic code would detail how Human Chromosome 2 is a fusion of two separate chromosomes; this explains why humans have 23 chromosomes, instead of the 24 found in the great apes.

Meyer proposes including none of these exciting scientific discoveries. All he offers students is his tired, dull “challenging the theory” rhetoric.

⁷ Gould, 1989, p. 277.

10. Origin of Life

Meyer asserts, “The origin of life is obviously a foundational issue in biology.”

If Meyer had more training in science rather than philosophy, he might have known that the origin of life is not usually a major component of biology coursework. In a standard Biology 101 textbook, such as Neil Campbell’s *Biology*, the discussion of the possible origins of life takes up 10 pages out of 1,203 (0.83%), hardly making it a “foundational issue.”

Yet Meyer proposes that the TEKS Earth & Space Science standard (c)(8)(A) declare that students should learn about:

“... the strengths and weaknesses of various hypotheses about the origin of life, including those involving a pre-biotic soup, hydrothermal steam vents, and the transport of organic chemical to Earth by comets ... organic monomers under primitive Earth conditions; the origin of complex biopolymers such as proteins, RNA, or DNA; the origin of sequence-specific information in proteins, RNA and DNA; the origin of the modern genetic code system; the origin of a primitive self-replicating life-form; and the origin of a minimally complex free-living cell.”

This description is almost as long as the textbook sections on origins of life!

Meyer’s main target in evolution. However, like so many creationists fixed for religious reasons upon the moment of “creation,” Meyer misunderstands that evolution does not speak to the origin of life. Rather, evolution is concerned with what happened *after* life began.

In summary, Meyer’s review is a disaster of half-truths nestled within deliberate distortions. Meyer’s main goals are to undermine science education in Texas by:

- injecting “alternative explanations” where none are scientifically justified
- introducing supernatural forces as pseudoscientific explanations
- confusing students with caveats about unspecified “new evidence”
- supporting usage of the current “strengths and weaknesses” language and expand this language into environmental topics
- misrepresenting the importance of research into the origin of life
- and redefining evolution to suit creationism rather than science education.

Ralph Seelke

Ralph Seelke, one of six outside reviewers selected by the Texas State Board of Education to critique the proposed Texas Essential Knowledge and Skills (TEKS) standards.

Bio:

- PhD, microbiology, 1981
- Professor, Univ. Wisconsin, Superior
- co-author of creationist book *Explore Evolution*
- has worked with *E. Coli* to examine if genetic defects in sugar utilization could be corrected through evolution; he claims corrections are not occurring.

Seelke's review breaks down into these main subjects:

1. Agreement with many of the standards
2. Ethics
3. Natural Selection
4. Problems with Grade 7 (b)(11)
5. (C)(3)(a)
6. "Scientism"
7. 9-12 Subject Sections
8. Richard Lenski

1. Seelke Agrees with Many of the TEKS Standards

Seelke follows the TEA format more than the other two reviewers, and actually tries to answer the questions presented to him. He opines about the introduction to the TEKS:

"I found no errors of fact in the scientific concepts presented."

"I have found correct and age-appropriate vocabulary and terminology used."

"The [Student Expectations] are, in almost all cases, fully aligned with the knowledge and skills that they demonstrate."

Seelke takes issue with some of the middle school standards, recommending that they be "toned down a bit," or eliminated. He recommends introducing the taxonomic concept of Domains, rather than just Kingdoms. He points out typos and problems in the numbering system. Overall, however, his tone is one of approval.

2. Ethics

Seelke recommends a discussion of ethics in conjunction with science classes, specifically in the 6-8 grade Middle School Science TEKS. He writes:

“All the TEKS have, in their introduction, a statement about the inability of science to answer all questions. At some point will there be an attempt to have students actually NAME some of the questions? A common statement is that while science may tell us what we **can** do, it doesn’t address what we **ought** to do. It can tell us that we can make hydrogen bombs, and hybrid cars, and human embryos in a test tube, but it doesn’t tell us whether we ought to do such things ... The place to bring this up is the science classroom.”

3. Natural Selection

Seelke takes issue with Grade 7 (a)(3)(E)(ii):

“ ‘Changes in traits that are observed in a population can occur over many generations through the process of natural selection.’

“This gives the impression that the changes that occur in a population are **only** due to natural selection. There are many other forces at work, which are beyond 7th grade: genetic drift and immigration are two that come to mind.”

Seelke is making a minor point here. He does not challenge that natural selection exists, or that it can operate on populations.

4. Grade 7 (b)(11)

“Grade 7 (b)(11): The student knows that populations and species demonstrate a variety of life and acquire many of their unique traits through gradual processes over many generations.”

Here Seelke takes umbrage for the first time. He writes:

“I strongly object to this TEKS requirement. Can we really ‘know’ that populations acquire many of their unique traits through gradual processes over many generations? I would submit that, except for examples of small-scale change, we know nothing of the sort. For all the interesting unique traits (such as photosynthesis, or sex, or flight in mammals), we are completely clueless as to any sort of clear path or gradual process. Most of these features appear suddenly in the fossil record. We simply have made a large extrapolation from the very small things that we can observe, such as what can be done with artificial breeding or selection in bacteria. The language invites students to ‘know’ things that are simply speculation and extrapolation. While I have nothing against speculation and extrapolation, it should not be confused with knowledge.”

Here Seelke raises the issue of macro vs. microevolution. He concedes microevolution, “small-scale changes,” have been observed; for the macroevolutionary “unique traits,” however, he claims scientists do not understand how they came to be.

- This is completely false
- Science recognizes no sharp line between micro/macro evolution
- There exists plentiful evidence about how “interesting unique traits” evolved

Seelke claims that unique “features appear suddenly in the fossil record.” He is referring here to the Cambrian Explosion.

- the Cambrian Explosion only appears sudden
 - prior to the Cambrian there were diverse soft-bodied organisms
 - during the Cambrian hard-bodied, shelled organisms appear
 - vastly increasing the number of fossilized remains
- the diversification of organisms in the Cambrian began far earlier than point at which hard-shelled organisms began to be fossilized in great numbers
 - supported both by molecular studies and Vendian fauna diversity

Knowing versus Extrapolating. Seelke makes a sharp distinction here between these, warning that they should not be confused. To help him understand why there is not such a sharp distinction, let’s use an example from his discipline, microbiology:

- to culture a bacterial colony, a sterile loop of wire exposed to bacteria is streaked across a plate of agar medium in a Petri dish, which is then put into a incubator for a set period of time
- when that time has elapsed, the microbiologist removes the Petri dish and observes bacterial colony growth along the streak line
- the microbiologist reasonably extrapolates that the bacteria have multiplied
 - the microbiologist “knows” this
 - this conclusion is grounded in more than “speculation”
- the microbiologist does not “know,” however, that someone else hasn’t gone into the incubator, swapped the Petri dish, and changed the label
- the microbiologist does not “know,” that someone else hasn’t gone into the incubator and sprinkled something that looks bacteria on the agar
- extrapolation is a reasonable pathway to knowledge

Seelke continues:

“It’s important to understand what is at stake here. If we want a citizenry that thinks and evaluates the claims of science, we need to be very careful not to present things that we *think* are true as things we *know* are true. Very rapidly, speculations become ‘facts.’ Students should not be left thinking, ‘I heard it in school, so it must be true.’”

Some problems with what Seelke is claiming:

- most citizens do not have the educational background to be able to “evaluate the claims of science” in any meaningful way

- any more than most scientists have the education to evaluate the monetary policy decisions of the Federal Reserve
 - Pop Quiz: What's the predicted monetary effect of reductions in M1, M2, and M3? Wait, you don't even know the difference between M1 and M2? Then what makes you think you are ready to meaningfully evaluate policy decisions of the Fed?
- children are influenced in what they consider true or untrue by many factors outside of their formal education
 - academic facts briefly memorized the night before tests may not have the lasting influence on a person that Seelke assumes
- the creationist obsession with having ordinary citizens challenge experts may be part of a broader cultural phenomenon identified by writers such as Thomas Frank (*What's the Matter with Kansas?*) as an assault on the idea of expertise and professions. In a 2006 *New York Times* column, Frank elucidated this point:

“To the faithful, theirs is a war against ‘elites,’ and, with striking regularity, that means a war against the professions.

“The anti-abortion movement, for example, dwells obsessively on the villainy of the medical establishment.

“The uproar over the liberal media, a popular delusion going on 40, is a veiled reaction to the professionalization of journalism.

“The war on judges, now enjoying a new vogue, is a response to an imagined ‘grab for legislative power’ (as one current Kansas campaign mailing puts it) by unelected representatives of the legal profession.

“And the attack on evolution, the most ill-conceived thrust of them all, is a direct shot at the authority of science and, by extension, at the education system, the very foundation of professional expertise.”

5. (C)(3)(a)

Seelke endorses having the (C)(3)(a) statement for all disciplines. The (C)(3)(a) Seelke is referring to in the first draft reads:

“analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;”

This phrasing became “strengths and limitations” in the second draft, but in the third has evolved to:

“analyze and evaluate scientific explanations, using empirical evidence, logical reasoning, and experimental and observational testing;”

Seelke may argue in his testimony that this language should be reverted to the original (C)(3)(a), and that this should be included as part of every subject.

Arguments against using first draft’s (C)(3)(a):

- potential “weaknesses” have already been discussed and addressed through the process of scientific peer review
 - experts, not beginning students, have evaluated problems
 - information appearing in a peer-reviewed journal has already passed through a gauntlet of determined, expert criticism
- the critiquing scientific explanations has already occurred in the venue of peer-review by other scientists
 - students do not yet have the knowledge to ask substantive questions at the high level of a broad “critique”
 - students generally struggle to learn the most basic concepts of a science

6. “Scientism”

Seelke now ventures into strange territory:

“...these TEKS do so in such a way as to devalue questions that can’t be answered by science, and at the same time promote scientism.”

“The statement reeks of *scientism*: the philosophy that the only explanations that count are those that rely on nature.”

By implying that there exist explanations outside of nature, Seelke posits supernatural, mystical phenomena. The assumption that “the only explanations that count are those that rely on nature” is indeed an important part of science; in fact, this is a foundational axiom for any rational thinking. Seelke seems to want the TEKS to include magic.

“The statement implies that ‘we’ (i.e., all us ‘educated people’) all ‘know’ there are no forces outside of nature.”

It needs to be said clearly: All educated people understand there are no forces outside of nature. Education implies abandoning childish beliefs about cause and effect—“I wrote Santa Claus a letter, and I got a present”—and learning how the adult world works. The mission of science in particular is to identify how the world works.

“The extra statements in Biology and ESS probably detract more than they add; they imply a contempt for other ways of knowing that will only serve to enhance the conflict between science and other disciplines.”

It would be interesting to learn what “other disciplines” Seelke thinks are in conflict with science. English literature, perhaps? Philosophy? Seelke is, of course, trying to elevate creationism to the level of a discipline on par with science.

“...it is in biology that the authority of the state is most used to suppress inquiry.”

Suppressing non-scientific, irrational inquiry involving creationism in public school classrooms is perfectly legitimate—in fact, allowing creationism in public schools would violate Supreme Court rulings such as *Edwards v. Aguillard*.

Seelke is wrong to claim that biology is singled out. If a public school teacher tried to claim electromagnetic forces were evidence of God, this would constitute an Establishment Clause violation in the same way if a biologist explained the diversity of species by saying, “God made them.” If a public school teacher claimed the reason we have seasons is that the Earth is closer to the Sun during summer, then that teacher should be subject to sanctions because that information is so grossly inaccurate; likewise, teaching creationism as a scientific explanation is grossly inaccurate.

“I suspect that this is deliberately placed to suppress critical inquiry into biological evolution, a theory that upwards of 50% of the population suspects as being flawed.”

Here Seelke seems to be citing an opinion poll as evidence about a scientific theory. While it may be correct that a significant percentage of the American populace does not believe in evolution, it is also true:

- 1 out of 5 Americans does not understand that the Earth revolves around the Sun
- half of Americans believe they have a guardian angel
- 44% believe in ghosts
- 25% believe they were once another person

One might also ask how many Americans could correctly answer these basic scientific questions:

- what causes the seasons?
- why causes the cycles of the moon?
- what is smaller than an atom?
- if you roll a heavy ball and a light ball down an inclined plane, which one hits the ground first?

The fact that poll show half of the American populace rejects evolution is therefore poor evidence against the theory of evolution, and is a reason to expand the teaching of evolution rather than accommodate unscientific, irrational beliefs.

7. 9-12 Subject Sections

Seelke is generally very positive about the subjections of the 9-12 TEKS. For example, for writing about Chemistry, he “found no errors” and thought the approach would “enrich” the subject.

Seelke even approved of the Earth and Space Science TEKS which Garner and Meyer criticized heavily. Seelke thought an ESS course would be “challenging,” would attract students, and noted that he “would love to take this course!”

Throughout the 9-12 Subject Sections, however, he reiterated his desire to include the (c)(3)(A) “strengths and weaknesses” language. We can probably expect him to ask in his testimony that this language be reintroduced.

8. Richard Lenski

Although Seelke does not directly address this issue, his main research focus is an attempt to refute the findings of Richard Lenski, whom Seelke strangely describes as a personal “hero.”

Richard Lenski is a professor microbial ecology at Michigan State University. He has maintained an *E. Coli* population since 1988, systematically analyzing the genetic changes taking place in what has now grown to represent 40k generations. Some samples have been subject to competitive experiments to observe for organismal fitness. Lenski has reported numerous evolutionary changes in his *E. Coli* population.

Seelke, by contrast, claims that Lenski is “not asking interesting questions,” that most of the evolution he observed occurred within the first 2,000 generations of his *E. Coli*. Seelke maintains that even if subsequent generations are fitter than previous, they are still fundamentally still *E. Coli*.

Seelke has attempted to repeat Lenski’s work and find a different result. Specifically, he is examining whether evolution can “repair” 2-step defects in sugar utilization. Seelke feels that although a one-step change might be acceptable as an example of microevolution, the “requirement for two changes at once is essentially an evolution stopper.”