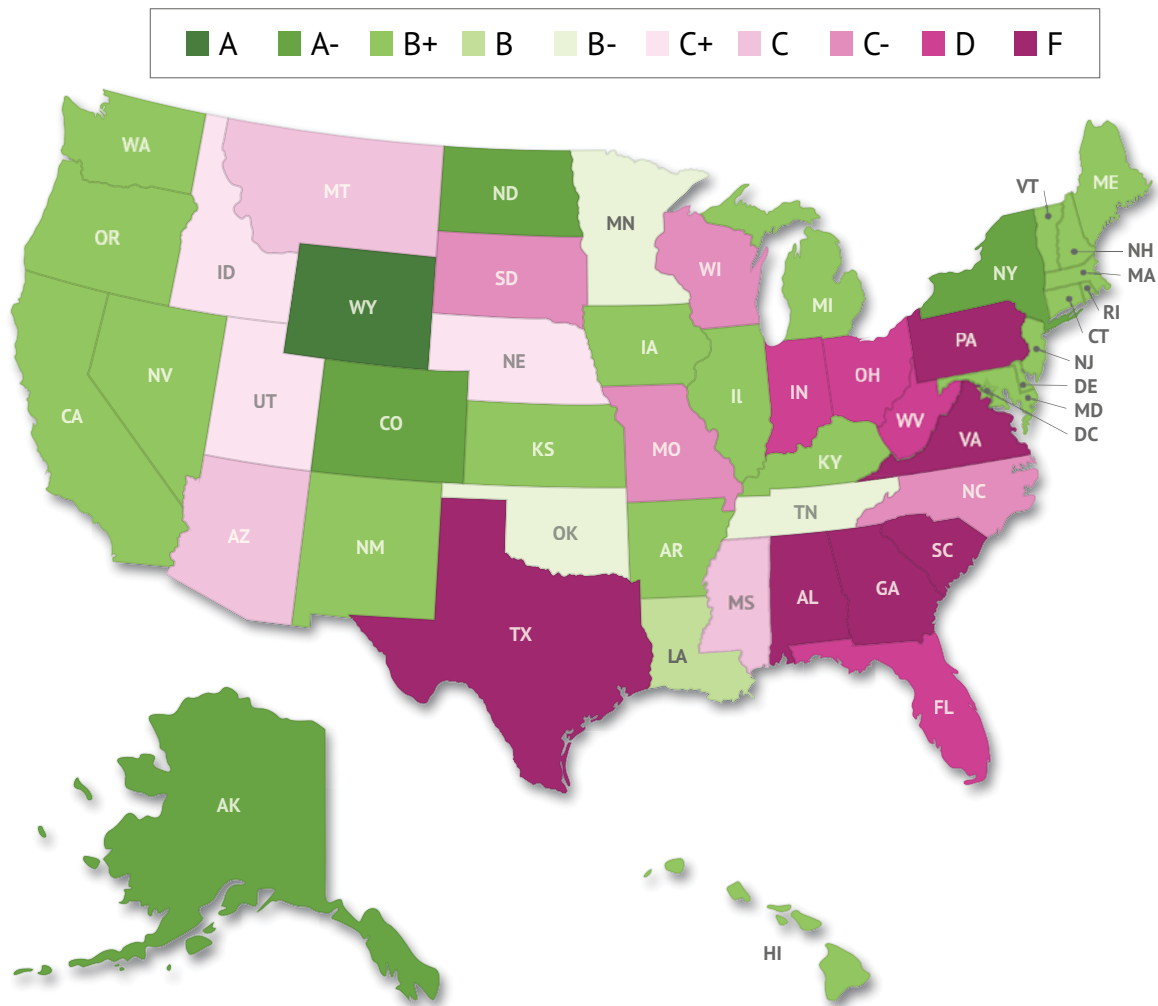


reports

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WHICH STATES "MAKE THE GRADE" ON CLIMATE CHANGE SCIENCE STANDARDS?



Map courtesy of the Texas Freedom Network Education Fund and NCSE

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EDITOR

Paul Oh

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

BOOK REVIEW EDITOR

Glenn Branch

PUBLISHER

Ann Reid

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Dear NCSE Members,

By the time you receive this issue of *RNCSE*, 2020 will be almost in the rear view mirror. It sure seems like it lasted a lot longer than 12 months. It was a decidedly mixed year for science. On the one hand, it provided evidence of how quickly and powerfully the scientific establishment can respond to a challenge, with multiple vaccines against the novel coronavirus developed in under a year. On the other hand, it also produced, or perhaps revealed, a widespread distrust of scientific advice, including the rampant spread of conspiracy theories. Certainly nothing that evolutionary biologists and climate scientists haven't seen before, but perhaps a bit of a surprise to epidemiologists!

By the same token, 2020 was also a profoundly challenging year for science education. At NCSE, we've done our best to help teachers counter misinformation and provide opportunities for practicing the essential skill of critical thinking. We were rewarded—and thrilled—when NCSE's new five-part lesson plan on the nature of science was featured in the November 2020 issue of *National Geographic*. By no coincidence whatsoever, these lessons use examples from the history of epidemiology to illuminate not only the ways in which science works but also (as NCSE's Lin Andrews explained) "all these stumbles that were made along the way."

In such a turbulent year, it is a source of pride that NCSE's staff has been diligent, creative, and hopeful throughout. Many of you have been kind enough to send us words of encouragement in addition to your financial gifts. Please know how much your kindness and support mean to us.

In the midst of all the new challenges this year, NCSE also continued its traditional work protecting the integrity of the science classroom—this time, by collaborating with the [Texas Freedom Network Education Fund](#) to produce a comprehensive evaluation of the treatment of climate change in state science standards. The resulting report lays the groundwork for arguing for the improvement of the treatment of climate change in state science standards, not only in Texas but across the country. As has been true for decades, our partnerships with local science defenders are both deeply satisfying and incredibly effective.

Please accept my best wishes for 2021 and the gratitude of all of us at NCSE for your continued support.



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



MAKING THE GRADE?

How State Public School Standards Address Climate Change

A new report from NCSE and the [Texas Freedom Network Educational Foundation](https://climategrades.org/)—“Making the Grade? How State Public School Standards Address Climate Change” (<https://climategrades.org/>)—examines the treatment of climate change in state science standards across the country. There is, unsurprisingly, both good news and bad news to be found in the report.

The good news is that a majority of states earned a B+ or better for how their standards address climate change overall. These 27 states include the 20 states that have adopted the Next Generation Science Standards (NGSS), which received a B+, and five states where the standards fared even better: Alaska, Colorado, New York, North Dakota, and Wyoming.

But the bad news is that of the remaining 24 states, twenty earned a C+ or worse; ten received a D or worse, including some of the most populous states in the country, such as Florida, Pennsylvania, Ohio, and Texas; and six states—Alabama, Georgia, Pennsylvania, South Carolina, Virginia, and Texas—received a failing grade. (See the accompanying table for all the grades.)

State science standards play a significant role in today’s public schools. They dictate the content of textbooks, provide the basis for statewide testing, influence the preparation of teachers, and supply the structure on which local school districts construct their science curricula and on which individual science teachers often base their day-to-day lesson plans.

So topics that are in the standards tend to be taught in the classroom, and topics that are not in the standards tend not to be. And when topics that are socially contentious, like climate change, are not included clearly and completely in the standards, teachers are left to their own devices—which results, too often, in their failing to convey the scientific consensus properly.

Alabama	F
Alaska	A
Arizona	C
Arkansas	B+
California	B+
Colorado	A-
Connecticut	B+
Delaware	B+
District of Columbia	B+
Florida	D
Georgia	F
Hawaii	B+
Idaho	C+
Illinois	B+
Indiana	D
Iowa	B+
Kansas	B+
Kentucky	B+
Louisiana	B
Maine	B+
Maryland	B+
Massachusetts	B+
Michigan	B+
Minnesota	B-
Mississippi	C
Missouri	C
Montana	C
Nebraska	C+
Nevada	B+
New Hampshire	B+
New Jersey	B+
New Mexico	B+
New York	A-
North Carolina	C
North Dakota	A-
Ohio	D
Oklahoma	B-
Oregon	B+
Pennsylvania	F
Rhode Island	B+
South Carolina	F
South Dakota	C
Tennessee	B-
Texas	F
Utah	C+
Vermont	B+
Virginia	F
Washington	B+
West Virginia	D
Wisconsin	C
Wyoming	A

= NGSS States

= Framework States

= Non-Framework States

In order to examine the treatment of climate change in the state science standards, NCSE and TFNEF recruited three Ph.D. scientists with varying specialties: Sarah Myhre, a climate scientist specializing in paleoecology; Steve Rissing, an evolutionary biologist (and a recipient of NCSE’s Friend of Darwin award); and Casey Williams, an educational psychologist specializing in climate change education.

The reviewers considered how well each of the 31 sets of state science standards currently in use address four key points which form a basic outline of the scientific consensus on climate change. These are, in the monosyllabic formulation due to Edward W. Maibach of George Mason University: it’s real; it’s us; it’s bad; there’s hope.

With respect to each of these four key points, the reviewers assessed how extensively and explicitly climate change was discussed, how coherently and clearly climate change was incorporated in the standards, and—arguably most important—how well the standards prepared students for further study in higher education and for responsible participation in civic deliberation about climate change.

Overall grades for the states were calculated on a curve from a weighted average of the three reviewers’ ratings; details of the curve and the weighting are contained in the report, which can be found at climategrades.org. Emerging from the welter of details, however, were a number of common problems with the state science standards’ treatment of climate change.

A few state standards promote the false narrative that the existence, cause, and seriousness of climate change are a matter of debate among climate scientists, when in fact there’s a clear scientific consensus. Particularly egregious are West Virginia’s standards, which specifically require students to debate the issue in their science classrooms.

In some cases, such as Pennsylvania and South Carolina, the standards essentially ignore climate change altogether. In other cases, the standards address issues that are part of the climate crisis without explicitly naming “climate change” or “global warming.” Teachers are provided with no guidance as to assess whether a particular standard offers an appropriate opportunity to discuss the issue.

A related problem evident in many state standards is a tendency to understate the strength or credibility of the scientific evidence. For

It's real;
it's us;
it's bad;
there's
hope.

example, while the NGSS expect students to study evidence that human activities as well as natural processes “have caused” a rise in global temperatures, Alabama’s standards suggest that such factors “may have caused” it and Missouri’s standards describe the rise as a “change.”

And quite a few standards, while acknowledging the reality of climate change, fail to discuss ways of mitigating or adapting to its impact. This was especially sad to see in states where disruptions due to climate

WORKING WITH NCSE TO IMPROVE CLIMATE CHANGE

For the past 25 years, the Texas Freedom Network has made defending sound science in our state’s public schools a major focus of our work. It hasn’t been easy—the Texas State Board of Education has a

“... the Texas Board of Education has a well-deserved reputation as a hotbed of anti-science extremism.”

well-deserved reputation as a hotbed of anti-science extremism. But we have built strong partnerships to succeed here.

So when the board announced that it would undertake a major revision of science standards for Texas public schools in 2020, the first call we made was to the National Center for Science Education.

NCSE has long been a valuable and trusted partner in battles over science education in Texas. The organization’s top staff were with us in 2009, when the board’s creationist chair tried to use the last major science standards revision in Texas to undermine the teaching of evolution. “Somebody’s gotta stand up to experts,” the chair thundered at one meeting.

He and other creationists on the board tried over the course of several meetings to rewrite fact-based science standards that educators, scientists, and other experts had spent months drafting. They listened raptly as a representative of the Discovery Institute testified, peddling long-ago-debunked claims about the Cambrian Explosion as a problem for evolution.

But we worked with NCSE, which brought important knowledge and experience in battling anti-science creationists in state after state. Together, we successfully shaped the media narrative around the debate and educated board members about the importance of rejecting efforts to undermine sound science with creationist buzzwords and arguments in our state’s public schools.

We didn’t persuade the creationists on the board, of course. But today Texas science standards don’t promote those arguments or require students to learn about the so-called weaknesses of evolution.

Still, the battle over science education is far from over in Texas. Creationists are still a united faction on the state board. Worse still, the science standards do a terrible job when it comes to climate change. The same creationist board chair who wanted to “stand up to experts” in 2009 also called the overwhelming evidence on climate change “hooey.” Others insisted that teaching students about

change continue to be challenging—including Texas, which faces rising sea levels, increased extreme weather and wildfires, and pressure on water resources, all as a result of climate change.

“Making the Grade?” offered recommendations to policymakers, including the obvious “revise state science standards as far as necessary to reflect the scientific consensus on climate change.” The report described the NGSS as a good model, but added “as the five states with science standards that received

Students,
and the rest
of society,
deserve
better.

higher grades illustrate, it is possible to improve even on the NGSS.”

The report concluded by emphasizing the crucial importance of equipping today’s students to cope with the challenges of tomorrow’s warming world: “Insofar as a set of state science standards fails to recognize that climate change is real, caused by human activity, serious, and soluble, it is not fit for [its] purpose. Students, and the rest of society, deserve better.”

Glenn Branch is deputy director of NCSE. branch@ncse.ngo



EDUCATION IN TEXAS...AND BEYOND



it amounted to pushing a “political agenda.”

So this year the TFN Education Fund worked with NCSE to conceive a research project examining how well science standards in every state across the country address the overwhelming evidence that human-caused climate change is a global crisis. Our two research teams worked together over the course of nearly a year to plan the project, recruit scientists to evaluate state standards, and then write and release the report in a national press conference in September 2020.

Our investment of resources in this project was well worth it. The final report, [“Making the Grade: How State Public School Science Standards Address Climate Change”](#) (see p. 3 for a detailed description of the report), highlights where science standards fall short both in Texas and across the country.

In fact, the Texas science standards barely mention climate change. In one of the brief instances in which they do, the standards actually suggest—falsely—that scientists are debating whether climate change is even happening. We are using that

information in our efforts to mobilize grassroots activists, scientists, and educators to put pressure on the board to ensure that the next generation of Texas students learn the facts about climate change.

This work will also have an impact on science education across the country. The report will be useful as NCSE rallies support for improved treatment of climate change in state science standards in other states in coming years. (Pennsylvania and South Carolina are in the midst of such revisions now, with improvements expected.)

All of this work—and our valued partnership with NCSE—is an important part of our efforts to build a grassroots network and promote an informed policy agenda to bring important change to Texas. And that change begins in our public school classrooms.

Val Benavidez is President of the Texas Freedom Network Education Fund. president@tfn.org





Don Haas has had a long and distinguished career working with science educators to

ensure that climate change is taught accurately and effectively. Currently the Director of Teacher Programming at the [Paleontological Research Institution](#) (a 2019 winner of NCSE's Friend of the Planet award), Haas began his career in education as a high school science teacher and is a past president of the National Association of Geoscience Teachers. He is co-author of the books [The Teacher-Friendly Guide to Climate Change](#) (2017) and [The Science Beneath the Surface: A Very Short Guide to the Marcellus Shale](#) (2013) and a past contributor to *RNCSE*.

Paul Oh: Tell me about your work at the Paleontological Research Institution.

Don Haas: I like to describe my job as helping educators kick butt in their teaching, and helping learners understand the nature of Earth's systems. My colleagues and I provide teacher development programming, which I help coordinate with an awesome team. Now, because of the pandemic, we do that online. We develop resources to help educators of all sorts, and also to help the general public, better understand the nature of the history of Earth and its systems, and how those two pieces play together. That includes contributing to books and curriculum materials and developing labs and working on exhibit development. Though I don't take the lead on any of that, I participate a fair amount. I've been at PRI full time since 2008. But I did some grant work with PRI in 2005 when I was a professor of science and math education at Colgate University and then when I was visiting faculty at Cornell from 2001 to 2003. So I've been connected with PRI for a bunch of years. And the whole time I've been involved, I've seen a growing role for climate education. PRI now has a dedicated Climate Team. That's me, Rob Ross, Ingrid Zabel, and Alexandra Moore. Most of what I'll talk about here is the work of all of us.

PO: You were instrumental in the creation of the freely available The Teacher-Friendly Guide to Climate Change. Can you tell me how that project originated?

DH: It was funded as part of the outreach for a major National Science Foundation climate science grant at Cornell University. PRI was the outreach partner on that grant, and our work involved writing the book and developing an exhibit on the carbon cycle. It's the 10th in the series of teacher-friendly guides. We have seven regional earth science guides for the US. And there are two teacher-friendly guides to evolution that use non-threatening—non-human—organisms to teach evolution. All were written with funding from NSF and all are free on our [website](#).

PO: What were you hoping to accomplish with The Teacher-Friendly Guide to Climate Change?

DH: We're trying to provide one clear resource for a good overview of the basic science of climate change that's accessible to teachers and also understandable to students. So that's one big piece of what we're hoping to accomplish—building knowledge among educators about climate change and energy science. We are also trying to help teachers navigate some of the political contentiousness related to treating climate change as a real and serious threat that's caused by humans. Understanding how to navigate the social and cultural and psychological issues that surround teaching climate change and energy is critical. Ingrid Zabel, I should mention, was the lead author of *The Teacher-Friendly Guide to Climate Change*. I wrote the chapters that are more social science-ish in orientation, which get at the reasons why there are different challenges for teaching earth science than photosynthesis, for example.

We at PRI are driven to make the world a better place. We think that understanding Earth's systems and the human use of energy and other things that humans do, but mostly our energy-use choices, are changing the world in scary ways. And we want to help people both understand the nature of climate change and energy

systems and understand what role we play in the changing of the climate and what we can do to respond to these changes and to hopefully minimize future bad changes. That's a pretty lofty goal, but hopefully we're making a dent.

PO: You've spent some effort trying to send The Teacher-Friendly Guide to Climate Change out to teachers.

DH: Just as we were about to go to press in the spring of 2017, the Heartland Institute hit the news with what I regard as propaganda—a booklet called "Why Scientists Disagree About Global Warming"—which was sent to every science teacher in the country. And we said to ourselves, "Oh my god, we have to address that in the book." So we added an FAQ section refuting the Heartland Institute's reports. We looked at the claim that this booklet was shipped to 200,000 science teachers and said, "We need to do that too." We do not have the deep pockets of the Heartland Institute, so we launched a crowdfunding campaign and succeeded in getting our book into 15 states before the pandemic shut us down. We're still hoping to get it into all 50 states.

PO: How do you see the work of NCSE supporting what you're doing with teachers?

DH: I think NCSE is a great organization and has really pretty similar goals to PRI. We've known each other for more than my whole time at PRI. Along with our climate change work, we've always focused on helping people understand evolution. We have a big Darwin Day celebration every February, for instance. NCSE helps get the word out about our work, which helps us extend our reach. And we were absolutely delighted to be a Friend of the Planet awardee last year. I should add that [NCSE Deputy Director] Glenn Branch is a member of the advisory board for the Climate Change Education Research Conference that PRI was to host physically in August of this year and which will now be online in January 2021. That's just one of many examples of ways our organizations support one another.

Paul Oh is NCSE's Director of Communications. oh@ncse.ngo





Amanda Glaze-Crampes of Georgia Southern University and **Briana Pobiner** of the National Museum of Natural History were among the 15 new Sinai and Synapses Fellows. A Jewish-sponsored interfaith organization, Sinai and Synapses describes itself as equipping “scientists, clergy[,] and dedicated laypeople with knowledge and skills to become role models, ambassadors and activists for grappling with the biggest and most important questions we face”; the Fellows will be “seeking out models for productive conversation surrounding religion and science” through 2021.

Toby Horn, formerly the co-director of the Carnegie Academy for Science Education, and **Joseph S. Levine**, a biologist and coauthor with NCSE Board President **Kenneth R. Miller** of a series of popular high

school biology textbooks, were both elected as Fellows of the American Association for the Advancement of Science in 2019. Congratulations to both. (And let the NCSE office know if we overlooked your name on AAAS’s list!)

Robert T. Pennock of Michigan State University was elected as president-elect of Sigma Xi and will serve as the society’s president from 2021 to 2022. A philosopher of science whose latest book is *An Instinct for Truth* (MIT Press, 2019), Pennock was among the expert witnesses for the plaintiffs in the *Kitzmiller v. Dover* trial in 2005.

Dan Phelps contributed a column to the *Lexington Herald-Leader* defending the documentary *We Believe in Dinosaurs* (in which he appeared) against criticism from Answers in Genesis’s Ken Ham. “He complains of bias and propaganda, which he is a

master at, and misrepresentations and errors, without being able to provide a specific example of anything factually wrong,” Phelps wrote. “In fact, the filmmakers were careful to let everyone speak for themselves with very little commentary. This is clear to anyone who has actually seen the film.” His column appeared on March 16, 2020.

After a teacher in Holland Patent, New York, was in the news for deprecating evolution in his science class, **Frank Price** contributed a column to the *Utica Observer-Dispatch* debunking common misconceptions about evolution, science, religion, and law. Especially at a time when a pandemic is underway, he concluded, “Correct understanding of evolution and science are critical.” His column appeared on March 21, 2020.

NCSE’s Branch honored with NABT’s Evolution Education Award

NCSE’s Deputy Director Glenn Branch received the Evolution Education Award for 2020 from the National Association of Biology Teachers. Sponsored by BSCS Science Learning, the award recognizes “innovative classroom teaching and/or community education efforts to promote the accurate understanding of biological evolution.”



Branch received the award on November 7, 2020, at the NABT’s Professional Development Conference, held online. He thanked, in addition to his colleagues at NCSE, “all the members, supporters, and friends

of NCSE who make it possible for it to continue its work to promote and defend the teaching of evolution.”

Previous members and supporters of NCSE to receive the award include Teacher Ambassador John Mead in 2019, Amanda Glaze in 2018, Bertha Vazquez in 2017, Jason R. Wiles in 2016, Andrew J. Petto in 2015, Paul Strode

in 2013, James Krupa in 2012, Mark Terry in 2011, Randy Moore in 2008, William F. McComas in 2007, and Steve Randak in 2002.

UPDATES

Are there threats to effective science education near you? Do you have a story of success or cause for celebration to share? E-mail any member of staff or info@ncse.org.

ARIZONA

Senate Bill 1368, introduced in January 2020, would have, if enacted, revised the state science standards to “include instruction on climate change using the 2013 Next Generation Science Standards.” Climate change is already part of one of the “Core Ideas for Knowing Science” in Arizona’s current state science standards: “The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth’s surface and its climate.” The bill evidently died in committee.

CALIFORNIA

Assembly Bill 1922, introduced in January 2020, would have, if enacted, amended California’s adopted course of study for science to include “coursework including material on the causes and effects of climate change” from grades 1 to 12. Additionally, at least one of the two courses required for graduation from high school would have to include such material. California adopted the Next Generation Science Standards, which address the causes and effects of climate change, in 2013. The bill died in committee.

CONNECTICUT

House Bill 5215, introduced by the Joint Committee on Education in February 2020, would have amended the Connecticut General Statutes to require the teaching of climate change in science classes consistent with the Next Generation Science Standards (which Connecticut adopted in 2015). Similar to a string of similar proposals in the 2018 and 2019 legislative sessions including Senate Bill 345 in 2018 and House Bill 5011 in 2019, the bill ultimately appears to have died in committee.

HAWAII

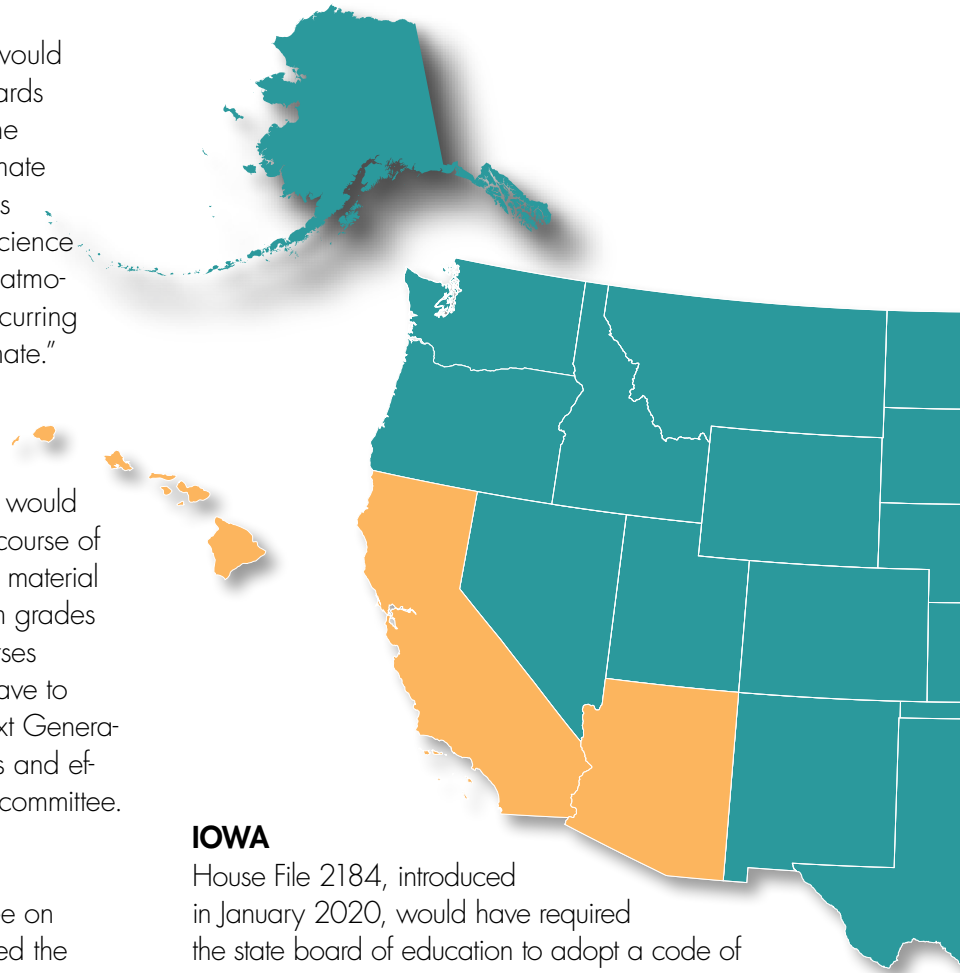
Describing Hawaii as “susceptible to climate change impacts in weather change, sea level rise, and natural disasters that can affect critical infrastructure and local economy,” Senate Concurrent Resolution 58, introduced in the Hawaii Senate in March 2020, would have, if adopted, urged the state department of education to “mandate a climate change curriculum in all public schools by no later than school year 2021-2022” and to incorporate such a curriculum in its 10-year plan. The resolution apparently died in committee.

IOWA

House File 2184, introduced in January 2020, would have required the state board of education to adopt a code of ethics to prevent public school teachers in the state from engaging in “political or ideological indoctrination,” defined so as to include teaching evolution and climate change. Two of the bill’s sponsors previously introduced legislation targeting the Next Generation Science Standards in part due to concerns over their inclusion of these topics. The bill died in committee in February 2020.

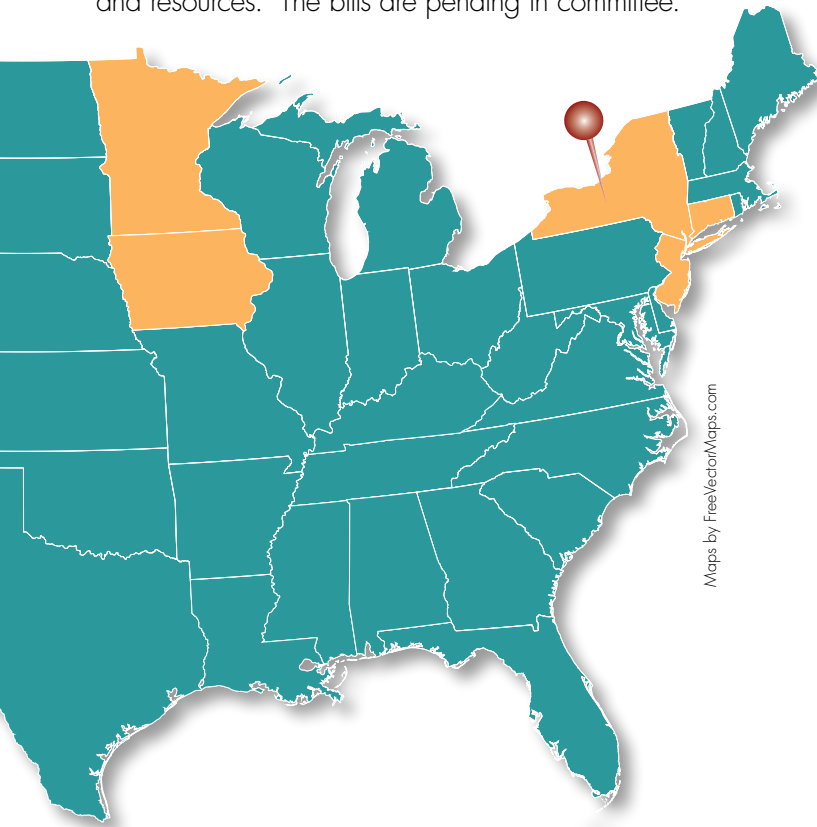
MINNESOTA

Senate File 3517, introduced in February 2020, would have required public school districts “to embed climate change education throughout all subject areas, not just in science curriculum” and allocated \$1 million yearly for the purpose, while Senate File 3949, introduced in March 2020, would have encouraged public school districts “to include practical, age-appropriate instruction on climate change in ... kindergarten through grade 12 curriculum,” with “starting a school garden or composting” offered as examples. Both bills died in committee.



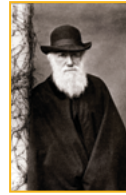
NEW JERSEY

Senate Bill 1970 and Assembly Bill 2767, introduced in the New Jersey legislature in February 2020, would, if enacted, require local school districts to include information on climate change in their curricula and to adopt instructional materials that “accurately portray changes in weather and climate patterns over time, the impacts of human activity on changes in weather and climate patterns, and the effects of climate change on people and resources.” The bills are pending in committee.



NEW YORK, HOLLAND PATENT

On behalf of a concerned parent, the Freedom from Religion Foundation wrote to the Holland Patent Central School District in February 2020 to complain about a high school biology teacher who was allegedly “undermining the theory of evolution, denigrating those who understand and accept the fact of evolution and ... falsely describing evolution to students using commonly debunked attacks on evolution” in his classroom. The district reportedly took action with the teacher to address the concerns.



NATIONAL

Darwin Day resolutions were introduced in both houses of Congress again in February 2020. The identical resolutions—House Resolution 847 and Senate Resolution 495—would, if passed, express support of designating **February 12, 2020**, as Darwin Day and recognition of Charles Darwin himself as “a worthy symbol of scientific advancement on whom to focus and around whom to build a global celebration of science and humanity intended to promote a common bond among all of the people of the Earth.”

UNITED KINGDOM, LONDON

Bnois Jerusalem Girls School in the London borough of Hackney was criticized in a December 2019 report by inspectors for Ofsted, the government agency responsible for inspecting schools, for, inter alia, teaching creationism in geography and science in accordance with the religious views of a segment of Orthodox Judaism. Independent schools in Britain are allowed to teach creationism “as part of a belief system” but not “as having a similar or superior evidence base to scientific theories.”



WHAT WE'RE UP AGAINST

A Streaming Pile of Young-Earth Creationism



The young-earth creationist ministry Answers in Genesis launched a streaming media platform of its own—Answers.tv—on May 1, 2020. According to the ministry’s CEO and founder Ken Ham, the platform was prompted both by the coronavirus pandemic (which caused the temporary closure of AiG’s Creation “Museum” and Ark Encounter) and by “the phenomenal impact AiG was having through social media with livestreaming and the enormous impact of AiG speakers ... through hundreds of videos.” AiG is charging \$4.99 per month for access to Answers.tv. In a May 1, 2020, post on The Friendly Atheist blog, Hemant Mehta reported on his exploration of the content available on the platform, sarcastically concluding, “the amount of misinformation you digest will take time and money to undo. For your sake, if you’re stuck at home right now and eager to watch new content, just bang your head into a wall and wait until you see stars.”

—GLENN BRANCH

GRADING “MAKING THE GRADE?”: NCSE TEACHER AMBASSADORS REACT

In theory, the connection between state science standards and the science classroom is clear: the standards specify what knowledge and abilities students are expected to gain in the science classroom.

The reality can be a bit less straightforward.

Do teachers actually teach to the standards? What if the standards are subpar—inaccurate or inappropriate? What if the local community is hostile to the ideas contained in the standards? How might a teacher handle situations like these? And how else do standards affect the day-to-day work of science teachers?

Recently, NCSE teamed up with the [Texas Freedom Network Education Fund](#) to assess the treatment of climate change in science standards from all 50 states and created a report card of sorts: “[Making the Grade? How State Public School Standards Address Climate Change](#)” (see p. 3 for more on the report). Since publication of the report, there have been newspaper editorials decrying the situation in states that received poor marks, and responses from departments of education acknowledging the shortcomings of their standards or protesting that they promote climate change education in different ways.

But we were curious: do those in the trenches—the science teachers—care about a report like this, and what do they make of its findings?

So we touched base with three of our Teacher Ambassadors—master teachers from across the country—to get their take on the significance of the report and their reaction to the grade each of their state’s science standards received when it came to climate change.



Kim Parfitt

“I shared this report with a number of people,” says [Kim Parfitt](#), who taught earth science, biology, and AP biology

for nearly 20 years in Wyoming, a state that received an A for its treatment of climate change.” And they were gob-smacked.” Wyoming, Parfitt acknowledges, would probably not be at the forefront of most people’s minds as a place where climate change education has a strong foothold, given the importance of fossil fuel production to the state’s economy. But, she says, the Wyoming she knows takes climate change—and potential solutions, such as wind-generated power—seriously.

That said, Parfitt points out there can be a disconnect between the state standards and actual classroom instruction. “People could misinterpret and say Wyoming is getting an A in climate change classroom instruction. And I don’t know if that’s the case. I don’t know if anyone has evaluated what’s actually being taught.”

[Melinda Landry](#), a high school environmental science and biology teacher in Virginia—a state that received an F—

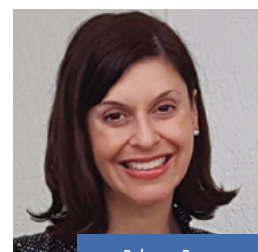


Melinda Landry

echoes that point. “These standards and that grade don’t represent what’s happening in the classroom—at least among

the teachers I know,” she says. Landry points out that the state’s curriculum framework, based upon the state’s science standards and meant to articulate specific content knowledge and skills, is ultimately more of a polestar for teachers. “In my curriculum framework for AP environmental science, it’s clearly spelled out—all the key points that the report reviewers looked for,” Landry says.

“The human effect, what climate change is doing to biodiversity, what it’s doing to humans across the planet, possible solutions. So I make sure it’s clearly spelled out in my classroom, too.”



Rebecca Brewer

Though teachers may not necessarily teach to the standards, Landry believes that identifying climate change in state science

standards does mean the topic is more likely to be covered. [Rebecca Brewer](#), a high school biology teacher from Michigan (which received a B+), agrees.

“If it’s in the science standards, even if you’re unsure about climate change, you probably realize it’s your job, that you have to teach this.”

Parfitt says having strong climate change standards—which in the case of Wyoming have been created by local representatives from districts around the state—can provide support for teachers who are dealing with students, parents, and even administrators who may be climate change skeptics. “If teachers do run into conflict, they can say, ‘This is what I actually need to be teaching.’”

Ultimately, Brewer sees the “Making the Grade?” report as a call to action.

“I don’t think a B+ is acceptable,” Brewer says of Michigan’s grade. “I think we all need to aim higher. This is about our future, about having a sustainable environment for future generations. It’s too important for all of us not to want to be As. And if you’re already an A? Figure out how you can keep improving on instructional practices.”

Whether your state’s science standards got an F, an A, or a score in between, there’s room for improvement. And the stakes couldn’t be higher.



Paul Oh is NCSE’s Director of Communications. oh@ncse.ngo

PLACE & TIME

Wyatt Archaeological Museum

The Wyatt Archaeological Museum opened in 1994 in Gatlinburg, Tennessee, and three years later moved to its current location in Cornersville, Tennessee. The museum, which displays the research of self-styled biblical archaeologist Ron Wyatt (1933–1999) and his colleagues, promotes young-earth creationism and the literal truth of the Bible.

Wyatt, who began studying Noah’s Ark in 1977, was especially intrigued by aerial photographs of a “boat-shaped object” in eastern Turkey taken in 1959 by a “Turkish captain.” In 1987, Wyatt was invited by Turkish officials to look for the Ark. He claimed to have found the Ark that year, with the exact dimensions as described in the Bible, 11 miles from Mount Ararat on Doomsday Mountain. Wyatt’s museum includes a six-foot-long model of Noah’s Ark that is displayed in a room dedicated to Noah’s Flood.

Wyatt’s museum also displays a petrified antler, a coprolite, and some of the actual wood from the Ark he discovered, which has no growth rings. Wyatt’s discovery was featured in the June 21, 1987, issue of the Turkish newspaper *Hurriyet* and later on news programs throughout the world. A video shown at the museum includes government officials announcing Wyatt’s discovery and cutting the throat

of a lamb in a “holy sacrifice” to protect the site from evil. Wyatt claimed that in 1989, the site became “Noah’s Ark National Park.”

On January 6, 1982, while excavating north of Jerusalem, Wyatt claimed to have found the Ark of the Covenant. He took pictures of his discovery, but, conveniently, “none of the pictures came out.” According to Wyatt, Israel asked that he not share any of the physical evidence that he collected about the Ark of the Covenant. Wyatt claimed that Jesus Christ had been crucified directly above the chamber containing the Ark of the Covenant, and that his blood seeped through a crack in the ground and into the Ark’s chamber, where it dripped on the “Mercy Seat” (i.e., the earthly throne of God) formed by the top of the Ark of the Covenant. Wyatt collected some of the blood from the Mercy Seat, reporting, “I’ve seen that blood [of Jesus]. I’ve taken samples of it. It’s been analyzed. It’s unique.” Wyatt claimed that “geneticists” had analyzed the blood (“with an electron microscope”) and concluded that “In Christ’s blood, there are 23 X chromosomes and one Y [chromosome]. There was not a human father.” After Wyatt’s “discovery” of the Ark of the Covenant, he could not get permits to return for more study. A visit in 2011 led by Wyatt’s friend and colleague Richard Rives with 65 volunteers in 2011 did not return to the Ark of the Covenant site.



Photo courtesy of Randy Moore

The Wyatt Archaeological Museum in Cornersville, Tennessee, displays the work of Ron Wyatt supporting a young Earth and biblical literalism

On other adventures, Wyatt claimed to have discovered the “Golden Calf Altar,” Mount Sinai in Saudi Arabia, and “undeniable evidence” of the location of Sodom and Gomorrah, which included several buildings, a sphinx, and “scientifically confirmed” brimstone. In 1978, at the Gulf of Aqaba, Wyatt claimed he found the “Red Sea Crossing,” which included coral-encased and gold-veneered chariot wheels, a horse’s hoof, and a human arm, hand, and ribcage. Wyatt’s discovery again made international news.

The Wyatt Archaeological Museum is located at 2502 Lynnville Highway in Cornersville, Tennessee (phone 931-293-4745). Tours are by appointment. The museum is managed by Rives, who lives next door and is the father of famous young-earth advocate David Rives, the founder of David Rives Ministries.

Randy Moore is the H. T. Morse–Alumni Professor of Biology at the University of Minnesota, Twin Cities. His most recent book, coauthored with Roslyn Cameron, is *Galápagos Revealed: Finding the Places that Most People Miss* (Galapagos Conservancy, 2019). Rmoore@umn.edu



“THEORY TO PRACTICE”

When communicating science to the general public, scientists must make their writing even more accessible. In addition to crafting pieces that are understandable, scientists must consider the reader’s background and point of view in order to drive interest in science or effect change in attitude. For many scientists, writing a piece that resonates with the public means first thinking about their work in novel contexts—such as how it may affect public policy or human health. Scientists must also explain difficult concepts to the public audience in a way that is understandable but not patronizing.

NCSE is committed to helping graduate students communicate the science of climate change and evolution effectively. The students participating in our [Graduate Student Outreach Fellowship](#) spend a year exploring how best to engage their communities in hands-on activities and immersive science experiences. While these local outreach efforts can be effective at leverag-

ing community context to help the public understand complex science, their in-person nature limits their ability to reach a broad, national audience. To overcome this issue, we encourage fellows also to write about their work in a series called “Theory to Practice.”

“Theory to Practice” articles challenge the fellows to combine scientific literature with their understanding of how the science they’re studying is applied. We encourage fellows to employ multiple formats, such as expert interviews, infographics, and personal narratives. After choosing a topic, each fellow writes several case studies and then works to find a narrative thread that connects the pieces and makes them understandable to a broader audience. For example, [Annie Stoeth](#), a doctoral student at the City University of New York, decided to showcase the complexity of the nation’s growing trash issue by asking a single, resonant question, “Is recycling worth it?” Through her piece, readers explore the numerous alternatives



Climate Change: From Literacy to Action by Annie Stoeth

For the most part, recycling is a more climate-friendly

option than landfilling, but that doesn’t mean that ten-bin systems are our future. Not all garbage is created equal, after all. Some waste is made to be recycled, while other waste isn’t worth the investment in extra trucks and infrastructure. Among the best recycling candidates are metals, especially those of the non-ferrous variety. The energy savings from avoidance of primary extraction, refining, and transportation makes metal the perfect material for recycling, so much so that recycling plants will buy metal waste from you. In some cities, metal recycling is an informal economy in and of itself. Glass is also perfect for recycling, although its fragility and weight can make it harder to

transport and protect than metal, resulting in lower carbon savings. Both metal and glass can be recycled indefinitely.

Paper is also a great candidate for recycling. Paper production, not to mention taking stored carbon (living trees) out of the ground, is very energy-intensive. Recycled paper production can be half as costly. By recycling paper, you also prevent it from decomposing in the landfill and releasing carbon rich greenhouse gases to the atmosphere. Unfortunately, paper can only be recycled about 5 times before it loses its integrity.

Food and plastic, on the other hand, are complicated. For plastic, much like trash in general, compositional heterogeneity impedes material processing. Different plastics behave differently and their varied compositions make some of them reasonably good candidates for recycling, with many others virtually impossible. Overall,

however, plastics are less energetically costly to produce from scratch than to recycle. Food is also tricky. Recycling food waste, via composting, helps return organic carbon to the soil system and can facilitate soil carbon stabilization via microbial processes. Composting produces a good deal of carbon dioxide, but it is more climate friendly than landfilling, in which decomposition occurs in oxygen-poor environments and produces methane, a greenhouse gas approximately 30 times more powerful than carbon dioxide, as a waste product. However, limited composting is not the reason food waste has become a climate issue. Crucially, the carbon emissions associated with food waste have less to do with final disposal strategies than with waste created along the supply chain.

(Read the full article: <https://ncse.org/climate-change-literacy-action>)

IN THEORY AND PRACTICE

to recycling and what the science says about their value. By asking a simple question, Stoeth was able to provide an accessible look into a complex, and growing, problem.

For other fellows, writing “Theory to Practice” articles can be a way to combine their academic research with outside interests. [Christie Vogler](#), who worked at the Iowa Children’s Museum while pursuing her doctorate in anthropology at the University of Iowa, chose to explore the science behind learning through play. In her piece, she interpreted some of the dense psychology and educational theory about the science of play through the lens of her experiences at the local science museum. [Catherine Henry](#), a fellow at Michigan State University, found her own love of forestry and outdoor education to be the link connecting all her case studies. Through tales about restoration efforts in her local Lansing, Michigan, forests, she makes an impassioned argument for place-based climate change education.

For many of the fellows, the most difficult part of the writing process was feeling confident in writing about something tangential to their own research. [Abigail Howell](#) at Arizona State University studied issues related to genetic literacy throughout her NCSE fellowship and wanted to understand how these issues manifest themselves in K–12 education. Her “Theory to Practice” project thus meant stretching herself not only to conduct interviews with teachers but also to tackle the labyrinthine Arizona state science standards. Through her work interpreting them and incorporating the feedback of experts, Howell has learned how to write better for the public and in her own academic work.



Below are two excerpts from our fellows’ “Theory to Practice” articles. Use the QR code at left or visit <https://ncse.ngo/articles/380> to read the rest of the set.

Kate Carter is NCSE’s Director of Community Science Education. carter@ncse.ngo



Modern Genetics Activities for a Modern World: Emphasizing Genetics Literacy in K–12 Education

 by Abigail Howell

Adopted in October 2018, the Arizona state science standards aim to make students “scientifically literate” and “college and career ready.” Batty and I talk through the standards relevant to genetics, and when we come to the standard “Communicate how advancements in technology have furthered the field of genetic research and use evidence to argue about the positive and negative effects of genetic research on human lives,” I ask what that is supposed to involve. Batty isn’t sure.

In the absence of any concrete guidance from the standards, Batty explains, she nevertheless attempts to discuss genetic technology and genetics in society. “We use clips from [the personal genomics com-

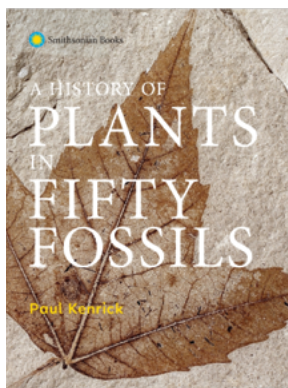
pany] 23andMe, just explaining some of the things they do, after we’ve covered the basics. But when they start getting into the SNPs [single nucleotide polymorphisms], that seems to be where the kids’ brain capacity maxes out,” she says.

So Batty has already gone beyond what the standards dictate, because they really don’t give her a lot to go on. How should she decide which genetic technologies to discuss? Which ethical discourses should she include, and which would be frowned upon by the district? How does she delicately approach the political implications of current genetic technology in one of the most contentious eras of American politics? The rapid advancements in genetics technology, combined with unclear state standards and high-stakes standardized testing, makes teaching and learning about genetics difficult in a K–12 classroom.

Glaringly absent from the state standards is the concept of genetic literacy: having the knowledge and ability to understand and make decisions about how genetics influences your everyday life. Such decisions may include whether to pursue genetic counseling in light of the results of an at-home DNA testing kit; whether the privacy risks of sharing your genetic data outweigh the potential health benefits; whether consuming genetically modified foods is safe; and whether the results of a study identifying a gene for alcoholism can be used to develop medical treatments or are sensationalized and unreliable. Rather than rote memorization of content, genetic literacy education focuses primarily on critical reasoning skills related to genetics and its everyday implications.

(Read the full article: <https://ncse.ngo/modern-genetics-activities-modern-world-emphasizing-genetics-literacy-k-12-education>)

THE RNCSE REVIEW



A History of Plants in Fifty Fossils

author: Paul Kenrick

publisher: Smithsonian Books

reviewed by: Stanley Rice

Everybody likes stories, preferably short ones. Even us scientists, who are always busy, would rather read short vignettes than long tomes. [*A History of Plants in Fifty Fossils*](#) provides this experience. One-to-two-page explanations accompany each of the fifty nice images of plant fossils. Reading this book is like strolling through a gallery or a science museum rather than like taking a paleobotany course.

Kenrick engages readers right from the start: “It’s not easy being a plant...” Indeed, this book explores, just briefly, many interesting concepts of ecology, such as the coevolution of plants and animals. As a result, although this book has no animal fossil photos, you can learn a lot about the animals that lived and interacted with the plants. Kenrick makes you

feel as if you are present in the ancient environments. I’ve read a lot about lepidodendrids—tree-like plants from the Carboniferous—but only upon reading this book did I realize that a lepidodendrid forest would cast very little shade.

Upon reading this book, you learn that fossils tell a lot of stories that are not immediately obvious. One Devonian wood fossil shows exquisite preservation of the xylem. In order to be preserved so well, the wood had to be burned and become charcoal. Therefore, the oxygen in the atmosphere had to be at least 15 percent, below which fires cannot burn.

Many of the stories are ones I’d never heard. I did not know that waterferns grew abundantly in the Arctic Ocean (in a thin layer of fresh water atop the salt water) for about 800,000 years, remov-

ing so much carbon from the atmosphere that they may have been the most important reason that the climate of the Earth cooled after the Eocene epoch, and contributing to much carbon to the sediments that they may prove an important contribution to the emissions of methane from the Arctic Ocean sediments.

Of course, Kenrick also includes the stories that botanists know but which are surprising to general readers. One example is the barely-fossilized remnants of large tree bases on Axel Heiberg Island. It is so close to the North Pole that the environment today is polar desert. Because such islands have not moved very much since the time that these trees grew on them, the polar environment must have been much warmer than it is today.

This is the book for someone who is interested in plant evolution but does not have time to read a long and thorough book. Especially in the light of the comparative neglect of plants in expositions of evolution in general, science educators will be happy to see it.

Stanley Rice is Professor of Biological Sciences at Southeastern Oklahoma State University. SRice@se.edu



Friend of Darwin and Friend of the Planet Awards of 2020

NCSE is pleased to announce the winners of the Friend of Darwin award for 2020: **Joe Felsenstein**, Professor Emeritus of Genome Sciences and of Biology at the University of Washington; the late **Larry Flammer**, a master biology teacher famously devoted to advancing evolution education through his teaching, writing, and mentorship; and **William McComas**, Parks Family Professor of Science Education at the University of Arkansas and editor of *The American Biology Teacher*.

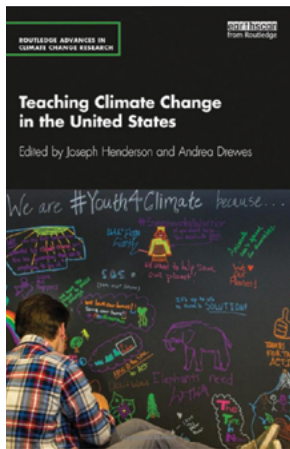
“The Friends of Darwin for 2020 have made profound contributions to the cause

of evolution education and to NCSE in a variety of ways,” commented NCSE’s executive director Ann Reid. “Joe Felsenstein is a towering figure in phylogenetic inference and theoretical population genetics, two scientific areas central to the study of evolution. Larry Flammer was the very model of a dedicated evolution educator in the classroom, online, and beyond, while William McComas continues to provide unparalleled leadership in evolution education.”

NCSE is also pleased to announce the winners of the Friend of the Planet award for 2020: **Jacquelyn Gill**, Associate Pro-

fessor of Paleoecology and Plant Ecology at the University of Maine and host of the “Warm Regards” podcast; **Frank Niepold**, the Senior Climate Education Program Manager and Coordinator at NOAA’s Climate Program Office and a founding member and co-chair of the leadership board of CLEAN; and **Spencer Weart**, the physicist-turned-historian who wrote *The Discovery of Global Warming* (2003; revised edition, 2008) and its constantly updated online companion.

“Both in her research and her outreach on climate change, Jacquelyn Gill has been



Teaching Climate Change in the United States

editors: Joseph Henderson and Andrea Drewes

publisher: Routledge

reviewed by: Glenn Branch

In *Teaching Climate Change in the United States*, Joseph Henderson and Andrea Drewes have assembled a dozen essays with the aim of highlighting “best practices in climate change education, as well as explaining the ongoing challenges that hinder progress toward climate mitigation and adaptation” (p. 5). To be clear, these are best practices for climate change education programs as a whole, rather than for individual educators: there are no tips for teachers to be found here. The book is distinctive in three main ways.

First, the chapters typically take the form of case studies of particular climate change education programs, co-authored by the researchers and practitioners who conducted them. As case studies, they are for the most part highly readable, abounding in interesting anecdotes, candid narratives, and

thoughtful insights. They clearly benefit from the complementary perspectives of their authors, whether they take the form in the text of a dialogue (as in chapters 4 and 6) or alternating voices (as in chapters 2 and 3) or otherwise.

Second, the book recognizes the wide variety of the venues in which climate change education occurs. The paradigmatic venues, middle and high school science classrooms, are discussed (primarily in chapters 2 and 3), but there is also discussion of such venues as kindergarten (chapter 4), classes in the humanities (chapter 5), and informal learning environments (chapters 9, 10, and 11). Moreover, and uniquely, there are discussions of climate change education in professional development and through professional organizations (chapters 6, 7, and 8).

Third, as the editors explain, although education for climate literacy is important, their focus is particularly on education for climate action, including “confronting entrenched systems of power” (p. 3). Not all of the chapters focus on climate action, but those that do are quite clear about it, even in their titles: “Engagement for climate action” (chapter 11, describing Climate Generation’s work); “Science alone will not save us. Civic engagement might” (chapter 13, coauthored by Michael E. Mann, a member of NCSE’s board of directors.)

Anyone involved in improving and expanding climate change education, particularly beyond middle and high school science classrooms, will find the essays contained in *Teaching Climate Change in the United States* to be a useful source of information and guidance as they pursue their own projects. And anyone who appreciates the urgent and continuing necessity for education for climate literacy and climate action will find the stories of struggle and success to be nothing short of inspiring.

Glenn Branch is deputy director of NCSE.
branch@ncse.ngo

nothing less than extraordinary,” Reid explained, “while Frank Niepold has been a truly indispensable part of practically every important climate education effort in the United States over the last two decades.” She added, “Spencer Weart’s work on the history of climate science is not only a riveting narrative but also a reminder of how solid the science underlying the present scientific consensus on climate change is.”

The Friend of Darwin and Friend of the Planet awards are presented annually to a select few whose efforts to support NCSE and advance its goal of defending the teaching of evolution and cli-

mate science have been truly outstanding. Previous recipients of the Friend of Darwin award include Barbara Forrest, David Hillis, Neil Shubin, and the Texas Freedom Network. Previous recipients of the Friend of the Planet Award include Richard Alley, Naomi Oreskes, and the Paleontological Research Institution.

Additionally, NCSE is presenting a special award to Macewill “Max” Yip. A volunteer at the NCSE office since 2012, Yip has helped out with projects that range from curating NCSE’s archives to entering data, guiding youth volunteers, and developing science activity kits. “That’s what I

appreciate most about Max—he has the flexibility and talent to take on any project and truly make it better,” said Kate Carter, NCSE’s Director of Community Science Education. Yip’s work behind the scenes has been instrumental to the success of NCSE.



CHANGE SERVICE REQUESTED

Kitzmiller v. Dover 15-Year Anniversary

NCSE is proud to have played a role in history



Richard Katskee
Pro bono attorney
representing the
plaintiffs in the
Kitzmiller v. Dover trial

The “intelligent design” movement hopes to trick people into thinking that a religious view is science rather than a matter of belief. The wonderful people at NCSE didn’t just supply the scientific expertise to expose that subterfuge; they also taught the legal team how to talk about science in ways that would be intelligible and engaging for the court, the media, and the public.

NCSE was so important during the trial. NCSE played a huge role in the judge’s decision.



Jen Miller
Science teacher
involved with the 2005
Kitzmiller v. Dover trial



Tammy Kitzmiller
Parent and
plaintiff in the
Kitzmiller v. Dover trial

NCSE’s involvement with *Kitzmiller v. Dover* was pivotal in establishing a clear and concise link between “intelligent design” and weaving creationism into Dover’s science curriculum. Not only did NCSE stand up for science, they stood up for ordinary citizens and for that, I will forever be grateful.

[NCSE.ngo/donate](https://www.ncse.ngo/donate)