

SUCKED INTO THE CULTURE WAR

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The most eye-opening year of my adult life began innocently in late 2002, when my neighbor, Dr. Steven Sanchez, who was the Director of Curriculum, Instruction, and Learning Technologies at the New Mexico Department of Education, asked me to help with revision of the “science standards” that specify what every student in New Mexico should know about science. My assigned role: Advise the Department about what scientific topics were important enough for inclusion, and make sure nothing obsolete or wrong got into the standards by mistake. That seemed simple enough. Within 12 months, however, I was engulfed in stressful conflict, which revolved around an interesting question—who or what determines the material that is taught in high-school science classes. Scientists? Teachers? Poll results?

Science standards

In the U.S., primary responsibility for education through the 12th grade lies at the state level. Each of the 50 states establishes “standards” for what every student should know, while each of the nation’s 15,000 school districts decides how its local “curriculum” will meet its own state’s standards. For example, New Mexico science standards¹ require that every eighth-grade student should know that Earth has a magnetic field, but it is up to each district to decide whether that is taught with magnetism, Earth science, astronomy, all of the above, or in some other context. The No Child Left Behind Act of 2001 tied federal funding to students’ scores on standardized tests based on each state’s standards. With so much money at stake, this law has had many effects, including the revision of science standards in most states beginning in 2002.

Like the standards for other subjects, the science standards are a coordinated multi-dimensional matrix of sentences, indexed by discipline (e.g., physics), topic (e.g., energy), grade level, and content or methodology of science. For example, one New Mexico standard says that every second-grade student should be able to

- “Describe how energy produces changes (e.g., heat melts ice, gas makes cars go uphill, electricity makes TV work).”

Important topics like energy are described with ever-increasing sophistication in later grade levels.

In New Mexico, like most states, science-standards revision was coordinated by the state Department of Education, but the actual writing was done by teams of volunteers, mostly teachers. We all love our own disciplines, and we wish more people would appreciate our favorite subjects, so it’s no surprise that this kind of volunteer-based process can drive standards to explode with detail and sophistication. If a biology teacher insists that chromosomal crossover during meio-

“...people have different ways of knowing things, and ... the scientific approach is only one of those ways...”

sis deserves inclusion, then a physics teacher may insist that dispersion in wave propagation ought to be there, too. As our New Mexico process evolved, one of my roles became pruning away the exuberant growth of each early draft of the document, mindful that every standard—every sentence in this 40-

page document—would apply to *all* students, would have the force of law, would be incorporated in standardized tests, and would eventually compete for classroom time with other topics within science as well as important topics in other disciplines such as civics and history. My pruning often consisted of collapsing one full standard into a parenthetical example of another standard. I also caught a mistake that someone had made in an astronomy standard. I felt like I was being useful. There were about 20 drafts in the course of the year, as our multi-dimensional matrix of standards took shape.

We ended up covering acoustics in the early grades:

- second grade, “... sound is energy, made by vibrating objects, has pitch and loudness.”
- fourth grade, “...sound waves carry energy through materials...”
- eighth grade: “...vibrations of matter (e.g., sound, earthquakes, water waves) carry wave energy, including:
 - -sound transmission through solids, liquids, and gases
 - -relationship of pitch and loudness of sound to rate and distance (amplitude) of vibration.”

I was glad my New Mexico teammates believed that everyone should know that pitch is a rate and loudness is an amplitude. Fearful of my personal bias toward acoustics, I would have been reluctant to suggest adding anything about acoustics myself.

I also studied the science standards in other states, and expert assessments of them, to try to understand why New Mexico’s pre-2003 science standards were judged to be among the worst in the country and what we would have to do to make our new standards among the best. And I took note of the situation in Kansas, where controversy about how to teach evolution was making national news at the time. How could so much conflict and confusion arise about evolution? When I went to high school (a Catholic school, in the post-Sputnik era), evolution was taught simply and confidently, like any other aspect of science. Had something changed? I decided I should study this issue, too.

Evolutionary science, and an alternative

I found that evidence supporting evolution has only grown stronger in the years since I took high-school biology in 1967-68. It is the only scientific explanation for the history, diversity, and commonalities of life on Earth. Alternative

explanations are not scientific. Talking about “weaknesses” of evolutionary theory makes as much scientific sense as talking about “weaknesses” of the atomic theory of matter.

At the national level, The Discovery Institute² orchestrates a well-organized, well-funded propaganda campaign claiming that natural processes cannot explain the diversity of life on Earth. Discrediting evolution is only the tip of its strategic wedge. Among the goals listed in a Discovery-Institute fund-raising document³ are:

- “To see intelligent design theory as the dominant perspective in science.”
- “To replace materialistic explanations with the theistic understanding that nature and human beings are created by God.”

These are astonishing goals, not limited to discrediting evolutionary science. Most people accept materialistic explanations of natural phenomena as easily *coexisting* with their understanding of God. That Discovery-Institute document says it wants to *replace* materialistic explanations with their “theistic understanding.” The anti-evolution campaign in Kansas was led by the Kansas office of the Intelligent Design Network, following Discovery-Institute tactics. So, I anticipated similar activity by the Intelligent Design Network of New Mexico.

Anti-evolution propaganda and push-poll techniques⁴ claim quickly and implicitly that scientific doubts about evolution exist, and then appeal to our sense of fairness that all sides of a controversy deserve respect and attention. Most Americans swallow the bait about the supposed scientific doubts, because they don’t know much about evolution, so their positive responses to the accompanying appeal to fairness are perfectly logical. The campaign gains sympathy by saying that suppression of its position on evolution is censorship by hidebound authorities or immoral atheists. Thus, “Teach the Controversy”⁵ has been very successful with the general public and with some public officials, even though there is no scientific controversy.

At first tempted by the bait in early 2003, I bought and read the top three books⁶⁻⁸ that popped up when I searched amazon.com for “intelligent design.” One of them struck me as wishful thinking but not scientific, and the other two convinced me that intelligent design is religious instead of scientific. For example, *Of Pandas and People: The Central Question of Biological Origins*⁸ says “Intelligent design means that various forms of life began abruptly through an intelligent agency, with their distinctive features already intact—fish with fins and scales, birds with feathers, beaks, and wings, etc.” There is no scientific evidence for that proposition; on the contrary, fossil and DNA evidence indicate that fish and birds shared a common ancestor about 450 million years ago. To me, that *Pandas* proposition sounded like something else I had studied in high school, though not in biology class—the creation narrative in the first chapter of the Bible⁹: “God created...all kinds of living, swimming creatures with which the waters abound and all kinds of winged birds.” So I came to regard intelligent design as one interpretation of a sacred text, as a new variety of creationism.¹⁰ (Famously, in 2004 the Dover, Pennsylvania, school district introduced *Of*

Pandas and People as a “supplementary biology text,” so the “controversy” would be taught in their high schools. The next year, a federal court declared in *Kitzmiller v Dover*¹¹ that the omission of overtly religious language was no disguise. The court ruled that intelligent design is “an interesting theological argument, but...it is not science,”...and teaching intelligent design as science in a public school is unconstitutional, as a government promotion of religion. But *Kitzmiller v Dover* came long after our science-standards revision in New Mexico.)

Despite the fact that creationist alternatives to evolution are unscientific, it is vital that science teachers make all students feel welcome in the science classroom, no matter what the students, or their parents, believe about the history of life or of Earth as a matter of religious faith. There is plenty of sound guidance for teachers regarding how this can be done.^{12,13} (See Fig. 1) It is a matter of describing evolution matter-of-factly as the scientific explanation for life on Earth, without disrespecting other approaches to knowledge. If a teacher’s presentation of evolution contradicts something that a student has learned from a parent or some other authority, it will surely not be the last time the student finds that different adults, each deserving of respect, have totally different perspectives on a subject.

The little words

To convey the importance of evolution in the New Mexico science standards, we ended up with a half dozen standards in the high-school biology section, including, for example:

- “Describe the evidence for the first appearance of life on Earth as one-celled organisms, over 3.5 billion years ago, and for the later appearance of a diversity of multicellular organisms over millions of years.
- Critically analyze the data and observations supporting the conclusion that the species living on Earth today are related by descent from the ancestral one-celled organisms.
- Understand the data, observations, and logic supporting the conclusion that species today evolved from earlier, distinctly different species, originating from the ancestral one-celled organisms.”

Elsewhere, standards about the age of Earth and the universe, radiometric dating, and fossils as evidence of the history of life on Earth reinforce some of these evolution standards. To encourage understanding that science doesn’t have all the answers, or cover all questions, we ended up with these standards in the high-school Science-and-Society section:

- “Understand that reasonable people may disagree about some issues that are of interest to both science and religion (e.g., the origin of life on Earth, the cause of the Big Bang, the future of the Earth).
- Identify important questions that science cannot answer (e.g., questions that are beyond today’s science, decisions that science can only help to make, questions that are inherently outside the realm of science).”

Evolution is Under Attack

But *you* can do something about it.

Join the NCSE, a nonprofit organization dedicated to defending the teaching of evolution in public schools. We help teachers, students, and parents deal with creationist issues around the country.



National
Center for
Science
Education

ncse.com/membership

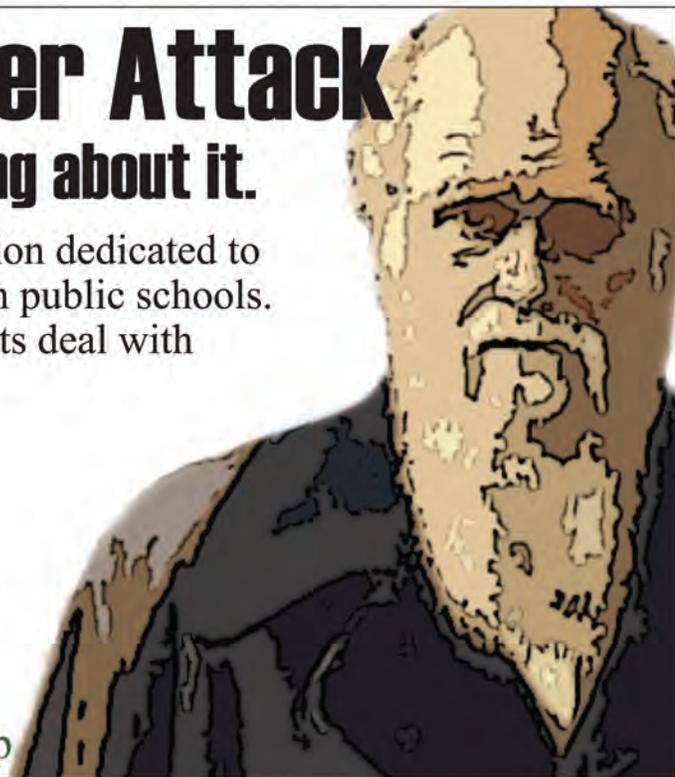


Fig. 1. The National Center for Science Education provides scientific and legal information about evolution to teachers, school administrators, the press, and the public.

As our standards development proceeded, the little lead-in words at the beginning of each standard provoked debate. I was bothered by an asymmetry that I saw as unnecessary and scientifically unjustifiable: Evolution standards, like those above, were introduced with lead-ins like “Describe the evidence...” and “Understand the data...” while non-evolution standards like “Know that matter is made of atoms” used dogmatic lead-ins like “Know that...” I argued that students would better learn about the methods of science and the nature of scientific knowledge if they had to understand the evidence leading to the conclusion that matter is made of atoms, instead of just knowing it as a fact. I made little headway on that issue: The chemistry and physics teachers wanted to retain their dogmatic emphasis on factual content, to save time and effort, and the anti-evolution contingent argued against dogmatic lead-in words only in standards involving evolution and the age of Earth. In the middle, the biology teachers were ok with lead-ins like “Describe the evidence...” as a simple reminder of how to make all students feel comfortable in science class.¹⁴

From advisor to activist

Soon after Steven asked me to help with the science standards, I had started asking around Los Alamos National Laboratory (where I’ve worked since 1981) to try to find a biologist who might also want to get involved. The Los Alamos Government Relations Officer asked me to stop. I love a surprise, and that was a big one. I had been assuming that advising the Education Department about science would be similar to other unofficial but acceptable science-related

volunteer activities, like reviewing articles for journals or helping organize conferences. Not so! He said that I would soon find myself crossing the line from advisor to advocate, and that Los Alamos employees cannot advocate for or against legislation—except as private citizens, of course. So my standards activity had to be as a private citizen—nights, weekends, vacation—and if I wanted to find a biologist I should try calling people at home. Many months later, it became obvious how wisely he had foreseen my transition from advisor to advocate—and then to activist, and eventually to all of the above in a blur of multi-tasking.

On July 28, 2003, the Intelligent Design Network of New Mexico (IDnet-NM) issued a press release¹⁵ announcing a Zogby International poll purporting to show that scientists at New Mexico’s national laboratories supported teaching intelligent design along with evolution by a five-to-one margin. Based on my decades-long employment at one of those national laboratories, this statement felt insulting and outrageous, almost as if IDnet-NM had said “five out of six members of the Acoustical Society of America believe the Earth might be flat.”

That poll nonsense triggered my personal transition to activism in the culture war, awakening me to the brazen mendacity of the leaders of the anti-evolution movement and the seriousness of their threat to public education.

In two weeks, we would be submitting our science standards to the State Board of Education. Those ten elected and five governor-appointed men and women might vote to adopt the standards, reject them, or amend them. IDnet-NM members had been helping write and review the standards

throughout the year, always encouraging revisions that would be friendlier to intelligent design. They had not gotten as far as they wanted. Their press release seemed to be aimed at the Board, whom they hoped would amend the standards on the spot, and then adopt them.

I know I took two years of French in high school—my report cards show straight A's, and I still remember the teacher's name and what she looked like. But today I can remember only seven words of French, and zero grammar. Memory fades after many years of disuse. So I meant no disrespect when I realized that these Board members might remember no more about science than I remember about French. They might have no more scientists among their friends than I had elected officials among my friends. In the face of that Zogby International poll and a related full-page newspaper advertisement a few days later, how could we convince the Board members that five out of six national-lab scientists did *not* endorse intelligent design? Did we have to convince their constituents, too?

The Los Alamos Fellows, appointed by the Los Alamos Director “in recognition of sustained outstanding contributions and exceptional promise for continued professional achievement,” are limited to two percent of the technical staff. One might think of them as among the best of the scientists and engineers at Los Alamos. In response to the IDnet-NM press release, the Fellows wrote and adopted a position paper¹⁶ in support of the science standards without amendment. It focuses on the importance of good science education to a technically literate electorate and skilled worked force, but mentions incidentally that “advances in chemistry and biology have led to an understanding of the molecular basis of heredity and of other biological processes, uniting chemistry and biology in ways that confirm and augment earlier understanding of the evolution of life. ... Biochemists have even begun to investigate the genomes of organisms near the roots of the tree of life billions of years ago, before multicellular organisms appeared.” There is, of course, no mention of intelligent design or weaknesses of evolution. The position paper was adopted by a vote of 53 to 1.

The President of Sandia National Laboratories publicly denounced the IDnet-NM poll as a “bogus mini-survey” with “no scientific validity,” and the Director of Los Alamos National Laboratory chimed in that “the ‘results’ come from less than one percent of the total employee base, hardly a response rate that can purport to represent the opinions of ‘all scientists’ at this institution.”¹⁷

One member of the Board of Education later said that IDnet-NM continued to stand by their poll results in one-on-one conversations with Board members, explaining that the leaders of the two national laboratories must have felt compelled to hide the truth about their scientists' opinions on intelligent design.

In hindsight, it seems likely¹⁸ that IDnet-NM gave the Zogby pollster a carefully selected short list of laboratory employees, at best falsely representing the list as a random sample of scientists but often actually claiming (e.g., in their press release) that the questions were sent to 16,000 laboratory employees. Furthermore, the poll questions used the push-

poll techniques described above, which may have biased the results even more.

The Board decides

Over a hundred people played important roles in the development and adoption of these standards, but three individuals were vital: Ms. Sharon Dogruel, Dr. Marshall Berman, and Dr. Steven Sanchez. In their stories are lessons for all of us who hope that reason can prevail.

Former chemistry teacher Sharon Dogruel worked in the New Mexico Department of Education from 1999 to 2004, under Steven's supervision. Sharon led the diverse group of volunteers who created the science standards. Her degree in philosophy must have helped her see through intelligent-designers' sometimes-tricky rhetoric, such as their conflation of the methodological naturalism at the heart of all scientific questions with the philosophical naturalism of atheism. Her tenacity brought the revisions to a high-quality conclusion on schedule. That high quality inspired enthusiastic support from New Mexico science teachers, national-lab scientists, university faculty, parents, and other science and education professionals, and some of these enthusiasts capitalized on the high quality by obtaining letters of support from out-of-state science organizations including the National Academy of Sciences, the National Science Teachers Association, the National Center for Science Education, the American Institute of Physics, the American Institute of Biological Sciences, and the American Geological Institute, as well as from in-state non-science organizations including the New Mexico Conference of Churches and the New Mexico Business Roundtable. The Board was well aware of this enthusiastic support.

As others in New Mexico orchestrated this flood of support, I realized that I was witnessing the climax of years of organizing and networking,¹⁹ and my sense of “we” expanded far beyond those of us who were writing and editing the standards themselves. When I met physicist Marshall Berman in 2003, he was the leader of the advocacy effort for the science standards. He had served as an elected member of the State Board of Education from 1998 to 2002. During those years, Marshall earned the respect and trust of his fellow Board members by bringing his scientific habits to bear on issues unrelated to science. In a political world where many decisions are made on the basis of unsubstantiated opinion and rhetorical appeal, simply asking “How do we know that?” and habitually seeking evidence, without a predetermined or hoped-for result, can make collective decisions much better, working toward consensus where ideological or party-line voting might otherwise be the norm. Today, Marshall continues to work in all three of the main pro-science activist organizations in New Mexico.²⁰

As Director of Curriculum, Instruction, and Learning Technologies, my neighbor Steven Sanchez set the tone and oversaw the entire process of standards development in New Mexico. On August 13, 2003, he formally submitted the final revision of the science standards¹ to the Board, with a 7-page cover letter, which included a few clarifying statements about evolution:

“Evolution is the accepted scientific explanation for the diversity of life on Earth, and Life Science cannot be taught coherently without a central role for evolution. Modern evolutionary theory has grown far beyond what was proposed by Darwin. To his ‘natural selection,’ science has now added mechanisms such as genetic drift, punctuated equilibrium, and sexual selection. These additions have strengthened evolution, not cast doubt on it.”

“...Intelligent Design is not science, because it has posed no testable hypotheses, nor tested such hypotheses, nor submitted such tests for mainstream scientific peer review, nor gained acceptance in the scientific community.”

“9-12 Strand I and Strand III describe the limitations of scientific knowledge and scientific content as well as its strengths and accomplishments. Students of all backgrounds will thereby appreciate that people have different ways of knowing things, and that the scientific approach is only one of those ways—a way that has been very successful in bringing logic and observation to the discovery of how things work, but a way that is always subject to revision. ... Learning ... about the strengths and limitations of science, students will be better educated, and better prepared to integrate science appropriately into the complexities of their own adult lives as parents, citizens, and workers.”

With Steven’s cover letter in hand, and with dozens of pro-science advocates in attendance, the Instructional Services Committee of the Board of Education voted 4-2 on August 27, 2003, to move the standards forward without revision. The next day, the full Board voted 13-0 to adopt the standards without revision. IDnet-NM’s anti-evolution campaign had failed. (See Fig.2) The Board’s final unanimity is

remarkable to me in light of the views of some Board members. I know that at least two Board members held religious beliefs that are incompatible with Earth being more than 10,000 years old. At a Board dinner party on August 27, a third Board member told me that *every* letter he had received from citizens in his district favored either no evolution in the classroom or a balanced evolution–creationism treatment. Another Board member told me that evening that his wife had begged him to skip the Board meeting entirely, because she truly feared that the stress of the evolution controversy would kill him, through stroke or heart attack. The Board members deserve much appreciation and respect for voting for sound science education in spite of such circumstances.

It is interesting that two Board members voted against adopting the standards on August 27 yet voted affirmatively the next day. I know that Sharon and I were trying to be gently persuasive at the intervening dinner party. Two members of IDnet-NM were at the party, too, chatting with Board members. Maybe we were more persuasive than they were. Or maybe the Board chose unanimity to bury this conflict as deeply as possible.

Another incident of August 27 continues to fascinate me. At the Instructional Services Committee meeting, the motion to pass the standards out of committee without revision was made by a Board member with a strong voice who was sitting not far from the chair. From my perspective at one front corner of the audience, it seemed that another Board member, closest to me, was starting to say something at about the same time. Knowing a little about his background, I wonder if he was about to make a motion to change a few lead-in words in the standards, e.g., from “Describe the evidence for...” to “Describe the evidence for and against...” Did the standards pass out of committee without revision only because one Board member was milliseconds quicker and a few dB loud-



Fig. 2. The Board’s decision to adopt the science standards made front-page headlines in the state capital’s newspaper the next morning. (Reproduced with permission of The New Mexican)

er than another Board member? We'll never know.

Based on Steven's cover letter to the Board, the standards themselves, comments made in public to the Board, conversations that I had with Board members, and things I've heard from other advocates who had conversations with Board members, I believe that this Board understood evolution to be the only current scientific explanation for the history and diversity of life, and that "alternatives" are essentially religious. After months of private and public discussion about evolution and its unscientific alternatives, most of them actually had a reasonable understanding of the unified, testable, yet inherently tentative nature of scientific practice and knowledge. They understood that, unlike some religious faiths, science makes no claim to Absolute Truth. Most of them also understood that science is no less certain about evolution than it is about other broad, unifying scientific theories.

I'm still proud (and a little surprised) that our Board members came to a pretty sophisticated understanding of scientific knowledge and evolution in 2003. It gave me hope that logical persuasion can affect elected officials, when there is enough time to get past sound bites and rhetoric, and when there are enough concerned citizens willing to write and speak patiently and respectfully about the issues.

To illustrate the plasticity of scientific knowledge, I still like to explain how the principle of conservation of energy had to be adapted to include nuclear energy in the 20th century. That profound change in scientific consensus arose as experimental evidence convinced the scientific community that the earlier, separate concepts of mass conservation and energy conservation were sometimes wrong. It did not arise from talking elected officials into changing how physics was taught in high school. And it did not make previous knowledge obsolete; it was an augmentation of previous knowledge.

The aftermath

The Department of Education gave the standards to New Mexico's 89 school districts, and to its Assessment and Accountability Division to help create standardized tests. They remain in force today.

The Fordham Institute judged our new science standards to be 7th best in the U.S., and the only state's standards to go from "F" to "A" in one step.²¹

IDnet-NM began a campaign of distortion of our science standards one week after the Board adopted them, with an op-ed²² in New Mexico's largest newspaper saying in part:

"The only way to preserve the integrity of science is to teach the facts that support the currently dominant paradigm [i.e., evolution] as well as those that challenge it. ... This is an area where it is necessary to present the evidence and the arguments for and against, and let the students decide for themselves what to believe. A great strength of the new standards is that they explicitly recognize these issues, and require their presentation and discussion."

This is worth studying, as a good example of anti-evolution sophistry. Sentence 1: Assert the falsehood that there are facts challenging evolution, as if everyone should know something so obvious. Sentence 2: Rephrase the assertion of

falsehood, and then appeal to the reader's sense of fairness—that students should be free to decide. Sentence 3: Assert another falsehood—that the New Mexico standards require that these non-existent facts be presented.

In late 2003, in a reorganization of state government unrelated to science standards, our State Board of Education was stripped of all statutory authority. Its former powers are now split between the state legislature and the governor-appointed Secretary of Education. The Department of Education was renamed the Public Education Department.

In 2005, a 3-2 vote by the board of one New Mexico school district adopted a policy friendly toward creationism, which was opposed by the district's science teachers, their superintendent, the Public Education Department, and most people who showed up at the school-board meetings. Local media covered the story month after month. When one seat changed hands in the next election, the policy was repealed in another 3-2 vote.²³

Current events

Creationist strategies are evolving.²⁴ One current approach is to try to guarantee teachers the "academic freedom" to "teach the strengths and weaknesses" of evolution, and "let the students decide." The phrase "intelligent design" is unlikely to find its way into curricula today, in the aftermath of the *Kitzmiller v Dover* decision. As a supplementary biology text, *Of Pandas and People* has been supplanted by *Explore Evolution*.²⁵ Avoiding "intelligent design," it uses the phrase "a polyphyletic view of life," giving a new, more scientific-sounding name to the same old claim that the sudden appearance of each kind of animal, without shared ancestry, is a legitimate scientific viewpoint.

Anti-evolution legislation, resembling a Discovery-Institute model,²⁶ has died quickly in the New Mexico legislature the past few years. At the 2007 committee hearing of 2007 HJM 14, the sponsor introduced his legislation with a discussion about immorality in youth, whom he said could hardly be expected to behave themselves if they were taught that they were no different than monkeys. No members of the audience spoke in favor, and about a dozen of us spoke against. The sponsor then graciously withdrew the bill before the committee could vote on it. Two years later, 2009 SB 433 was never even heard in committee, though many of us stayed on alert for weeks, ready to dash to the capitol on short notice, responding to false alarms once or twice. Most recently, with a committee hearing of 2011 HB 302 approaching, IDnet-NM supported the bill with a full-page advertisement in New Mexico's largest-circulation newspaper, which included the statement that evidence "that refuses to line up with the theory" of evolution is censored by "The Scientific Establishment," which is "ruled by what is in effect, a priesthood and the worldview of this priesthood is 'materialism.'" A few days later, I met the sponsor of the bill in his office, intending to show him the *Kitzmiller v Dover* case, how our science standards guide the teaching of evolution and respect the rights of students with contrary beliefs, etc. He seemed to already be comfortable with all of that. He expressed dismay that his bill had been "hijacked by those people" who bought

the full-page ad. I reminded him that he could withdraw his bill or privately ask the chair of the committee to delay it indefinitely. Two days later, he presented his bill to the committee. A half dozen members of the audience spoke in favor of it, and a couple dozen of us spoke or raised our hands against it. The sponsor then said he agreed with those of us who had just spoken *against* his bill. The chair gave him an explicit opportunity to withdraw the bill. He did not withdraw the bill. I do not understand any of this. My expectation that logical persuasion can be effective with elected officials is still intact, but a little weaker now. The committee tabled the bill, by a one-vote margin, and it died on the table a month later.

Years ago, I listened to the news when I had time, voted on election day, and trusted people in positions of authority to do the right thing often enough. Now I monitor government websites to look for trouble, write letters to elected officials, and show up at hearings and express my opinions on the handful of issues I follow closely.

Years ago, I did my thermoacoustics research without concern for the epistemology behind it. Now I also enjoy thinking about the philosophy behind scientific inquiry, impressed by its astounding productivity, within its limited realm of applicability.

When your neighbor asks for a little help, it might change your life. Embrace the opportunity.

Acknowledgement

Thanks to Glenn Branch, Sharon, and Marshall for thoughtful and thought-provoking suggestions about how to tell this story.

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