

reports

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Dear NCSE members,

Welcome to the second issue of the new *RNCSE*. Again, I think you'll be excited to hear what NCSE has been up to for the last few months. Inside, you'll find an in-depth report by Josh Rosenau on the results of the first-ever national survey of teachers that asked them directly what and how they are teaching about climate change.

Three generous donors—board members Lorne Trotter and Francisco J. Ayala, and the Wallace Global Fund—covered the cost of the survey itself. But even with their generosity, the survey couldn't have happened without the ongoing support of all of NCSE's members. Your dues and donations pay our talented staff, keep the lights on at the office, support teachers, organize local communities, and, of course, ensure that we find out about and respond to threats to science education wherever they arise.

But just think what we could do with more resources! I hope you will consider sharing this issue of *RNCSE* with your friends and colleagues, along with a personal request that they consider joining NCSE. There are millions of scientists, teachers, people who work in STEM industries, parents, and others who want science to be taught honestly, accurately, and completely. Frankly, I think each and every one of them should be an NCSE member! This next quarter, I challenge each of you to recruit one more person to join. Together, we can bring about a day when science denial gains no purchase in our science classrooms.



Ann Reid is the
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Dear RNCSE readers,

Find it fitting that press coverage of NCSE's national survey on climate change education coincided with seriously strange weather from coast to coast. Here in New England, we had one of the warmest winters in decades, while an abnormally strong El Niño, fueled by warming oceans, drenched California. When I look back at this winter, though, it won't be my idle snow shovel that sticks in my mind. Rather, winter 2015–2016 will always be associated with the “new” *RNCSE*.

The redesigned and reimagined *RNCSE* was a year in the making. As the issue went to press, I was so proud of what we had accomplished, but also nervous about how you would respond. To my immense relief, the vast majority of e-mails I received contained positive comments and constructive criticism.

Based on your feedback, we've made a few minor tweaks and one not-so-minor change—the replacement of a glossy stock with a matte stock. This change is not only environmentally responsible, since the paper is recycled, but also should ease some eyestrain. So as the new normal of no-normal weather continues through spring, *RNCSE* can be more easily read, whether in the spring sunshine or by candlelight (should a big storm cut your power).

I welcome further comments and suggestions, and I and the rest of us at NCSE thank you wholeheartedly for your steadfast support as the winds of change—literal and figurative—rage around us.



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TAKING THE TEMPERATURE OF CLIMATE CHANGE EDUCATION

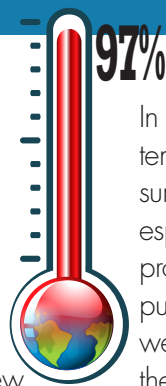
by Joshua Rosenau

Here at NCSE, we've been tracking attacks on evolution in schools for over thirty years. After decades of working with parents and teachers, we have a strong sense of the challenges taking place in classrooms. Even with all that experience, though, a 2007 survey of high school biology teachers by Michael Berkman and Eric Plutzer gave us new insights (Berkman and Plutzer 2010). We knew that creationism was taught in many schools, but not that one in eight teachers would acknowledge advocating creationism. We knew that strong science standards were important, but not how they stack up against other factors, such as training, a teacher's personal views, or pressure from the community or administrators.

When NCSE took aim at climate change denial, we knew that we needed a similar survey of climate change education to guide our efforts. We also knew that assessing climate change education posed a new set of challenges. Unlike evolution, climate change is new to science standards and doesn't fit squarely within any single science class, and relevant training and other resources for teachers are of unreliable quality and availability. Climate change is a topic of social contention, as is evolution, but unlike evolution, the controversy is not rooted in religious ideology, but in what some scholars refer to as "free market fundamentalism."

Regardless of its root causes, we were confident that the confusion and miasma of climate denial and manufactured doubt were affecting how teachers approached the subject—though we did not know to what extent. Eric Plutzer, who directs the Penn State Survey Research Center, was excited at the opportunity once again to break ground with a survey of what's happening in America's classrooms. He collaborated on the project along with his student A. Lee Hannah (now a professor at Wright State University).

Because of climate change's interdisciplinary nature, we opted to query middle school teachers as well as high school teachers of biology, physics, chemistry, and Earth science. No one, to our knowledge, had attempted to comprehensively survey such a wide range of science teachers, let alone to ask them about climate change.



In assembling our questionnaire, we turned to previous attempts to gauge climate science education. Sarah Wise's survey of Colorado science teachers (Wise 2010) was especially valuable, since she had developed a question probing teachers' tactics for defusing or confronting the public controversy over climate change. Other questions were drawn from national surveys of climate literacy by the Yale Project on Climate Change (<http://environment.yale.edu/climate-communication/>), or were modified from the previous teacher survey by Berkman and Plutzer.

We mailed surveys to 5000 teachers, along with a crisp \$2 bill as a pre-incentive. Of those, 1500 replied: 568 middle school teachers, 308 biology teachers, 285 Earth science teachers, 183 chemistry teachers, and 156 physics teachers. Responses came from all fifty states, and statistical tests gave no indications of bias in which teachers chose to answer.

The results surprised us. We had expected that, other than Earth science teachers, few would spend much time on climate change. In fact, three quarters of all the teachers who responded said they spent at least an hour talking about climate change, including about half of physics and chemistry teachers and 85% of biology teachers. Nearly every student takes middle school science and high school biology, so the frequent coverage in those classes is an especially welcome sign. Half of all teachers spend 1–2 hours or less on climate change, though, hardly enough time to give a deep understanding. Earth science teachers, on the other hand, report devoting a median of 3–4 hours to the subject—unfortunately, few schools offer a high school Earth science class, and almost none of those that do require it.

It is undeniably important—and encouraging—news that a clear majority of science teachers cover climate change. Getting a new subject into the classroom is a big hurdle to leap, and this survey shows that the teachers have already cleared that barrier. Expanding the coverage remains a challenge, but it's easier to expand an existing lesson than to add one from scratch.

But here's the bad news: Students aren't being taught the science as climate scientists understand it.

Asked whether their climate change lessons “emphasize that many scientists believe that recent increases in temperature are likely due to natural causes,” a full one in three teachers agreed. There’s no credible scientific literature making such a claim; in fact, surveys of climate scientists indicate that fewer than three percent would endorse the idea that recent climate change is due to natural causes. While far more teachers (about two thirds) indicated in their responses to a separate question that they emphasize the consensus that humans are primarily responsible for modern climate change, many teachers either present only the contrary view (about one in twelve teachers), or say that they teach both ideas (one in four). That mix of contradictory claims can only serve to confuse students.

Some teachers present these false and misleading lessons due to their own personal views. While only about two percent of the teachers deny the reality of climate change, one in six endorsed the view that recent “global warming is caused mostly by natural changes in the environment” and another sixth volunteered that they think natural and human causes contribute equally, while the remaining two thirds correctly stated that humans are the primary cause. These results are far better than one would get from the public at large, but a far cry from the scientific consensus. Furthermore, it is clear that even teachers who get the science right often introduce contrary views into their classes.

It’s possible that some of these teachers who understand the science are unaware that the scientific consensus is essentially universal (about 97%). We asked them to estimate what percentage of scientists agree that humans are causing climate change. The average estimate among the teachers fell close to 72%, with one teacher in five unwilling to even venture a guess.

No doubt, one reason for this consensus gap between teachers and scientists is that half of teachers graduated from college in the ‘90s or before. This means that they completed their formal science training before the scientific consensus about the causes of climate change solidified. Unless they took subsequent professional development or undertook their own research, these teachers may simply be relying on outdated information. But another reason may be ideological.

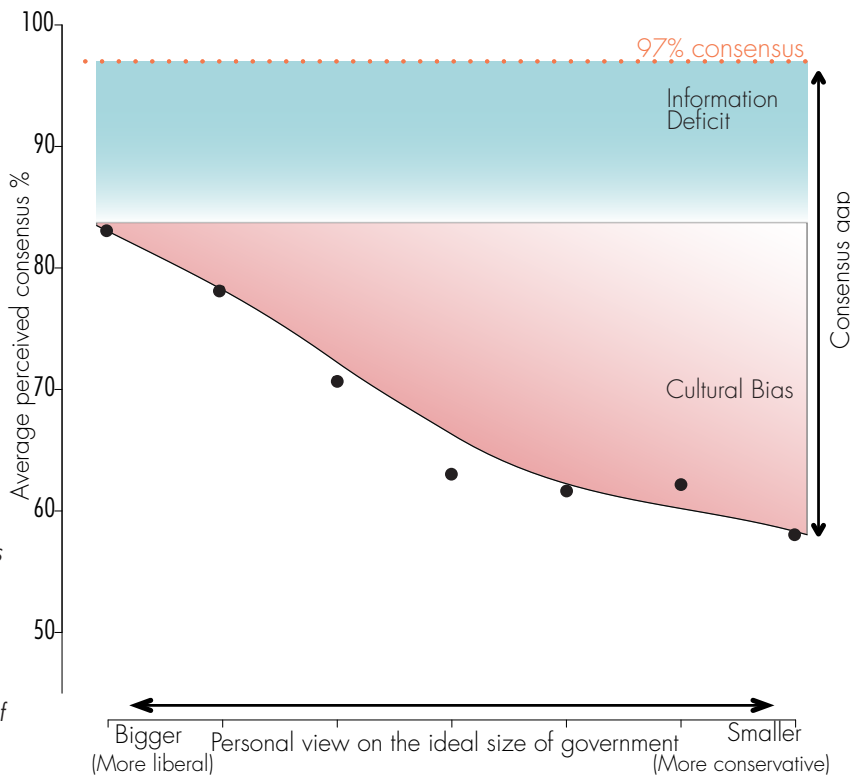
We can distinguish these effects by plotting average estimates of climate change consensus against political ideology (**Figure 1**). To assess the effect of the simple lack of information about the strength of the science, observe that even the groups that are the most ideologically predisposed (those favoring larger government) to accept the science provided an average estimate of the consensus about 15 percentage points below its true level. But the groups most ideologically predisposed against the consensus (those favoring smaller government) made average estimates approximately 40 points too low.

We can thus estimate that the information deficit accounts for about 15 percentage points of this consensus gap, while ideology can drive up to 25 percentage points worth of difference. This result matches studies of the US public, which routinely find that those with more individualistic or libertarian politics are the most likely to reject climate science, while those with a more communitarian tendency are the most likely to accept the science.

Teachers’ perception of consensus—which strongly predicts their decision to teach about “natural causes”—is not just dictated by personal

**Figure 1:
The Two-Part
Consensus Gap.**

Teachers were asked to estimate what percentage of scientists agree that climate change is caused by humans, and separately to answer a standard question about political ideology. The seven points represent the average estimates of the scientific consensus for each of the seven options on the political scale, with a smoothed line to clarify the trend. The distance between those estimates and the actual 97% of scientists who agree that climate change is caused by humans represents a “consensus gap.” Some of that gap derives from lack of knowledge (“information deficit”), but much can be attributed to political ideology shaping teachers’ perceptions of the consensus (“cultural bias”).



knowledge and ideology. Some teachers have gone through more training than others, and training can help counteract ideological predispositions. Holding ideology constant, the teachers with the most training give estimates of the consensus up to 13 points higher than their peers with less training. Another factor clearly at play is the prevailing ideology of the communities in which teachers work. Teachers in the most politically conservative communities offered estimates of the consensus that were as much as 15 points lower than ideologically similar teachers in the most politically liberal communities (Figure 2).

Taken together, it's clear that the effect of ideology can outweigh the effect of training. So can pressure from the community, though interestingly, few teachers report overt pressure not to teach climate change. Fewer than one teacher in twenty reported overt pressure from parents, administrators, or students to avoid the subject. This was far lower than we expected, and far below the 22% of teachers who reported pressure not to teach evolution in the Berkman and Plutzer survey.

To understand how subtle community pressure affects the classroom, we asked what techniques, if any, teachers used to “acknowledge that climate change is controversial.” Some options, such as avoiding the matter, letting students opt out of those lessons, sending warning letters to parents, or giving “equal time to perspectives that raise doubts that humans are causing climate change,” are problematic. Others, like emphasizing the nature of science, sticking to state standards, or discouraging debate “because I believe most climate skepticism is not based on sound science” are solutions we would endorse. A few options, such as meeting students after class or allowing student discussion without the teacher stating a position up front, are ambiguous.

Over one third of teachers acknowledged employing one of the problematic techniques, and half either have done so, or would be willing to “if the situation were to arise.” We found this deeply troubling. Teachers do not encourage students to discuss germ theory without the teacher taking a stance, or send parents a letter warning that the unit on gravity is coming up, or give “equal time” to critics of the periodic table. By singling climate change out, and treating it, or encouraging students to treat it differently than other

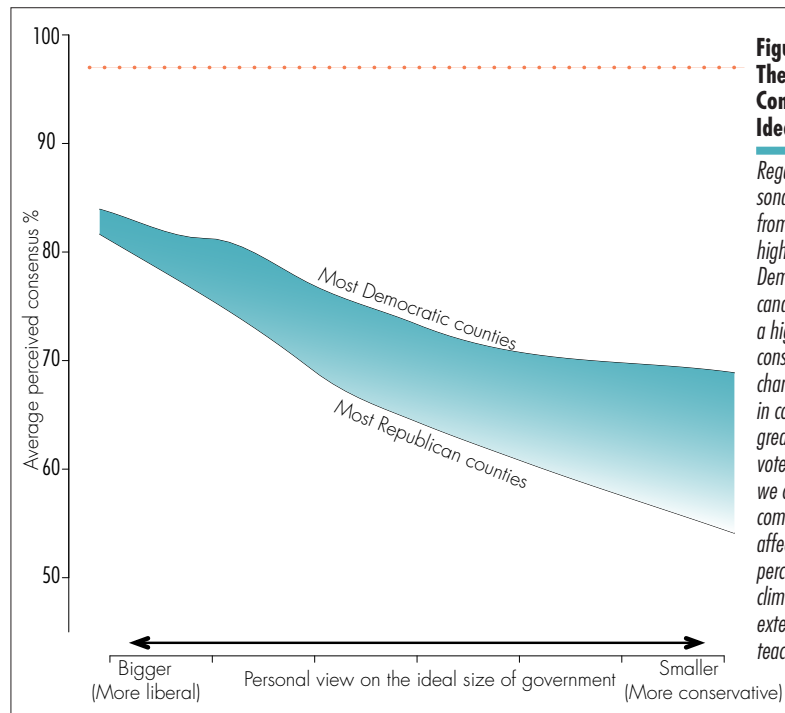


Figure 2: The Effect of Community Ideology. Regardless of their personal politics, teachers from counties with the highest voteshare for Democratic presidential candidates perceive a higher scientific consensus on climate change than those in counties with the greatest Republican voteshare. From this we can conclude that community ideology affects how teachers perceive the science of climate change and, by extension, how they teach it.

scientific findings, teachers subtly and perhaps inadvertently communicate that climate change is less of a science, or less certain, than it really is.

In addition to the teachers’ academic background, personal politics, and prevailing community ideology, there’s another form of pressure they experience. Every year, NCSE hears from teachers who have received climate change denial propaganda from groups such as the Heartland Institute. Sometimes it takes the form of videos that they can show in class; in other cases it comes in the form of slickly prepared reports that mimic real scientific publications. And if teachers try to find sources online, or vet those mailings with a quick Google search, they are likely to encounter copious denialist misinformation. Even if they succeed in identifying and rejecting the misinformation, the wealth of competing claims can make it seem as if the science behind climate change is in genuine dispute. (The survey asked teachers what websites and supplements they use, responses that we are still analyzing.) The denialist strategy has always held that “doubt is our product,” and teachers’ self-reported underestimation of the scientific consensus is a measure of that strategy’s success. (“What We’re Up Against,” p. 6, notes how this rhetoric has been a staple of attacks on climate education for decades.)

The survey results do offer some cause for optimism that these doubts can be dispelled. Most teachers, even those who personally doubt the science, or who don’t perceive a strong scientific consensus, expressed interest in taking a

continuing education course about climate change. As more states adopt standards that emphasize climate change, such training will become more common. Changing standards will also bring changes to textbooks, giving teachers a reliable source for the state of the science.

These findings also show the critical role NCSE can play. Fighting to stop laws, standards, and other policies that promote a message of denial or false balance is a necessary part of removing pressure from teachers, clearing the way for them to bring the best science into their classrooms. When members like you speak out against climate change denial, it also helps teachers see that their communities support accurate climate education, giving them the confidence to teach the science forthrightly.

The survey itself has also been a chance to raise the profile of climate education. In February 2016, the results of the survey were published in the journal *Science* (Plutzer et al. 2016). The findings received significant media attention, with in-depth coverage on National Public Radio, *The New York Times*, and other leading news outlets. Our findings were even satirized in *The Onion*—a sure sign that our study “made it.” It was a chance to remind the public of the importance of climate change, and hopefully to reach teachers as well.

Another paper based on the survey has been published in the *Bulletin of the Atomic Scientists*, highlighting how climate change denial affects schools across the country,

**“WE DON’T
HAVE TIME FOR
CONFUSION OR
MIXED MESSAGES”**

even in places where parents might assume their students are “safe” (Branch et al. 2016). In coming months, we plan to continue delving into the rich data from the survey, publishing new findings and helping other education and science groups gain new insights. We are actively seeking funding to carry out more surveys so that we can continue monitoring climate and evolution education, and the toll denial takes on our schools.

Students today will grow up to be the citizens of tomorrow, making decisions about a world that will be shaped by climate change. We don’t have time for confusion and mixed messages. Our work, and your support, are needed now more than ever.

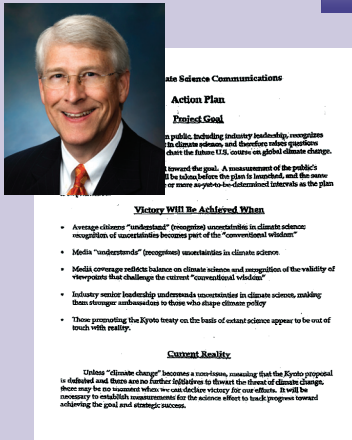
REFERENCES

- Berkman M. B., Plutzer E. 2010. *Evolution, Creationism, and the Battle to Control America’s Classrooms*. New York: Cambridge University Press.
- Branch, G., Rosenau, J., Berbeco, M. 2016. Climate education in the classroom: Cloudy with a chance of confusion. *Bulletin of the Atomic Scientists* 72(2):89–96.
- Plutzer, E., McCaffrey, M., Hannah, A. L., Rosenau, J., Berbeco M., Reid, A. H. 2016. Climate confusion among U.S. teachers: Teachers’ knowledge and values can hinder climate education. *Science* 351(6274):665–666.
- Wise, S. 2010. Climate change in the classroom: Patterns, motivations, and barriers to instruction among Colorado science teachers. *Journal of Geoscience Education* 58(5):297–309.

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WHAT WE’RE UP AGAINST Scientific “Uncertainties”



In July 2015, the US Senate considered a successor to the No Child Left Behind Act. The law does little to dictate classroom content, but Senator Roger Wicker (R–MS, pictured here) proposed an amendment encouraging schools to cover climate change in a “balanced” manner, emphasizing “the natural

causes” and scientific “uncertainties.” This misleading emphasis is part of a long trend in attacks on climate change education, from a 2012 plan by the denialist Heartland Institute to develop curricula portraying climate science as “controversial” to a recently-revealed 1998 plan (see left) by the oil industry to fend off a climate treaty by “informing teachers/students about uncertainties in climate science,” using teacher associations and grassroots allies to press denial into schools. Our survey of science teachers reveals how this rhetoric and pressure have polluted science classrooms.

—JOSH ROSENAU



At the February 2016 annual meeting of the American Association for the Advancement of Science, there was a symposium on “After the Dover Intelligent Design Trial: Law, Politics, and Education” to commemorate the tenth anniversary of *Tammy Kitzmiller, et al. v. Dover Area School District, et al.*, the 2005 case in which teaching “intelligent design” in the public schools was held to be unconstitutional. NCSE was out in force. **Robert T. Pennock**, a professor of philosophy at Michigan State University who was among the plaintiffs’ expert witnesses, spoke on “Scientific Integrity

and the Rise and Fall of Intelligent Design Creationism”; **Kenneth R. Miller** (a member of NCSE’s Advisory Council), a professor of biology at Brown University who was among the plaintiffs’ expert witnesses, spoke on “Why ID Failed: Evolution and the True ‘Design’ of Biological Systems”; **Richard Katskee** (a member of NCSE’s board of directors), a lawyer at Americans United for Separation of Church and State who was on the plaintiffs’ legal team, spoke on “Why It Mattered in Court that Intelligent Design Isn’t Science”; Judge John E. Jones III, who presided over the trial,

spoke on “The Decision”; and Jennifer Miller, a biology teacher at Dover Area High School, spoke on “What *Kitzmiller v. Dover* Means to Teachers.” NCSE’s founding executive director **Eugenie C. Scott** would have spoken on “Fallout from Dover: Effect on Science Standards Adoption and Academic Freedom Laws” but was unable to attend owing to illness. The symposium was organized by **Ida Chow** of the Society for Developmental Biology, **Jay B. Labov** of the National Academy of Sciences, and Scott.

—GLENN BRANCH

PLACE & TIME

A Science Center with No Science



On May 26, 2005, financial planner and former science teacher William Sanderson II opened the Akron Fossils and Science Center at 2080 South Cleveland-Massillon Road in Copley, Ohio. Sanderson’s goal was “to connect people to the truth of Creation” by advocating creation science (i.e., young-earth creationism) and “intelligent design,” “in contrast to teaching evolutionary models.” The museum offers “biblical truth” to help visitors “see past the world’s theories of random origin to the loving design of a master Creator.”

Sanderson’s nonprofit museum consists of three parts: the Sanderson Lecture Hall, the Science Hall, and the Biblical History Hall. The Sanderson Lecture Hall includes a model of a coelacanth and replicas of fossils such as a *Tyrannosaurus rex* tooth. Guides tell visitors that a flood created the entire fossil record “probably within

two weeks,” and support this claim by displaying a crusty “Teddy Bear from Czechoslovakia” that “fossilized in two weeks.” Visitors are also told that “fossilized clams on mountaintops” provide evidentiary support of the worldwide flood.

In the Science Hall, visitors are encouraged to “critically analyze the theory of evolution” and conclude that “the facts of science” prove that Earth is only a few thousand years old. Large displays describe Ohio’s fossils, “intelligent design,” the Grand Canyon (formed during and after the Flood), and radiometric dating (unreliable!). There are replicas of Ica burial stones on which are painted a theropod eating a human, as well as two large displays “proving” that humans lived with dinosaurs; the evidence presented here includes the Glen Rose “Caldwell Track,” here misinterpreted as evidence of humans and dinosaurs walking together, and fossilized human fingers supposedly excavated from Cretaceous limestone near Glen Rose, Texas.

Finally, the Biblical History Hall “opens the doors of truth” by documenting the reliability of the Bible. Exhibits include descriptions of the days of creation and a model of Noah’s Ark that features, rather inexplicably, a live guinea pig.

During the summer (the museum’s busiest season), 40–150 students visit the museum each day and are subjected to the egregious and groundless claims of its displays and guides. After touring the museum, these children can enjoy the large “Truassic Park” playground, which includes mini-golf, a zip line, swings, and exhibits that enable kids to “explore creation with hands-on science.” According to the guide I spoke to, approximately half of the school groups who visit the museum come from public schools.

Randy Moore is Professor of Biology at the University of Minnesota, Twin Cities. His upcoming book (coauthored with William F. McComas) is *The Scopes “Monkey” Trial* (Arcadia Press, 2016).



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.

ARIZONA

Sylvia Allen (R–District 6) was named as chair of Arizona’s Senate Education Committee, according to the *Arizona Republic*, which observed, “Allen is best known for her controversial public comments over the years. During a legislative hearing in 2009, she said the Earth is 6,000 years old, a belief held by ‘Young Earth’ biblical creationists.” Only one antiscience bill was introduced in Arizona’s legislature in the last decade, Senate Bill 1213 in 2013, which targeted both evolution and climate change.

FLORIDA, BOCA RATON

Eleven-year-old Brandon Silver and his attorney father Barry Silver are suing the Palm Beach County school board for not teaching evolution, contending, “There are currently schools and textbooks which provide false, misleading, and dangerous information about certain religions and purposely omit factual information if it appears unfavorable to them and/or politically incorrect, which cause Palm Beach County public school students not to receive a high quality education required by the Florida law.” Their similar suit in 2013 was dismissed.

FLORIDA

Two bills introduced in the Florida legislature—House Bill 899 and Senate Bill 1018—are ostensibly aimed at empowering taxpayers to object to the use of specific instructional materials in the public schools on the grounds that they fail to provide “a noninflammatory, objective, and balanced viewpoint on issues.” There is reason to believe that evolution and climate change are among the targets, since the bills were written by organizations that have criticized the treatment of those topics in Florida textbooks.

FLORIDA, PENSACOLA

The flamboyant young-earth creationist Kent Hovind of Creation Science Evangelism is free. In 2006, he was convicted of fifty-eight federal charges, and in 2007, he was sentenced to serve ten years in federal prison. While in prison, he was charged with mail fraud and related charges and with criminal contempt; he was found guilty on the criminal contempt charge in 2015 but the verdict was overturned and the charges dismissed without prejudice. Hovind is apparently returning to his busy speaking schedule.

LOUISIANA, BOSSIER PARISH

In September 2015, the ACLU warned the Bossier Parish School Board about a pattern of religious proselytization at Airline High School—which includes attacks on evolution education. “Some Airline teachers are teaching creationism as science,” Zack Kopplin reported in *Slate*, and one student told him that one teacher “got in trouble last year for teaching evolution as a fact” and another “didn’t want to teach evolution because she was scared.” E-mails reveal that the Bible is used to “debunk” evolution.

KENTUCKY

A bill in the Kentucky legislature would extend summer vacation to boost tourism to Answers in Genesis’s Ark Encounter project. Senate Bill 50 would “require schools to schedule the first student attendance day no earlier than the Monday closest to August 26, unless a school has adopted a year-round calendar.” The bill’s cosponsor Damon Thayer (R–District 17) told the *Grant County News*, “Grant County is set to become a major tourist destination due to the presence of the Ark.”

MICHIGAN

The Michigan state board of education voted 7–1 to adopt the Next Generation Science Standards on November 10, 2015. The state becomes the seventeenth to adopt the NGSS, joining Arkansas (so far only for middle school), California, Connecticut, Delaware, Kansas, Kentucky, Illinois, Maryland, Nevada, New Jersey, Oregon, Rhode Island, Vermont, Washington, and West Virginia, as well as the District of Columbia. A bill in the 2013–2014 legislative session would have blocked the NGSS, in part because of their inclusion of climate change.

OKLAHOMA

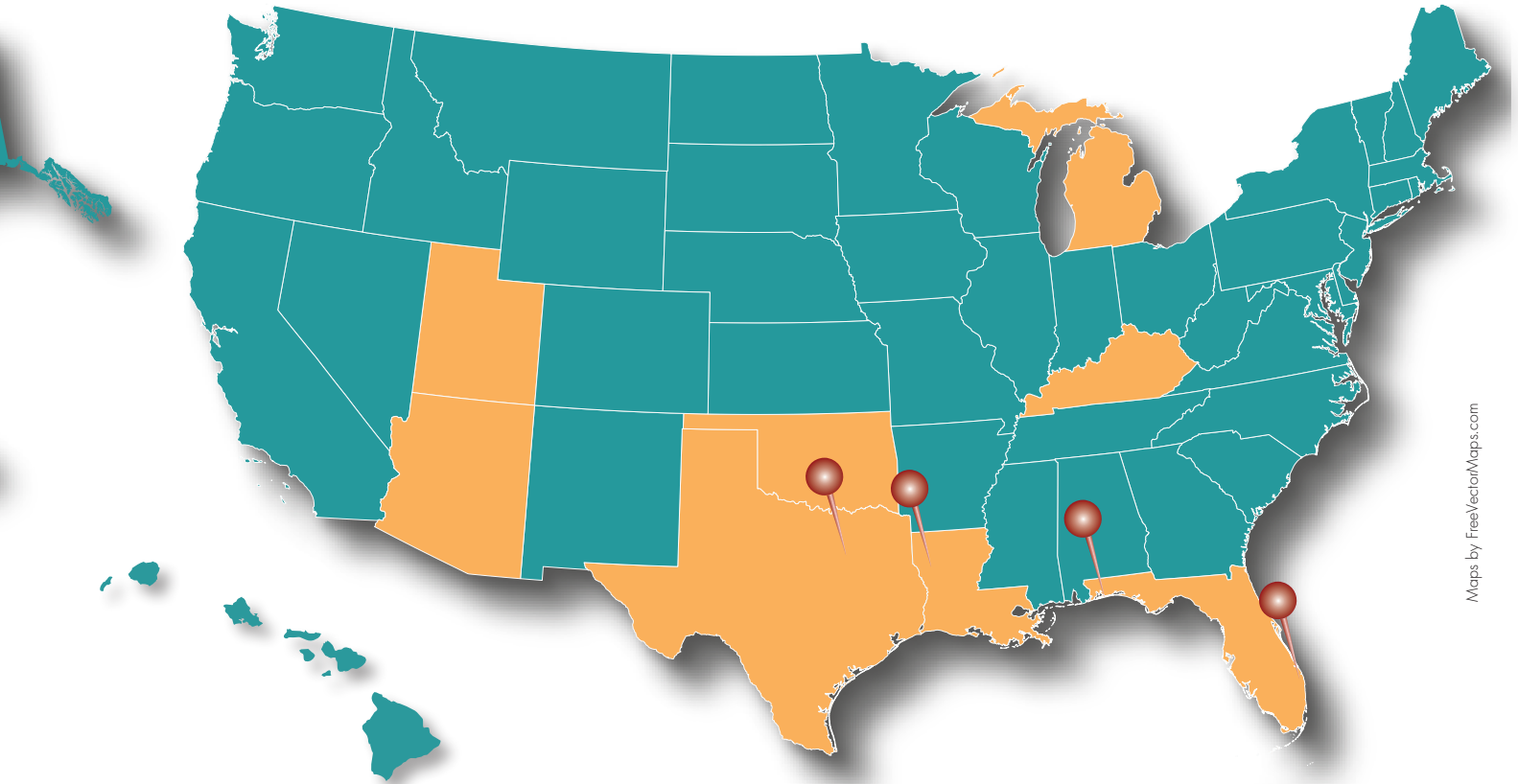
Two antiscience measures, Senate Bill 1322 and House Bill 3045, were introduced in the Oklahoma legislature in late January 2016 by sponsors with a record of introducing anti-evolution legislation. These bills, if enacted, would have deprived administrators of the ability to prevent teachers from miseducating students about “scientific controversies.” Both died in committee in late February 2016. Also dying in committee was House Bill 3077; ominously styled the Oklahoma Academic Freedom Act of 2016, it never contained any specific provisions.

TEXAS, HIGHLAND PARK

State senator Don Huffines (R–District 16) told a town hall meeting, “I look at creationism as believing in a supreme being, believing in God ... I believe all students should understand that. Maybe not as science, but certainly in the context of a curriculum,” KERA reported. In 2014, he told KERA, “Teaching it as science, it should be taught on equal footing.” First elected to the Texas state senate in 2014, Huffines is a member of the Senate Education Committee.

NATIONAL

A measure that would have amended H.R. 8—the North American Energy Security and Infrastructure Act—to acknowledge “the overwhelming scientific consensus that climate change is real” was rejected in the U.S. House of Representatives on December 3, 2015. Introduced by Matt Cartwright (D–Pennsylvania), who described it as “a chance for the Congress to avoid the harsh light and the implacable judgment of the historians,” the motion was defeated on a 180–243 vote, which was along party lines.



Maps by FreeVectorMaps.com

UTAH

The Utah state board of education voted 11–4 on December 4, 2015, to adopt a new set of science standards for grades 6–8. The word “evolution,” omitted in a previous draft, was restored, and natural selection is mentioned, but there is no standard specifically devoted to it. A misleadingly phrased sixth-grade standard about the greenhouse effect was clarified, but climate change is still not introduced until the eighth grade. Science standards for grades 9–12 are next on the agenda.

NATIONAL

House Resolution 548, introduced by Jim Himes (D–Connecticut) in the United States House of Representatives on December 3, 2015, and Senate Resolution 337, introduced by Richard Blumenthal (D–Connecticut) in the United States Senate on December 17, 2015, would, if passed, express support of designating February 12, 2016, as Darwin Day, and recognition of “Charles Darwin as a worthy symbol on which to celebrate the achievements of reason, science, and the advancement of human knowledge.”



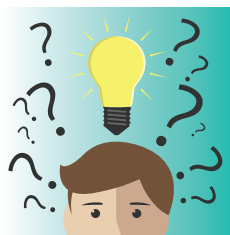
news from the teacher network

What Does the NCSE Survey Mean for NCSEteach?

From the cover story by my colleague Josh Rosenau (see page 3), you know that NCSE just released the results of a survey on teachers' perceptions and teaching of climate change in the United States. And the news? Well, a little good and a little bad. As Josh noted, the good news is very good—a majority of teachers are covering climate change! They are covering it not only in Earth science courses, but also in biology and chemistry classes—even middle school teachers are devoting at least an hour to it. And when they cover it, they address key concepts like the greenhouse effect and impacts such as sea level rise. This is all great to see, and in many ways unexpected.

So what's the bad news?

Well, it turns out that although climate change is getting a lot of coverage, a lot of that coverage involves mixed messages about its causes. And mixed messages are bad news indeed. Students must know the science of climate change, including its human causes and impacts, because they need to know about it in order to actually do something about it. Leaving them in a state of confusion helps nobody.



Why are teachers giving their students mixed messages? Is it due to pressure from community members or administrators, a common culprit when it comes to sub-par evolution education? Anecdotal evidence suggested that it might be, but the survey did not bear that out. Although a few teachers did report experiencing overt pressure, the vast majority did not.

So what is behind the murky messaging about climate change? Well, many factors are in play. Some teachers weren't aware of the scientific consensus, some are trying to dissipate potential controversy in their classroom, and some just lack the confidence to teach the material effectively.

So what are we going to do about it?

Thanks to NCSEteach, our newly launched teacher network, we feel ready to counter each and every one

of these potential issues. Through the network, we can connect with teachers regularly and provide access to scientists who can help clarify the consensus, support from NCSE staff on how to minimize controversy, and vetted materials to help bolster their coverage of climate change in the classroom—you can be sure that there are no mixed messages in anything we recommend! Thanks to the survey results, we now know that offering tips on what to do if an administrator tells teachers not to teach climate change (though we have those available if required) is not nearly as important as these other benefits of NCSEteach membership—all of which we are continuing to develop.

NCSEteach's signature program, Scientists in the Classroom, for example, is slated to expand dramatically in fall 2016 with technical support from Code the Change (a community of computer science students using their skills for social change). In addition, this spring we have started our first-ever webinar series for teachers on how to teach socially contentious topics. From addressing misconceptions to dealing with controversy in the classroom, these webinars, featuring NCSE staff, will be providing support for teachers and preparing them to address climate change and evolution. The webinars will be recorded and archived on YouTube. If you are interested in finding out more, e-mail me at berbeco@ncse.com.

The survey data has provided invaluable insights, surprises, and affirmations. Now we have a lot of work ahead. As we learn more about what teachers need from us as an organization, we'll be building out our programs and no doubt starting some new ones. None of this work would be possible without our members. You can support us in our efforts by connecting with any member of staff via e-mail, Facebook, or Twitter, and of course, by donating to NCSE.

Minda Berbeco is a programs and policy director for NCSE. berbeco@ncse.com



Spotlight on Scientists in the Classroom



Fisher teaching the students about overfishing.

Since the Scientists in the Classroom program piloted in the fall of 2015 and launched in the spring of 2016, its success has exceeded expectations. In fact, the biggest

problem right now is that we can't keep up with the demand to match scientists and classrooms! We want to spread the excitement, so from time to time, we will share the stories of the program's success in *RNCSE* and on NCSE's Science League of America blog (<http://ncse.com/blog>).

Here's such a story, featuring Mary Fisher, a first-year graduate student at the University of Washington specializing in marine population genomics and Eileen Hynes, an elementary school teacher at Lake and Park School in Seattle.

Fisher first visited Hynes's classroom to field questions about being a "real scientist." I think that it's safe to say that students' perceptions of what a scientist looks like were challenged—

rather than a white lab coat, Fisher brought her scuba gear! After the first visit, Hynes and Fisher arranged for the class to visit Fisher's lab, tour the research collections, and complete an activity (designed by Fisher and Hynes) connecting Fisher's research to what they were learning in the classroom. That wasn't all, though: Fisher subsequently joined the class on a whale watch, where she and Hynes gave students a taste of fieldwork. It's no wonder that Hynes's class is now full of aspiring marine biologists!

The whale watch was followed by further visits from Fisher to the class during their unit on evolution. Together, Fisher and Hynes introduced the students to everything from cetacean phylogeny to the evolutionary transition of whales from land to the sea. When the semester was over, both scientist and teacher were eager for more, requesting to stay paired up in the spring—this time, though, to talk about climate change. Hynes reports that her students showed remarkable enthusiasm and interest for science, and attributes much of it to Fisher's presence. Moreover, both Fisher and Hynes felt inspired and energized by their partnership, and have carried these positive feelings over to their individual work. A clear win for all.

—KATE HEFFERNAN

BEST OF THE BLOG

ncse.com/blog



The NCSE blog covers everything from history to politics, popular science to common misconceptions about evolution and climate change. Here are a few highlights from the last quarter.

- Ann Reid gives you the back story and inside scoop on NCSE's **climate change education survey**. [<http://bit.ly/1Qp6W0f>]
- A **Harmful Exchange on Science Friday** has Stephanie Keep screaming **Say What????** Part 1: [<http://bit.ly/1XIKXrd>] Part 2: [<http://bit.ly/1RiXP4H>]
- **Flat Out Wrong:** Rapper B.o.B. vs. Neil deGrasse Tyson. Josh Rosenau referees. [<http://bit.ly/1UiCCus>]
- **Just What America Needs: Another Creationist "Museum."** Steve Newton huffs and puffs and blows this man, er, museum, down. [<http://bit.ly/1Qu8o1n>]
- **Want to Teach Middle Schoolers about Climate Change?** Start with a fish tank, says Minda Berbeco. [<http://bit.ly/1Q6orDB>]
- **Who F*cking Loves Science?** Emily #@\$% Schoerning does! [<http://bit.ly/1Q6orDB>]



news from the booster clubs

Science Booster Clubs: News from the First Expansion

Good news! NCSE's Science Booster Club (SBC) project is getting closer and closer to being ready for rollout in your community. In the last issue of *RNCSE*, I reported that the pilot SBC in Iowa City had already reached over 1,700 people with our special brand of fun, accessible science outreach. From November 2015 to January 2016, we expanded to three new locations in Iowa: West Branch, Cedar Rapids, and Amana. Now that the new clubs are up and running, in the first two months of 2016 we will have reached an additional 2,600 people. That's right! In just two months, we have more than doubled our live audience reach, and the pace is only going to continue accelerating. The events we have booked with our new partners throughout the region through June 2016 should bring high-quality, accurate, engaging information about important scientific topics to an additional 8,000 to 10,000 people. To say I'm excited is a huge understatement.

The importance of data

Excitement is all well and good, of course, but it doesn't usually lead to additional funding or support. What does? Data. So we've partnered with the University of Iowa to handle SBC expansion as a research project, held to the highest academic and ethical standards. Because of this, we've been able to conduct surveys in these communities about what people there think about scientific topics with potential for societal controversy, their level of community engagement, and their degree of scientific literacy. By repeating the surveys periodically, we will be able to monitor how these factors change over time in response to SBC presence. Hopefully, the research will indicate that SBCs have value beyond making participants and organizers "feel good." If we're doing the kind of work we want to do with the SBC project, we won't just be helping communities have fun with science: we'll be helping to create an environment

in which science is normalized and science denial cannot flourish. Our expectation is that the research will document a significant increase in science literacy and support for science education among the communities the SBCs serve.

Building a model for all communities

As the SBCs continue to spread and grow, we are continually improving our model for what a SBC can and should do. For example, we're learning how to serve different types of communities, including both urban and rural communities. After some trial and error, we are also starting to find successful models for fundraising. All of our all-ages events are free to the public, but we need to solicit and receive donations if we are to become self-sustaining. Our last major fundraiser, an adult-focused astronomy night at an observatory complete with wine, cheese, and giant telescopes, yielded enough donations to fund an unexpected March microgrant cycle for teachers. Many if not most science teachers spend hundreds of dollars out of pocket a year on materials for their classrooms. Microgrants, which meet requests for funding under \$200, help take the burden for these costs off teachers. By the end of March, we will have granted at least two more teacher equipment requests, bringing our lasting impact in the region in terms of classroom equipment up to 500 students a year.



Where we've been and where we're going

We're reaching a lot of people with the SBC project, but what kinds of things are we up to? All sorts! We've provided programming for community science nights and we've partnered with major regional events and festivals to reach broad audiences with clear, interesting information about climate change. Along with Ann Reid, our executive director, I participated in Iowa City's annual Darwin Day festival, giving a speech and conducting a workshop on how to talk about topics

like evolution and climate change with individuals who oppose the scientific consensus.

In the near future, we will be focusing on outreach to kids. This summer, we plan to host a weeklong summer day camp for area students in grades 6–8. We already have enlisted volunteer scientists and community members, and if we can raise enough money to buy supplies, we'll be able to provide this camp at no cost. The goal of the program is to reach children in rural areas who would not otherwise have access to informal, non-ideological science education. But the benefits extend beyond the student participants to the larger community who will get an opportunity to see scientists and STEM professionals as individuals who are engaged with and care about communities like theirs. These experiences will help build connections and personalize science and scientists, as well as provide real-life role models to young students.

Big picture goals

With the SBC project, we're working to turn the tide on science education in many ways. We're funding teachers, we're providing people with up-to-date information on current issues, and we're helping them develop tools to engage with others on these topics, rather than engage in endless (and fruitless) "debate." The Science Booster Club Project is a package deal: the goal is to help communities find ways to strengthen science education and fight science denial on all fronts, with local energy, and with special attention to local issues and interests. We plan on expanding throughout the state of Iowa in 2017 under the auspices of the University of Iowa, but we may add extra satellite sites without data collection depending on the success of our initial trials. Come 2018, we hope to have a SBC starter kit freely available to any community that wants to start an SBC—including yours!

If you're interested in finding out more, or if you want to be on the early list for our national program launch, follow my blog entries at the Science League of America (<http://ncse.com/users/emily-schoerning>) or contact me at schoerning@ncse.com!

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



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Dear NCSE,

At a recent PTA meeting, we were told that our school district allows for parents to take their children out of class when they are learning about climate change. I was shocked! How is this kind of policy allowed? What should I do?

Sincerely,

Worrying Heavily Over Opt-out Policies

Dear WHOOPS,

Ah, the infamous opt-out policy—we catch wind of a few of these highly problematic policies every year, believe it or not. They're "allowed" because education in the United States, for better or worse, is largely controlled at a local level. But they're not a good idea. They compromise the learning and the future scientific literacy of the students who are opted out, of course, but they also disrupt the classroom and hamper the school and the district in complying with the educational expectations of the state.

So opt-out policies are bad, but what can you do about them? The first thing to do is to investigate. Is there really an opt-out policy in your district? Does it really apply to central principles of science such as climate change or evolution? Are the specified procedures for requesting to be opted out being followed? You'd be surprised how often the answer to these questions is no.

If there really is an opt-out policy that applies to climate change or evolution, you can work to have it revised. Find some like-minded parents, teachers, and community members, and make them aware of the policy and the problems with it. Once you're organized, you can ask to talk to the local superintendent of schools or address the local school board about the issue. And of course, feel to get in touch with NCSE for advice!

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

THE RNCSE REVIEW

The Deeper Genome: Why There is More to the Human Genome Than Meets the Eye

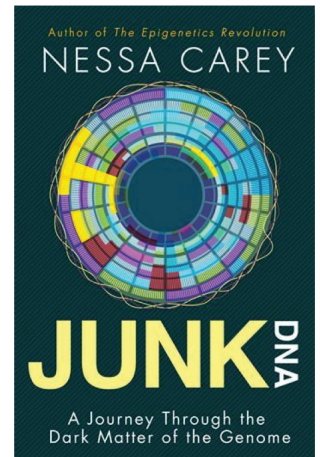
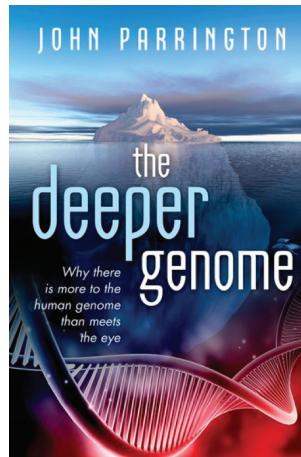
author: John Parrington

publisher: Oxford University Press, 2015

Junk DNA: A Journey Through the Dark Matter of the Genome

author: Nessa Carey

publisher: Columbia University Press, 2015



The field of functional genomics, which uses genomic tools to understand gene expression and its regulation, has recently found itself at the center of a controversy. Multiple converging observations and theoretical arguments have for decades suggested that only a small fraction of our genome is functionally constrained, the rest being largely “junk DNA.” Disputing the existence of junk DNA has been a staple of creationist (including “intelligent design”) literature, which assumes that an intelligent designer/creator would not create genomes full of junk. Thus any studies that supposedly reject its existence would be warmly welcomed in creationist circles.

This is the general context in which the ENCODE project, which aims to characterize all functional elements in the human genome, published its initial report in 2012. The main integrative ENCODE paper associated 80% of the human genome with biochemical function. ENCODE researchers considered an area of the genome as “functional” if it could be associated with reproducible produc-

“Disputing the existence of junk DNA has been a staple of creationist (including “intelligent design”) literature, which assumes that an intelligent designer/creator would not create genomes full of junk.”

tion of RNA or occupancy by regulatory proteins using various functional genomic tools. However, this techni-

cal definition and the associated caveats were later ignored. Instead, the story featured in press releases and popular communications was that most of the genome has an important biological function—a conclusion found nowhere in the ENCODE report. Thus, many who read about ENCODE (in particular proponents of creationism and “intelligent design”) thought that it had roundly debunked the notion of ubiquitous junk DNA, when in fact, ENCODE had done nothing of the sort.

Among the first books aiming to bring the discoveries of functional genomics to popular audiences are *The Deeper Genome* by John Parrington and *Junk DNA* by Nessa Carey. Unfortunately, the flawed and oversimplified conclusions perpetuated in the press also form the core of both books, albeit at very different levels of scientific sophistication. Both books argue that recent discoveries reveal an unsuspected level of complexity of genome biology and that the idea of junk DNA has as a result been debunked, with ENCODE data providing a main pillar of this narrative.

There are multiple problems with such thinking. First, much of what is being touted as radically transforming our knowledge is not new but has been known or suspected for decades (complex gene regulation in 3D space, functional long noncoding RNAs, etc.) or previously interpreted quite differently (the transcriptional machinery is permissive to a certain level of background transcription while the act of transcription itself might, on occasion, be functional rather than the transcripts). Second, what *is* genuinely new is often either irrelevant to how much of the genome is functional or actually fits better with junk DNA theory. The widespread biochemical activity and complex regulatory networks of vertebrate genomes can be comfortably understood within the framework of junk DNA theory, enriching, rather than overturning, our understanding of genome biology.

The presentation of ENCODE data through the lens of popular writings about it rather than the primary literature means that the much more nuanced interpretations of it found in the latter are completely missing. Specifically, there is no mention of the fact that biochemical activity is only one criterion for assessing function, on its own far from sufficient to establish it. There is also little discussion of the functional genomic assays (and their interpretative limitations) on which such groundbreaking discoveries are based. Additionally, there is neither a proper discussion of the foundations of junk DNA theory nor any real explanation of exactly how the new findings are supposed to invalidate them—an obviously glaring flaw given

the primary message of both books. Early in *Junk DNA*, Carey makes an especially egregious declaration that *all* DNA not coding for proteins should be (and has been) considered as “junk.” According to Carey, ribosomal and transfer RNAs and the untranslated regions of mRNAs are therefore classified as junk! I am unaware of any biologist that would agree with this definition. She then proceeds to dismantle junk DNA theory by telling the reader about ENCODE and about all the functional noncoding RNAs and regulatory elements outside of coding areas (most of them known for decades), a true triumph of circular reasoning.

“Both books under review ... perpetuate distortions of genomics that will only sow deeper confusion.”

In contrast, Parrington’s *The Deeper Genome* provides a more sophisticated and scientifically accurate treatment of the subject, including an enjoyable introduction to the history of genetics, molecular biology, and the earliest studies on the mechanisms of gene regulation. But it also ultimately misrepresents both the science and its history by

proclaiming that it is a completely new, unexpected, and groundbreaking finding that more than the protein-coding 2% of the genome is functional. The book builds a more general case for genome complexity than just the debunking of junk DNA, but this too is often based on overhyped science—for example, Parrington devotes a chapter on the importance of Lamarckian evolution through epigenetic mechanisms in mammals, something far from conclusively established.

Precisely because of its more technical nature, *The Deeper Genome* may not reach as wide an audience as *Junk DNA*, which is specifically written for readers with no scientific background. However, both books, especially because they were produced by major academic publishers, will be equally embraced by and provide further ammunition for creationists, always eager to add to their arsenal examples of seemingly credible literature supporting their views.

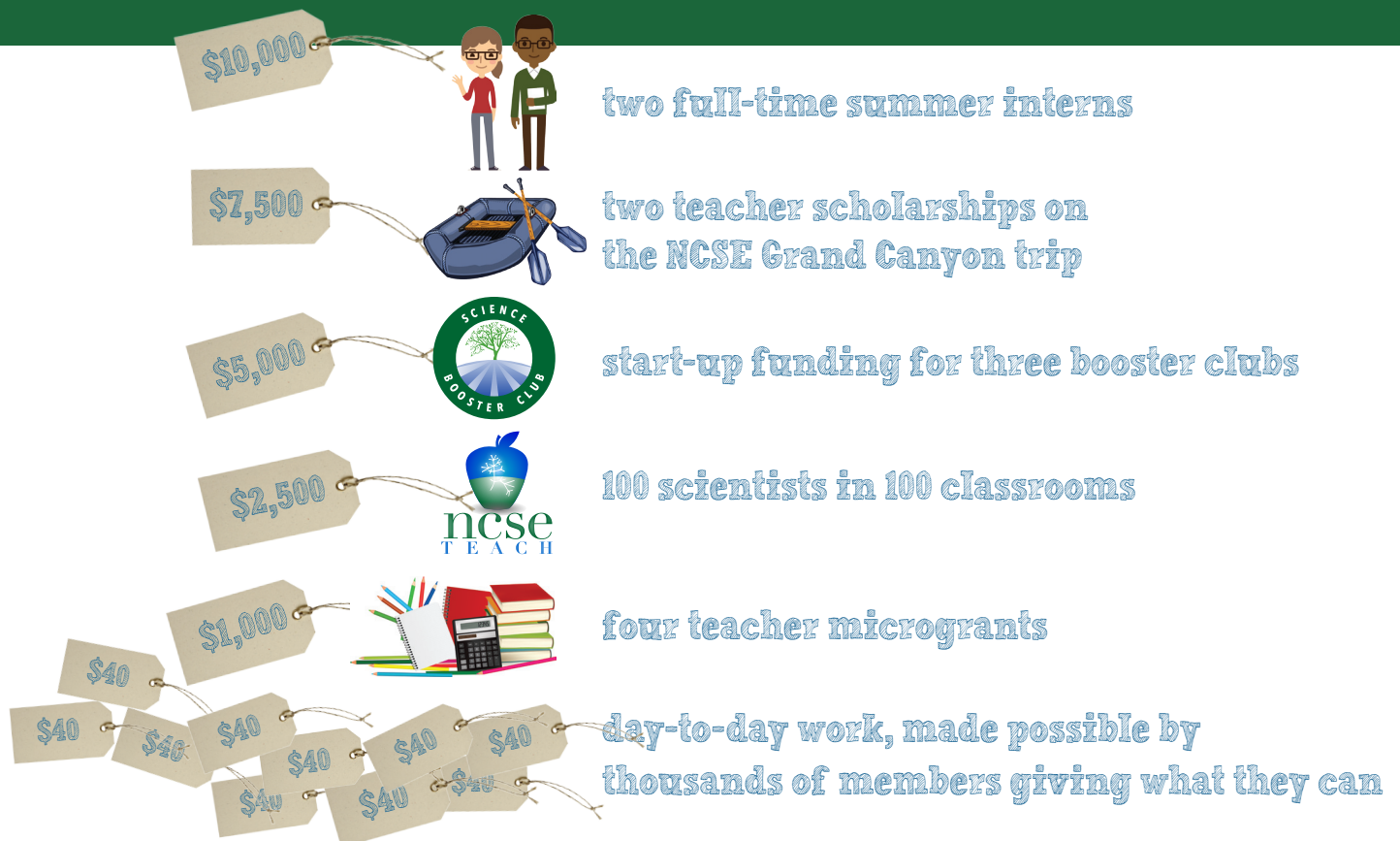
Modern genomics is certainly in need of accessible expositions that properly communicate its key results to the public. Such expositions, however, have to feature an accurate representation of the science. Both books under review fail to deliver. Instead, they perpetuate distortions of genomics that will only sow deeper confusion.

Georgi Marinov is a postdoctoral researcher in the Lynch Lab at Indiana University. He reviewed *The Deeper Genome* and *Junk DNA* in further detail for *Evolution: Education and Outreach* 2015;8(22). gkm359@gmail.com



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