

reports

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EDITOR

Stephanie Keep
National Center for Science Education
1904 Franklin Street, Suite 600
Oakland CA 94612-2922
phone: (510) 601-7203
e-mail: editor@ncse.com

BOOK REVIEW EDITOR

Glenn Branch

PUBLISHER

Ann Reid

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Dear NCSE members,



Buster and I, ready to march!
Photo: Robert Luhn

On April 22, 2017, over [one million people](#) (and [five penguins](#)) marched for science. And NCSE was there. As one of the earliest official partners of the event, NCSE's logo was prominently displayed next to the big stage in Washington DC. You can see pictures of NCSE marchers in Washington, San Francisco, and Boston on pages 3 and 16.

Why did we march? In my last letter, I described the intense excitement I experienced as a scientist deciphering the genetic sequence of the 1918 influenza virus for the first time. That was the kind of private, thrilling moment that scientists live for. But science isn't a private activity; its discoveries have meaning in the world. Certainly, understanding where the 1918 flu came from, and why it was so deadly, had immense public health significance. If we as a society lose confidence in the scientific enterprise, if we start to see it as just one more partisan activity where spin is more important than substance, we lose an immensely important shared tool. I think that's why so many people showed up to march for science in so many places around the world—to shout to the rooftops that we need science to make sure we have the best evidence possible to plan for our mutual future.

The tone of the march, I'm happy to report, was overwhelmingly positive. Of course, as you would expect, and indeed value, there were a diversity of views represented among a million people in dozens of countries. But there was strikingly little name-calling or partisanship. That's good news for NCSE, because the last thing we need to achieve our mission is further polarization over science.

Our core mission is to make sure that science teachers—you know, the people who will make sure that the next generation understands what science is and how it works—have the support they need to teach evolution and climate change confidently, even when they fear that many in their communities might disagree. Science teachers work in red states and blue states, in conservative communities and liberal ones. We want all of those teachers to know that NCSE supports them. We have to be extra careful about any suggestion that entire categories of people are “anti-science.” From the success of our Science Booster Clubs in communities throughout Iowa, we know that such a simplistic characterization is just not true.

What NCSE does is unique. And we can't do it without you. Thank you so much for your continued support.

Marching on,

Ann Reid is the executive director of NCSE. reid@ncse.com



NCSE MARCHED FOR SCIENCE

On Earth Day (April 22) 2017, NCSE members and staff participated in the March for Science. It was a truly remarkable event; it is not every day that tens of thousands of science enthusiasts take to the streets.

Ann Reid, Claire Adrian-Tucci, and the UCSF Science Policy Group participated in the

national march in Washington DC, NCSE staff members Rae Holzman and Nina Hollenberg and former executive director Eugenie C. Scott marched in San Francisco, while Stephanie Keep represented NCSE in Boston.

Below are some of our favorite pictures. May every day be so full of love for science.



Images from the various science marches attended by NCSE staffers (clockwise from top left): A) clever signs in Boston; B) Ann Reid taking shelter in Washington DC; C) a future astronaut in Boston; D) Reid and Claire Adrian-Tucci, brain caps visible, in Washington DC; E) Reid (left) and Adrian-Tucci (front right) with members of the University of California, San Francisco, Science Policy Group in Washington DC; F) NCSE sign held aloft in San Francisco; G) Eugenie C. Scott representing in San Francisco.

If They Have Not Learned, You Have



by Jon Perry

A frame from one of my videos.

Seven months after the 1859 publication of Darwin's *On the Origin of Species*, a heated debate broke out during a science conference at Oxford University's Natural History Museum. It included all the guilty pleasures we've come to know and love about evolution debates: name-calling, Bible-thumping, and personal attacks. The debate was so intense that at one point, a lady in the audience is said to have fainted in shock. The event turned Thomas Henry Huxley into a celebrity of sorts. He later came to be known as "Darwin's Bulldog" for his defense of evolutionary theory.

Over the years, Huxley's bulldog tactics did seem to work as tools for persuading a crowd, but they often had the opposite effect on the people he directly debated. Many responded by doubling down on their rejection of his arguments, a psychological phenomenon now often referred to

as the backfire effect (a delightful explanation of the backfire effect can be found in *The Oatmeal*, an on-line cartoon: <http://theoatmeal.com/comics/believe>).

While the scientific community has long since accepted evolution, the 1860 debate seems, sadly, to have set the tone for discussions outside the community ever since. I have come to experience this firsthand through my work teaching genetics and evolution on-line through a YouTube animation series called "Stated Clearly." The animations have pulled me into countless on-line debates, and more interestingly, intense one-on-one discussions with friends and extended family who have been opposed to the science.

In these conversations, I've found that if I want to actually change the mind of my debate partner, bulldog tactics are not helpful. With friends and family they can even ruin important relationships. In their stead, I offer five guidelines, which when applied carefully, will help turn nasty arguments into genuine teaching opportunities. While the approach is intended for individual discussions on-line and in person, classroom teachers may find aspects of it useful in their work as well.

PLACE & TIME

Boneyard Creation Museum

In 2012, after two years of construction and gathering exhibits, Steve Sommer opened the Boneyard Creation Museum in Broken Bow, Nebraska. The non-profit educational museum uses "scientific evidence for creation" to document "the accuracy of the Bible" while proclaiming, "[E]arth is thousands of years old, not billions." Som-

mer, a former high school science teacher, has been a self-described "creation fanatic" for more than thirty years. In addition to frequent speaking engagements at churches, Bible camps, and public schools, he offers classes and tours for individuals and groups at his museum.

The Boneyard Creation Museum includes models of several life-sized dinosaurs, a pit where children can dig up fake fossils, and a "Biblical Timeline" exhibit claiming creation occurred in 4004 B.C. and that there was a worldwide flood in 2348 B.C. There are also a variety of exhibits claiming that evolution is insufficient to explain many events and phenomena, including the Cambrian Explosion, the importance of mutations, "living fossils," transitional

fossils, whale evolution, spontaneous generation, DNA, radiometric dating, homologous structures, and the appearance of humans on Earth (because humans did not evolve). Other exhibits describe evolutionary "frauds and controversies" such as Piltdown Man and Haeckel's embryo drawings.

The exhibits include many standard creationist claims, including the notions that radiometric dating can't be trusted because radioactive atoms' half-lives decreased during Noah's flood owing to increased temperatures and pressures, and that the speed of light is decreasing over time: at creation, the speed of light was $5 \cdot 10^{11}$ times faster than it is now; this means that creation occurred in 4040 ± 100



The Boneyard Creation Museum in Broken Bow, Nebraska, includes a variety of exhibits condemning evolution.

1. Assume the role of an educator

The title of this article “If they have not learned, you have not taught” is a modified quote from basketball coach and high school educator John Wooden. I first heard it five years ago, right as I began Stated Clearly, and I try to take it to heart by assuming the role of an educator (modeled after the wonderful teachers I have had in the past). In doing this, I accept the responsibility to meet my students at their current level of understanding, and gently help increase it. What I teach must be accurate, backed by solid research, and



An example of how I handle insults in online comments

never exaggerated to help “win” a debate. If I find that my partners are not learning, I cannot blame them. Instead, I must keep my cool, change my approach, and try again. If they have not learned, I have not taught.

2. Ignore insults

Many see the science of evolution as a direct assault on their faith. Add that to the fact that evolution debates have historically been peppered with colorful insults, and it’s pretty much guaranteed that your partner is expecting a brutal boxing match. Don’t be surprised if round one starts with a series of low blows ... especially if the conversation is on-line.

When insulted, ignore it. In a classroom setting, you may not have this luxury, but on-line or with a friend, just let it slide. Don’t respond with a wittier insult (however tempting); don’t expect an apology; don’t even bother asking for a change in behavior. Instead, look past the insult to find the actual question or confusion, then respond to that question or address that confusion directly. Not only will this help your students learn, but also, in almost every case (yes, even with a stranger on the Internet) your conversation partner will

B.C. Also included are attacks on scientists and the scientific endeavor; it is claimed that scientists suppress evidence that does not support evolution.

Other claims are more novel, including these:

- pterosaurs lived with humans and “are even alive today”;
- dinosaurs such as *Pachycephalosaurus* lived with humans, but died out after Noah’s flood;
- dinosaurs such as *Apatosaurus* are alive in central Africa;
- humans have no ancestral species: *Homo erectus* and *H. ergaster* were modern humans, while *H. habilis*, *Australopithecus afarensis* (“Lucy”), and *Ardipithecus ramidus* were apes;
- “Evolutionists say that whales evolved

from some land animal. Creationists say that this is ridiculous” because “whales are whales”; and

- “All fly genetics of all time for all flies were in the two flies that came off of the ark.”

Sommer’s 335 m² (3,600 ft²) museum is complemented by an impressive on-site rock and fossil shop, which opened a year after the Boneyard Creation Museum. According to Sommer, the museum is self-supporting, and he uses profits from selling rocks and fossils to add exhibits in the museum (the most recent exhibit is a walk-through model of a human cell). Sommer also sells the usual selection of books promoting creationism (including human giants) and denouncing evolution. Free materials available at the museum include anti-evolution

DVDs and brochures entitled “Question Evolution: 15 Questions for Evolutionists” and “Evolution or Biblical Creation: Does It Matter?”

Boneyard Creation Museum (<http://boneyardcreationmuseum.org>; phone 308-880-0407) is at 1709 South E Street in Broken Bow, Nebraska.

Randy Moore is author of *A Field Guide to the Scopes Trial* (Rhea County Historical and Genealogical Society, 2016) and co-author (with William McComas) of *Images of America: The Scopes Monkey Trial* (Arcadia Press, 2016). He is the H. T. Morse–Alumni Professor of Biology at the University of Minnesota, Twin Cities. RMoore@umn.edu



ERRATUM The headline for Place & Time in the printed version of RNCSE 2017;37(2):5 was incorrect: it should have read “Discovery Center and Creation Emporium.” We apologize for the error.



Monitor lizard immunity to cane toad toxin is evidence for evolution.

immediately calm down and mirror your respectful demeanor.

To speed things along, another tip is to avoid open public conversations when possible. In these settings, most people will defend their initial position (and therefore reputation) to the bitter end. Whenever I've moved a heated discussion to a private venue—e-mail, messenger, or best of all, a face-to-face conversation—I've found that people are far more willing to accept new ideas and ask meaningful questions.

3. Ask and listen

The drawing I did for the cover of this issue of *RNCSE* is more than a homage to M. C. Escher; it represents two doomed debate partners, attempting “battle” but marooned hopelessly on separate foundations. If you want to connect with your partners, you must first discover where they stand. To do this, you must ask questions and then listen to the answers. For example, does your partner reject evolution for theological reasons? If so, what specifically is the problem? Does your partner reject evolution simply because of a misunderstanding of the science? What does he or she in fact know—or believe—about evolution? Figuring these things out is crucial preparation for a fruitful conversation. Otherwise, you might as well be shouting into the wind.

4. Cite sources that your student is likely to trust

Let's suppose that after asking questions and listening to your partner's answers, you find that she rejects evolution because she worries that all biologists are just trying to “convert” the world to atheism. In this case, I don't recommend sending her home with the complete works of Richard Dawkins, brilliant as his writings are. Don't hide them from her, of course, but let her know there are countless sources of religiously neutral materials for her to consume—almost all scientific journals, articles produced by NCSE, and the works of my favorite *evo*-author, Carl Zimmer, to name a few.

It can be especially effective to cite evolution-friendly materials produced by people that share your partner's religious beliefs. For example, *Biologos.org* produces wonderful articles written by evangelical Christians that, as far as I have seen, do not compromise the science. Biologist (and NCSE board member) Ken Miller is another good source of religion-friendly material. He does not shy away from affirming his Catholicism in his popular science writing and presentations. I recently discovered a wonderful book called *God's Word or Human Reason?* (Inkwater Press, 2016). Its authors (Jonathan Kane, Emily Willoughby, and Michael Keeseey) were all once card-carrying young-earth

creationists. Though I'm not a huge fan of the book's title, it has the most careful and respectful dismantling of the arguments put forth by the YEC movement that I am aware of.

Even given non-antagonistic sources, many people will have trouble trusting the words of authors, and even scientists. However, most people can't help but trust their own two eyes! Evolution is a visual science. Show your partner fossils, embryos, gene sequences, and comparative anatomy. If you need help with that, the Stated Clearly animation “What is the evidence for evolution?” presents a mountain of visual evidence in a short friendly presentation. Although people can be trained to ignore what they see, it isn't easy, and the more they see, the harder it is to deny.

5. Set small goals

This last guideline is really more to help you than to help your discussion partner. It will keep you sane! If your goal as a science communicator is to convince each student that evolution really happened and is happening in the way described by modern biology, your life is going to be miserable. Savor the little victories!

To give you a sense about achievable but still worthwhile goals, here are a few I set and achieved:

- I called into a creationist radio show and managed, before being muted and yelled at, to explain that bird wings are modified arms and that listeners can see for themselves if they ever eat chicken. Result: After several calls with similar small goals, I was invited to post my articles and animations on the show's web forum where I now get feedback from its fans.
- I showed my cousin a study on how simple point mutations gave monitor lizards immunity to the toxic excretions of cane toads, opening up a brand-new food source for the lizards. Result: She continued studying how new traits evolve and now accepts a form of theistic evolution.
- I invited an angry twitter follower to read a paper on *in vitro* RNA evolution. Result: it helped him understand that Darwinian evolution may have been occurring before the origin of the genetic code (his big hold-up) and has since led to several pleasant offline conversations.

In a world filled with bulldogs, be an educator! This approach has helped me make a diverse group of new friends, and keep things pleasant with family, all while standing up for the science I care so much about. Remember: If they have not learned, you have not taught.

Jon Perry is an artist and science communicator running statedclearly.com and its associated YouTube channel. He also does classroom and public presentations on the evolution of flight and the chemical origins of life. You can support his work at <https://www.patreon.com/statedclearly>. [jon@statedclearly.com](https://twitter.com/statedclearly); Twitter: @statedclearly





NCSE is delighted to congratulate **Richard Alley** on receiving the Climate Communications Prize and **Naomi Oreskes** on receiving the Ambassador Award from the American Geophysical Union (AGU). The Climate Communications Prize “highlights the importance of promoting scientific literacy, clarity of message, and efforts to foster respect and understanding of science-based values as they relate to the implications of climate change,” while the Ambassador Award honors “outstanding contributions to the following area(s): societal impact, service to the Earth and space community, scientific leadership, and promotion of talent/career pool,” according to the AGU. Alley is the Evan Pugh Professor of Geosciences at Pennsylvania State University and the author of *The Two-Mile Time Machine* (2000) and *Earth:*

The Operator’s Manual (2011). A professor of the history of science at Harvard University, Oreskes is the author, with Erik M. Conway, of *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco to Global Warming* (2010). Both Alley and Oreskes are previous recipients of NCSE’s Friend of the Planet Award, Alley in 2014 and Oreskes in 2015.



Carl Zimmer

NCSE congratulates **Carl Zimmer** for winning the 2016 Stephen Jay Gould Prize from the Society for the Study of Evolution (SSE). A 2012 recipient of NCSE’s Friend of Darwin award, Zimmer is a prolific science journalist whose writing on evolution includes *Evolution: The Triumph of an*

Idea (2001), the textbook *The Tangled Bank* (second edition, 2013), and the textbook *Evolution: Making Sense of Life* (second edition, 2015), coauthored with Douglas J. Emlen. The Stephen Jay Gould Prize is awarded annually by the SSE “to recognize individuals whose sustained and exemplary efforts have advanced public understanding of evolutionary science and its importance in biology, education, and everyday life in the spirit of Stephen Jay Gould.” NCSE’s founding executive director **Eugenie C. Scott** was the recipient of the first Gould Prize, in 2009, followed by **Sean B. Carroll** in 2010, **Kenneth R. Miller** in 2011, David Quammen in 2012, **Judy Scotchmoor** in 2013, Steve Jones in 2014, and **Francisco J. Ayala** in 2015. Both Miller and Ayala are members of NCSE’s board of directors.

—GLENN BRANCH

WHAT WE’RE UP AGAINST Not Warming, Not Round

When Avi Wolfman-Arent, a reporter for WHYY’s Newsworks, set out to research a story about the ways local science teachers navigate socially controversial topics, he was expecting to hear a lot about climate change. He wasn’t disappointed, because the Heartland Institute’s campaign of [mailing unsolicited climate change denial materials](#) to science teachers included Philadelphia. “The Heartland Institute’s guerrilla lobbying effort,” he wrote in his [April 12, 2017, article](#), “illustrates the predicament today’s science



The flat earth as of 1893.

Map courtesy of the Library of Congress, <https://www.loc.gov/item/2011594831>

teachers face” in sorting, and helping their students to sort, through conflicting claims about science. But chillingly, he discovered that it isn’t only misinformation about climate change such as purveyed by climate change deniers that can make its way into the classroom—a student teacher reported, “a jarring episode where a number of students told him the Earth was flat.” Climate change deniers, creationists, and flat-earthers: never a dull moment at NCSE.

—GLENN BRANCH

UPDATES

ncse.com/updates

Do you want to let us know about threats to effective science education near you? Or do you have any cause for celebration to share? E-mail any member of staff or info@ncse.com.

ALABAMA

Alabama's House Joint Resolution 78, which ostensibly urges state and local education authorities to promote the "academic freedom" of science teachers in the state's public schools, was passed by both houses of the state legislature in April and May 2017. "Biological evolution, the chemical origins of life, global warming, and human cloning" are specifically identified in the resolution as controversial, although the lead sponsor, Mack Butler (R-District 30), seems to object primarily to evolution. As a non-binding resolution, HJR 78 has no legal force.

ARKANSAS

Arkansas's House Bill 2050 died in committee in May 2017. The bill would have, if enacted, allowed Arkansas "public schools to teach creationism and intelligent design as theories alongside the theory of evolution." The federal courts have repeatedly held that teaching creationism in the public schools, whether under the guise of "creation science" or "intelligent design," is unconstitutional. The bill's sponsor, Mary Bentley (R-District 73), submitted only the heading, but never the full text, of the bill.

FLORIDA

Florida's House Bill 989 was passed by both houses of the state legislature in April and May 2017. The bill, which as this issue goes to print is awaiting the governor's signature, is aimed at empowering taxpayers to object to the use of specific instructional materials in the public schools. Climate change and evolution are clearly among the targets: affidavits filed in support of the bills complained, "I have witnessed students being taught evolution as fact ... rather than theory ... I have witnessed children being taught that Global Warming is a reality."

ILLINOIS, MORTON

In December 2016, a sixth-grade earth and space science textbook was adopted by the Morton School Board despite a solitary vote objecting to its acceptance of the scientifically ascertained age of Earth. "I don't have an issue with the Old Earth theory being taught," Jeff Schmidgall told the *Peoria Journal-Star*. "I just think there needs to be critiques along with it." A colleague on the board found his vote troubling, noting, "we're a public school district."

INDIANA

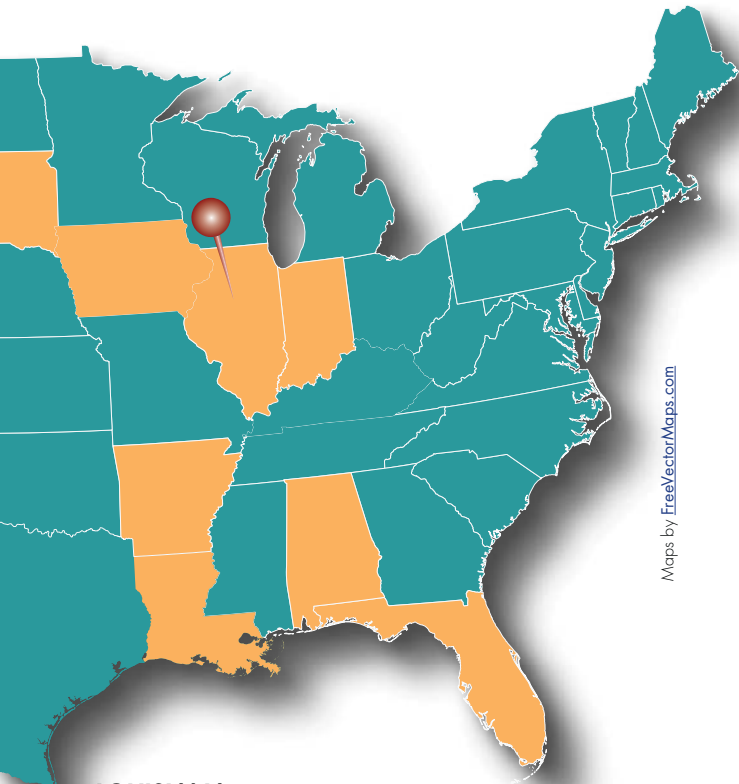
In February 2017, Indiana's Senate Resolution 17 was passed on a 7-3 vote by the Senate Committee on Education and Career Development and then passed in the Senate by a wide margin (40-9). The non-binding resolution ostensibly urges the state department of education "to reinforce support of teachers who choose to teach a diverse curriculum," but its initial sponsors, Jeff Raatz (R-District 27) and Dennis Kruse (R-District 14), have a history of sponsoring antievolution legislation.

IOWA

House File 140 died in committee in March 2017. If enacted, the bill would have prohibited the state board of education from "adopting, approving, or requiring implementation of the [N]ext [G]eneration [S]cience [S]tandards by school districts and accredited nonpublic schools." The bill's lead sponsor, Sandy Salmon (R-District 63), is on record as opposing the NGSS, which were adopted in Iowa in 2015, in part because of their treatment of evolution and climate change.

IOWA

House File 480 died in committee in March 2017 shortly after it was introduced. If enacted, the bill would have required teachers in Iowa's public schools to include "opposing points of view or beliefs" to accompany any instruction relating to evolution, the origins of life, global warming, or human cloning. There was no requirement that those "points of view or beliefs" have any scientific credibility—only that they are opposed to whatever material is presented in the classroom.



LOUISIANA

Louisiana's state board of elementary and secondary education voted to adopt a new set of state science standards in March 2017—but not without a nod in the general direction of creationism. After critics complained that no alternatives to evolution were included in the standards, a committee of the board voted 7–2 to add a reference to the creationism-friendly Louisiana Science Education Act in a related document. The unrevised standards themselves were unanimously approved by the whole board.

SOUTH DAKOTA

South Dakota's Senate Bill 55, which would have empowered science denial in the classroom, was defeated in the House Education Committee in February 2017. A motion to pass the bill was defeated on a 6–9 vote, while a subsequent motion to defer further consideration of the bill to the forty-first legislative day—effectively killing it—passed on an 11–4 vote. SB 55 previously passed the Senate in January 2017 despite opposition from the state's educational and scientific communities.

NATIONAL

Senate Resolution 59, introduced in the United States Senate in February, would, if eventually passed, express the Senate's support of designating (retroactively) February 12, 2017, as Darwin Day, and its recognition of "Charles Darwin as a worthy symbol on which to celebrate the achievements of reason, science, and the advancement of human knowledge." Sponsored by Senator Richard Blumenthal (D-Connecticut), S. Res. 59 is the third Darwin Day resolution ever to appear in the Senate. The bill is in committee.



Artwork by Ray Troll © 2017 www.trollart.com

I Read Heartland's Propaganda So You Don't Have To by Brandie Freeman



A few months ago, a small package arrived, unsolicited, in my school mailbox. As soon as I saw that it was from the Heartland Institute, I knew its contents would be misleading and deceptive. I wasn't wrong. Inside the envelope was a letter, a DVD, a comment card, and a glossy 110-page booklet called *Why Scientists Disagree About Global Warming*. I read every word of the booklet and then stayed

up all night—while on vacation no less—to research and craft a chapter-by-chapter rebuttal, which I [published on my blog](#) on April 5, 2017. Here is a brief synopsis.

Introduction

The introduction offers some arguments that fly in the face of accepted evidence for anthropogenic (human-caused) global warming (AGW), which might seem compelling until you turn to the end of the section and notice that *half* the citations are from the Heartland Institute itself. This self-citation, as it turned out, was a foreshadowing of the echo chamber that was the rest of the book.

Chapter 1: No Consensus

Let's start with this nugget: "Many prominent experts and *probably* [my emphasis] most working scientists disagree with the claims made by the United Nations' Intergovernmental Panel on Climate Change (IPCC)" (p. 7). Between 2013 and 2014, only 4 of 69,406 authors of peer-reviewed articles on global warming, 0.0058% or 1 in 17,352, rejected AGW according to a [2016 study](#) by James Lawrence Powell in the *Bulletin of Science, Technology & Society*. Thus, the consensus among publishing scientists that humans are causing climate change is above 99.99%, verging on unanimity. So, unless "most" means 0.01%, Heartland's claim is patently false.

Chapter 2: Why Scientists Disagree

This chapter attempts to defame not only climate science but also well-established scientific practices, such as peer review. Yes, you read that right. To introduce the second chapter, the authors claim that the disagreements "among those participating in the climate change debate may be sharper ... than other topics" because it is interdisciplinary

and involves insights from various fields such as geology, oceanography, physics, statistics, economics, etc. (pp. 31–32). Doesn't medicine involve biology, physics, chemistry, economics, and psychology? Perhaps we should start ignoring the work of medical researchers as well?

But it doesn't end there. Chapter 2 attempts to discredit not only climate research but also scientific research *in general*. It does so by misusing a famous article by John Ioannidis with the sensationalist title "[Why most published research findings are false](#)," claiming, "Ioannidis's work generated widespread awareness that peer review is no guarantee of the accuracy or value of a research paper" (p. 48). In the first place, Ioannidis was looking at medical research in particular. Moreover, it is hardly as though the scientific consensus on climate change stands or falls with a single research paper. If that wasn't enough, the concluding remark of the chapter will make any science teacher's skin crawl: "While it would be ideal if scientists could be relied on to deliver unvarnished truth about complex scientific matters to governments and voters, the truth is they almost always fall short" (p. 52).

Chapter 3: Scientific Method vs. Political Science

This chapter begins by saying the official IPCC reports are invalid because their "implicit" hypotheses about AGW fail to consider a null hypothesis (p. 56). But why would they? The IPCC reports do not contain any hypotheses at all (and they shouldn't) because the IPCC is not performing any experiments! That's why Heartland had to use the word "implicit" to describe them. The IPCC's purpose, as the Union of Concerned Scientists [explains](#), is to have "climate experts from around the world synthesize the most recent climate science findings every five to seven years ... It does not carry out new research or monitor climate-related data."

The authors attempt to discredit climate scientists by claiming that they are victims of confirmation bias (the tendency to use new information to confirm what is already believed). They offer, "the only way to avoid confirmation bias is [the] independent review of a scientist's work by other scientists ... This sort of review is conspicuously absent in the climate change debate" (pp. 58–59). So they are calling for peer review of climate science—which, of course, already exists, but which they have already rejected as ineffective.

Chapter 4: Flawed Projections

Teachers, have you ever had students turn in a research paper that failed to cite any sources other than themselves? Then you'll be at home with chapter 4. Here the authors compile a laundry list of assertions concerning global climate models, temperature forcings and feedbacks, and climate sensitivity, citing only Heartland's own literature. And they conveniently omit any temperature data from the last twenty years.

Chapter 5: False Postulates

The purposeful selection of outdated information continues in chapter 5. A cursory glance at the references (pp. 84–86) reveals that the peer-reviewed articles they employed are, on average, over fifteen years old. Similarly, if you look carefully

at figure 10 (p. 76), you'll find that data from the last thirty-five years or so are missing.

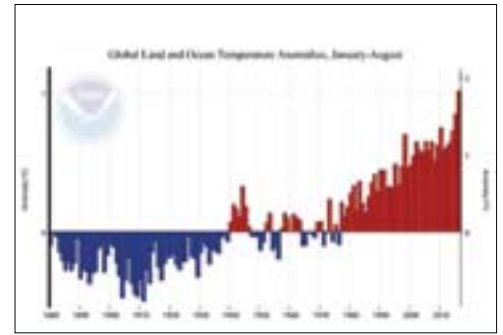
For comparison, I've included here an [updated graph](#) from NOAA, which

helps to explain why Heartland's data set omits the consistent warming over the last four decades.

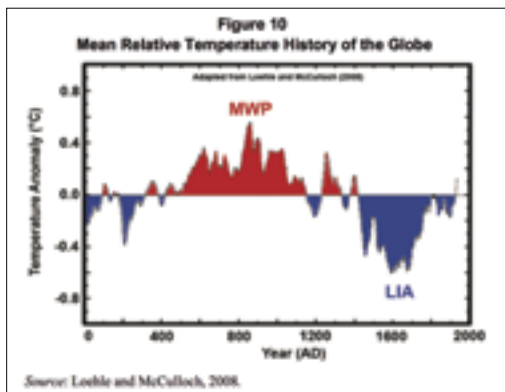
I wrote my response to expose the fallacies contained in the Heartland mailing

in the hope that fellow teachers wouldn't get caught up in the deception. I had no idea that it would lead to interviews with [German news outlets](#), the [Huffington Post](#), or [Inside-Climate News](#), nor was I prepared for being trashed both as a teacher and as a person by internet trolls on [climate change denial websites](#). It's been quite an experience.

Fellow teachers, thank you for educating the youth of America in a time when ignorance and intolerance are as abundant as atmospheric carbon. Even though this book may make you so angry that you want to burn it, please don't. Combustion creates carbon dioxide, which actually does cause climate change.



NOAA graph with data up to 2016. What a difference a few decades make!



Graph included in Heartland's material. It ends at around 1980.

Brandie Freeman teaches AP chemistry and AP environmental science in Cartersville, Georgia.



*Dear NCSE,
With the Trump administration riddled with creationists and climate change deniers, are you seeing, or do you expect to see, a spate of attacks on the integrity of science education as a consequence?*

*Signed,
Every Journalist Since January*

Dear EJSJ,

Well, curriculum and instruction in the nation's public schools is controlled mainly by state governments and local school districts. Even so, conceivably the presence of creation-

ists and climate change deniers in the federal administration inspires efforts to undermine the integrity of science. But so far there isn't strong evidence of it.

At the state level, NCSE expects to monitor between half a dozen and a dozen antiscience legislative measures per year. There were eleven in 2017, making the year busy but not unprecedentedly busy. With the exception of Texas's House Bill 1485, introduced by a first-year legislator, all of the measures were introduced by legislators who introduced similar legislation in previous years, so there's no evidence that the shift in the national political landscape played any role here.

What about the success of these measures? Three passed—Indiana's Senate Resolution 17 and Alabama's

House Joint Resolution 78, which have no legal force, and Florida's House Bill 989, which helps creationists and climate change deniers challenge the use of instructional materials. And two proceeded farther than ever before: Oklahoma's Senate Bill 393 and South Dakota's Senate Bill 55 both passed the upper house of their legislatures. Yet these are awfully small sample sizes.

With no centralized source of information about controversies over science education in the more than 15,000 local school districts across the country, it's hard to know for sure whether there is any effect at the local level, but there's no visible uptick. Still, constant vigilance is a good idea!

Have a question?
Write to us at askncse@ncse.com.

—GLENN BRANCH



news from the science booster clubs

Coast-to-Coast Update

At the beginning of 2017, NCSE launched a national expansion of our Science Booster Club (SBC) program. Many of the new clubs have already started holding events, and more are scheduled through the spring and summer. We estimate that already around 3,000 people have participated in SBC events held by volunteer-led clubs in California, West Virginia, Ohio, Texas, Nebraska, and Indiana. Meanwhile, the SBC program continues to thrive in Iowa, where clubs have already worked with nearly 20,000 people in 2017, while our clubs in Kentucky, Virginia, and Oklahoma have events in the works. Here are some highlights:

Indiana

Since late May 2017, Tara Schremser has used her community connections to provide weekly programming at farmers' markets. She's been practicing and developing her presentation skills by using SBC materials to teach kids about climate change at her local middle school. Schremser, the mother of three young children, has business experience and is passionate about science education, but has never done this kind of outreach before. We are grateful for her support! She is a great example of how one person who cares about a cause can get the ball rolling in their community.

work with through our contact person, Eric Engle, is composed mostly of retirees. Their goal? To make their region, which is suffering in the throes of the opiate epidemic, a place where their grandchildren will thrive. We are so lucky to work with this committed, deeply involved group of community activists.

Nebraska and Kentucky

Farmers' markets are a popular venue for upcoming events at the SBC expansion sites. Our volunteer teams led by Anna Selmecki of Creighton University in Nebraska and Ribhu Kaul of the University of Kentucky target both day and night market events with their graduate students. Since young families tend to come to the markets during the day while single adults attend at night, these teams will gather information on how to best tailor content to these different audiences—and how to best recruit volunteers.

California

In California, Carlina Pothast has taught over five hundred people about climate change from her home base at San Jose State University. Pothast, an undergraduate, is a non-traditional student. She owned her own business for years, and recently made the decision to go to college. She is interested in science communication, and wants to learn how to teach people about climate change. In her first few months volunteering with NCSE, she has definitely shown herself up to the task!

Virginia

Rob Marken Jr. is leading our efforts in Virginia, where he has just worked out an arrangement to provide regular, advertised programming through his local library system. Public libraries have been great partners in Iowa, and we're glad to see more SBCs connecting with the library community.

Iowa

Clearly, our volunteer leaders are doing amazing work getting expansion clubs off the ground in their communities. Meanwhile, our SBC sites supported by NCSE staff are going like gangbusters. Brian Pinney, of Des Moines,



Ohio and West Virginia

Throughout the Ohio River Valley, the Ohio River Valley Climate Action Group has been presenting SBC materials at middle schools, high schools, and city councils, reaching many hundreds of people at seven separate events. This passionate group of volunteers, which we

DC SBC volunteer Tom Lake helps a student at John Burroughs Elementary School to conduct an ocean acidification experiment on STEM night in May 2017.

Photo: Claire Adrian-Tucci



Iowa, joined the NCSE staff in January 2017 to support our Iowa expansion project. In this short time, he's already arranged to work with over ten thousand people in central Iowa! He's adding more events all the time, from the Des Moines Climate March on April 29, 2017, to county fairs across the region throughout June and July 2017.

Our volunteers in Iowa City continue to provide programming across eastern Iowa. They've participated in at least one major event every month this year. In the month of April 2017 alone, they had ten community outreach events on the schedule, with audiences large and small, at public schools, libraries, and major festivals. Since the beginning of the year, they have worked with almost twenty thousand Iowans. Their hard work has recently attracted the attention of Iowa's Department of Natural Resources. Our club, after two years of service in eastern Iowa, has been invited to apply for state-level funding for our outreach on climate change.



Washington DC

NCSE's Claire Adrian-Tucci is building a strong, diverse SBC in the Capital Area. She has events on the calendar serving underprivileged students in the metropolitan area, and is participating in an upcoming event on the White House lawn. Her events on the calendar for early 2017 are approaching five-figure audiences, and will give us important new perspectives on work in urban areas. We have feet on the ground in all sorts of places, but only Adrian-Tucci is working in a dense urban area. We value

her experience and insights as she charts the benefits and challenges of this new territory!

Upcoming Plans

Looking back on the first season of the SBC program's national expansion, I'm immensely proud of our many leaders and many volunteers' determination, growth, and success. Working together, we will reach so many of our fellow Americans in 2017. As our networks expand, and as the weather gets nicer, we'll be outside working with even more people in late spring and early summer events.

We're also planning to send new materials to our expansion leaders. Our first kit focused on climate change. Our next kit, developed in response to the creationist exhibit at the 2016 Iowa State fair, helps to counter common misconceptions by teaching genetics in the context of evolutionary theory. If that sounds complicated, don't worry. The "Genetics and Evolution" kit has been extensively field-tested here in Iowa, and is popular and accessible to general audiences. How could it not be, when people get to learn about selection and drift through preying on innocent candy populations?

I'll update you again in our next issue! If you want to get in touch with me about the SBC program, email me at schoerning@ncse.com. And if you want to support us, ten bucks from you equals a hundred people on the ground for us. Donations can be made directly at <https://ncse.secure.force.com/booster>

Emily Schoerning is NCSE's Director of Community Organizing and Research. schoerning@ncse.com

STAFF NEWS



We are thrilled to report that **Emily Schoerning**, NCSE's Director of Community Organizing and Research,

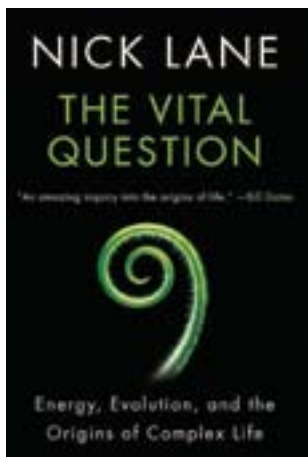
has been elected to a three-year term as the National Science Teachers Association's Research Division Director, beginning in June 2017. In addition to her considerable skills in organizing and inspiring volunteers to start Science Booster Clubs, first in Iowa and now across the country, Schoerning's election

reflects the respect with which she is held in the education research community. Indeed, the Science Booster Club program includes a rigorous research component, examining the impact of the clubs on community science literacy and acceptance.



Meanwhile, **Claire Adrian-Tucci**, who has been coordinating the NCSEteach network and Scientist in the Classroom program since September 2016, has

now taken up new duties as Manager of National Science Booster Club Operations and Regional Club Organizer. Adrian-Tucci will be working closely with the volunteer leaders of twelve new science booster clubs in eight states, helping them find venues for science club activities, sending them kits and instructions for new activities, and introducing them to the NCSE Science Booster Club's "no-conflict" approach to science outreach. She will also be organizing a club herself in the nation's capital.



THE RNCSE REVIEW

The Vital Question: Energy, Evolution, and the Origins of Complex Life

author: **Nick Lane**
publisher: **W. W. Norton, 2015**
reviewed by: **Matthew R. Kaser**

There is a revolution going on in the study of the origins of life. The simplest form of life is a cell—a collection of organic and inorganic molecules bound by a membrane. For a number of decades, it was thought that organic molecules emerged in methane-ammonia-water atmospheres with lightning or volcanic energy sources, or in shallow pools filled with muds that provided a template for amino acids, lipids, and nucleic acids, or in deep ocean rifts where iron sulfides from magma-derived hydrothermal vents induced the formation of many familiar organic compounds, or more recently, in hot-spring pools. So there are a number of plausible explanations of the origins of simple organic molecules and of macromolecules, but just how did the spark of life come about enabling evolution by natural selection to proceed? It is in answering these questions that some scientists are formulating revolutionary theories.

Nick Lane's recent book *The Vital Question* is a spirited and readable explanation of how life—"a living system"—may have arisen. Many origin-of-life researchers have focused on how self-replicating molecules, such as RNA, emerged, on the assumption that the ability to self-replicate is essential to life. Rather

than take such a replication-first approach, however, Lane takes a metabolism-first approach, focusing on how macromolecules came to transfer energy. Lane argues, "energy is central to evolution ... the origin of life was driven by energy flux" (p. 13). And in this view, proton pumps take center stage.

Lane's arguments are both nifty and plausible.

Proton pumps are proteins embedded within a biological membrane that transfer protons from one side of the membrane to the other. They are found in the membranes of energy-converting structures within the cell: mitochondria (found in all eukaryotes) and chloroplasts (found in plants and algae). There they serve as part of the protein machinery that generates energy in the cell. The work of proton pumps result in a hydrogen ion gradient (an increase in pH on one side of the membrane) that then drives a membrane-spanning enzyme, ATPase. As the protons surge back through the ATPase, they generate new molecules of adenosine

triphosphate (ATP), the universal currency of energy in biochemistry. If the pumps stop pumping, energy production stops, metabolism grinds to a halt—and the cell dies.

Lane observes that proton pumps both pump protons across the membrane and transport electrons among their own iron- and sulfur-rich components. Electron transport is a fundamental process in all energy transfer in living organisms, so Lane posits that these reactions were probably the first to develop. But how did they originate? Lane suggests that iron-sulfur clusters were initially located at the mineral interface of porous walls within the structure of alkaline (basic) deep-sea hydrothermal vents. On the other side of the wall there would be more acidic seawater, hence a significant pH difference (potential proton gradient). Here, he hypothesizes, there could be organic molecules, say, nucleic acids, which would then undergo chemical reactions with the iron-sulfur, thereby initiating the proton pump across the porous wall. Experiments performed in his lab confirm the possibility.

Lane's arguments are both nifty and plausible. He succinctly guides the reader through a series of simple chemical steps that could have resulted in the modern energy flow pathway. He further describes how cells developed, from simple systems on either side of a thin semiconducting inorganic barrier, through intermediate microbial forms, to the eukaryotes and their complex organelles. (This section may also be of interest to students of inorganic chemistry who wish to understand

how to approach the upcoming bio-nano-semiconductor world that we are now entering.) A subsequent chapter argues, "All eukaryotic traits—all cell physiology—evolved in the ensuing tug of war" between mitochondria and their host cells.

Lane devotes a chapter to considering how this continuous back-and-forth of protons across membranes, which also results in production of oxidants in the cell, is relevant to human lives. Particularly worthwhile was

his discussion of the importance (or lack thereof) of free radicals and antioxidants as an essential in our diet, widely but uncritically promoted as dangerous and salubrious, respectively. Lane rebuts these claims, noting that reputable scientists at the lab bench found them wanting decades ago. Indeed, those very compounds may have effects opposite to those advertised.

Anyone teaching a course that includes a section on evolution should buy

this book, which features plenty of examples of intermediate forms from the history of life as well as a surprising recent discovery of an unusually large microbe. And anyone who is interested in learning about the latest scientific thinking about the origin of life should want to read it as well.

Matthew R. Kaser is a biochemist and molecular biologist now working in patent law. With Gary C. Howard, he edited *Making and Using Antibodies: A Practical Handbook* (second edition, CRC Press, 2014).
m.kaser@comcast.net



Random Samples with Barbara Forrest



Photo: Randall Bergeron

Since its formation in the early 1980s, NCSE has had many extraordinary people serve on its board of directors, including leaders in science education, research, activism, and law. This year, one such extraordinary board member is leaving after thirteen years of service. Barbara Forrest is a historian of the "intelligent design" movement and testified in that capacity as an expert witness for the plaintiffs in *Kitzmiller v. Dover* in 2005. In her testimony, Forrest exposed the religiously motivated underpinnings of the movement, demonstrating that "intelligent design" is creationism. Forrest is the co-author with Paul R. Gross of *Creationism's Trojan Horse: The Wedge of Intelligent Design* (revised edition, 2007) and Professor of Philosophy at Southeastern Louisiana University. Let's pick her brain!

First, quick word associations. What's your immediate reaction to the following?

- **NCSE:**
Absolutely essential.
- **Wedge:**
Exposed by my work.
- **Louisiana:**
Bad weather and worse politics.
- **Education:**
As I told my kids, education is life.

Next, short answer. In 25 words or less...

What moment stands out to you as the most significant in Kitzmiller v. Dover?

When eleven parents stepped up to serve as plaintiffs. Without them, Judge John Jones III would never have written his wonderful legal opinion.

What's the biggest threat to science education today?

There are two: the usual anti-evolutionism from the Religious Right, and free-market fundamentalism, which is a relatively new threat aimed at climate science.

Finally, I hear you're an expert, so tell me: what makes a good praline?

A recipe from your French grandmother and low humidity!

—STEPHANIE KEEP



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