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Teaching Science From A Distance p.3

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Dear NCSE members,

On March 19, 2020, when the previous issue of *RNCSE* was being finalized, NCSE was beginning its first week of working from home. I still thought a long-planned family trip to Hawaii in May might happen. I definitely thought another planned trip to New York City over Memorial Day weekend would happen. Well, here it is mid-June, and not only did I not go to Hawaii or New York, I have barely left my San Francisco house for well over two months.

You might have thought I'd have been more prescient, having spent almost a decade of my life studying the virus that caused the 1918 influenza pandemic. I'm a more sober judge now. Having failed to shut the spread of the coronavirus down quickly, we now probably face many months—possibly even years—of surges and retreats until a treatment, a vaccine, or the gradual acquisition of herd immunity brings the virus to heel.

At NCSE the pandemic inspired us to redouble our efforts to help science teachers bring accurate information to their students. And not only students—the pandemic has revealed a deep hunger in people of all ages for explanations and predictions. Most people look to scientific and medical experts for help in wading through a sea of information that is often premature, overhyped, misleading, or downright wrong. So NCSE is stepping up as a trusted source to provide resources for teachers to help them help their students identify not only faulty information, but also—and perhaps even more importantly—faulty reasoning. The pandemic offers constant incentive and daily opportunities to improve everyone's critical thinking skills.

In this issue of *RNCSE*, you will learn of the many ways we've adapted our programs to better fit a world where everyone is learning at home. I have never been prouder of the NCSE team—each and every one of them has adjusted to all the changes forced by the pandemic with grace and good humor. Thank you so much for your continuing support of our work. I think that it is beyond dispute that working to improve science education has a particular urgency right now, whether we're doing it from a distance or face-to-face.

Thanks for your support, and take care of yourselves.

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

Teaching Science from a Distance

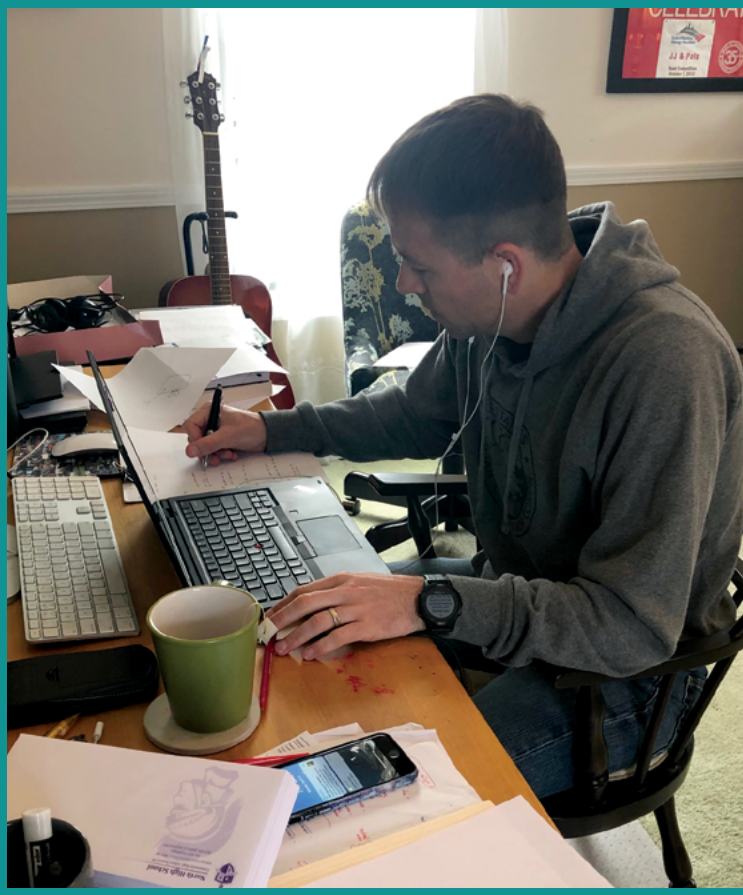
Blake Touchet is an award-winning biology teacher in Louisiana. He is a Teacher Leader Advisor working with the Louisiana Department of Education, a workshop presenter on behalf of among others the Teacher Institute for Evolutionary Science, and an integral member of NCSE's Teacher Ambassador corps. Yet for all his accomplishments, one thing he has never had to do is teach online.

Until now.

Blake Touchet *Photo Brooke Broussard*

"It's been a huge learning experience," Touchet comments. "There are a lot of teaching practices that I typically do in my own classroom that didn't or couldn't translate well to online learning. But through trial and error, my students and I figured it out."

Touchet's experience reflects what has seemed to be true for most if not all the NCSE Teacher Ambassadors—they were thrown headfirst into a new and challenging distance learning situation and figured out ways to make things work despite the many (and sometimes enormous) obstacles. We spoke with a number of Teacher Ambassadors in the spring of 2020, while school was still in session, to get a better sense of how they were approaching the difficult task of teaching their students from afar. Jeff Grant, who teaches biology and anatomy/physiology at Downers Grove High School in Downers Grove, Illinois, set up virtual office hours and created bite-sized lessons for his students, but still saw participation dwindle. "It's like trying to help a kid when they're out sick for a day," Grant says. "Except now they're all out sick, every day."



Jeff Grant teaching from his home office *Photo courtesy of Jeff Grant*

Meanwhile, Touchet recognized that his students had other obligations—caring for siblings or working to stock shelves at the local grocery store in the rural community where he teaches—so he gave up on synchronous class time. Instead, he developed asynchronous learning opportunities so his students could engage when they had time. "I teach seniors and probably half of them moved to working full-time once school closed—they really were needed here in our small community to keep things running," Touchet explains. "I just found the reality of a synchronous learning environment where I would sit down with them and hold a class every day did not work at all."

Andy Epton, who teaches earth science, environmental science, and astronomy at Gretna High School in Gretna, Virginia, had already constructed a website (ghsearth.weebly.com) years earlier to help his students review for the state standardized test. Being able to point his students to that site eased the transition for them when it came to learning course content online. Epton was more concerned about the misconceptions his students seemed to be picking up when it came to COVID-19 and coronavirus. Before his school closed due to the pandemic, his students were inundated with misinformation—from the popular media, from one another, and from a host of other sources of questionable authority.

Andy Epton *Photo courtesy of Andy Epton*

"I got all sorts of questions from my students. 'Is it true that alcohol can cure it?' 'Is it true that marijuana can kill it?' I got that a few times." Epton continues, "Once school ended for the year, I missed being able to correct their misconceptions, to clear their misunderstandings up."

Realizing that teachers around the country would likely run into these same kinds of issues, NCSE Executive Director Ann Reid and Director of Teacher Support Lin Andrews launched a weekly series of articles in March 2020 to explain the science behind the latest novel coronavirus and COVID-19 news. From documenting the reasons why vaccines take so long to develop to explaining how to determine the efficacy of social distancing, the articles are written in an approachable style and include interactive online resources that allow students to dig into the evidence and understand these developments for themselves. "We've all been surprised by the positive reaction to our coronavirus resources, not only from teachers but also from NCSE members and even our own friends and relatives," Reid says. "Anyone who might have thought that most people aren't interested in science should think again—when understanding science feels like a matter of life or death, people are hungry for clear, accurate, and trustworthy information."

Andrews also began meeting online with the NCSE Teacher Ambassadors regularly, giving them opportunities to discuss their current situation with one another and offer advice on how to meet the challenges they face. Despite the summer break, the weekly gatherings continue. During this time, Andrews and the Teacher Ambassadors also work on a set of lessons on the nature of science they hope to have ready for the upcoming school year. Before tackling any business, Andrews starts each session with a chance for the ambassadors to share "good news"—celebrations of their weekly victories, from distance learning successes when they were teaching to effective parenting of their own families. "I feel it is extremely important for them to be able to unwind and say whatever is on their mind about current events," Andrews explains. "I work hard to keep our meetings light and engaging for their own well-being." Additionally, Andrews and Teacher Ambassador John Mead have set up a series of videoconference sessions with prominent scientists in the fields of evolution and climate change—under the punning title "Tea and Synapomorphy"—as a unique professional development opportunity meant to refresh and renew the teacher ambassadors.

NCSE's Breaking Down Barriers program, meanwhile, is trying out new ways to do science outreach without the benefit of face-to-face interactions. Most notably, Director of Community Science Education Kate Carter has embarked on a collaboration with Charlie Kilman, who produces climate change awareness videos for his large YouTube following. Carter has arranged for the program's Graduate Student Outreach Fellows to co-author scripts on topics that spring from their research priorities and work in the fellowship. The first video https://youtu.be/1cvMX82iwRM which was released in early May 2020, focuses on the effects of climate change on biodiversity, using as examples the pollination of wildflowers in the Rocky Mountains, the damage wrought by the recent wildfires in Australia, and the fragile habitat of the honeycreeper, a bird endemic to Hawaii.

"Not only has it been a great opportunity for the fellows to learn about communicating science, but YouTube has enabled us to reach a broader audience than traditional outreach would have," says Carter.

Ultimately, Touchet is optimistic about the prospects for teaching and learning in the fall of 2020, whether face-to-face or online. His advice to science teachers, should distance learning be the norm in the upcoming school year? First, to remember that great teaching resources already exist online. "Nothing needs to be recreated or reinvented." Second, Touchet says, "Stay connected. I have a great network of biology teachers from all over the country that I talk with on a daily or a weekly basis who give me ideas, who I can bounce ideas off of, and who just help keep me hopeful in this time." And, finally, "Do the best you can, stay flexible, be compassionate, and reach out for help if you need to."

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

news from the **membership**

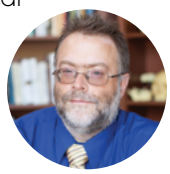
NCSE is pleased to congratulate **Richard E. Lenski** on receiving the American Society for Microbiology's D. C. White Award for 2020 in recognition of his distinguished accomplishments in interdisciplinary research and mentoring in microbiology. The Michigan State University evolutionary biologist famed for his *E. coli* Long-Term Experimental Evolution Project also received NCSE's Friend of Darwin Award in 2017.

Photo: Joshua Yospyn

Congratulations are in order for **Michael E. Mann,** a member of NCSE's board of directors, on his election to the National Academy of Sciences, in recognition of his distinguished and continuing achievements in original research. Mann is Distinguished Professor of Atmospheric Science at Penn State University, with joint appointments in the Department of Geosciences and the Earth and Environmental Systems Institute. He is also director of the Penn State Earth System Science Center. Mann's latest book, coauthored with Tom Toles, is *The Madhouse Effect* (Columbia University Press, 2016). He received NCSE's Friend of the Planet Award in 2014 and was interviewed by Peter Buckland in *Reports of the NCSE* in 2016. Also elected to the National Academy of Sciences was **Anna K. Behrensmeyer** of the Smithsonian National Museum of Natural History.

NCSE is pleased to congratulate **Naomi Oreskes,** Professor of the History of Science at Harvard University and a member of NCSE's board of directors, on receiving the British Academy Medal, for her books (coauthored with Erik M. Conway) *Merchants of Doubt* (2010) and *The Collapse of Western Civilization* (2014), and for "her commitment to documenting the role of corporations in distorting scientific findings for political ends." The president of the British Academy, David Cannadine, commented, "At a time of fake news and the distrust of experts and expertise, there can surely be no better time to acclaim and applaud those who are standing up for truth and evidence."

NCSE's founding executive director **Eugenie C. Scott** was named as a Fellow of GWUP, der Gesellschaft zur wissenschaftlichen Untersuchung von Parawissenschaften (the Society for Scientific Investigation of Parasciences) in March 2019. GWUP is the German cognate of organizations like the Committee for Skeptical Inquiry, of which Scott is also a Fellow.



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

Comings and goings on NCSE's Board of Directors

NCSE is pleased to announce the addition of **Sarah B. George** of the University of Utah to its board of directors. Previously the executive director of the National History Museum of Utah from 1992 to 2019, George is now the University of Utah's chief philanthropy officer. "I'm thrilled to be able to aid NCSE in its important and invaluable work in supporting and defending science education," George commented.

George joins Kenneth R. Miller, Lorne Trottier, Benjamin D. Santer, Michael Haas, Vicki Chandler, Michael B. Lubic, Michael E. Mann, Naomi Oreskes, and Barry Polisky on NCSE's board of directors. At the same time that George joined the board, **Robert "Mac" West** departed, having served on the board a record thirty years—from 1986 to 1988 and again from 1992 to 2020.

West served for all but two of those years as secretary.

"We're going to miss Mac West," NCSE's executive director Ann Reid commented. "As a member of NCSE's board from the beginning he was a model of dedication and support, and his connections to the world of informal science education were invaluable. But we are excited to welcome Sarah George to the board, and I'm confident that she will make a great contribution in helping to guide the organization's efforts in the years to come."

Photo by ???

RanDom Samples with Nathan H. Lents

Nathan H. Lents is Professor of Biology at John Jay College of the City University of New York, where he studies the recent evolution of the human genome in an effort to help understand the underpinnings of human uniqueness. He is also active in promoting the public understanding of evolution, which recently led to his tangling with a variety of creationists. He was interviewed while recovering from a mild case of COVID-19.

*Glenn Branch: The title and subtitle of your latest book—*Human Errors: A Panorama of Our Defects, from Broken Genes to Pointless Bones *(2018)—accurately reflects the topic. But you're not conducting a mere inventory. Can you summarize the message that we should take away from considering these defects?*

Nathan Lents: The main message is that the human body, including our DNA, our cells, our organs, even our minds, have a fair number of, shall we say, quirks. These quirks reveal a body that is not the product of design, but rather a product of evolution, which is sloppy, aimless, and even cruel at times. The quirks are interesting to me for two reasons. First, they are useful for teaching biology, which is a big part of my day job. And second, if we probe them carefully enough, they reveal interesting things about our past. By understanding the forces that shaped our bodies and genes into their current form, we can live in better harmony with our bodies and make better decisions with our minds.

GB: After the publication of Human Errors, *you were surprised, I understand, to discover that it was under attack by creationists, from young-earthers like Kent Hovind to "intelligent design" proponents like the folks at the Discovery Institute.*

NL: Yes, I was completely caught off guard. I assumed they would ignore or laugh off the book, but instead they took great umbrage and wrote articles about me or the book almost daily for a while. In the end, I am happy that they did because it served to recruit me into the cause of the public defense of evolutionary science. As for their concerns, as you can imagine, they are quite incoherent. Many of the articles attempted to quibble with individual quirks that I discuss and spin them as *good* design instead. Other articles attempt to defend "intelligent design" (which I wasn't aiming to attack anyway) basically by saying, "we never said *perfect* design!" And that was just the beginning of the contradictions. I was a little bewildered at first, attempting to counter each criticism, but I soon realized that this was a futile attempt because they would simply ignore my refutations and continue repeating debunked claims as if they were accepted science. What I was experiencing was a sort of Google bomb attempting to overwhelm the public space with their criticisms of the book. They don't have a contained and coherent theory on which their claims rest, so typical academic

PLACE & TIME
Origins Museum of Nature

The Seventh-Day Adventist Church of South America opened its Origins Museum of Nature along Charles Darwin Avenue in Puerto Ayora, Santa Cruz Island, Galápagos, on February 29, 2020. The grand opening was attended by scientists, governmental officials, tourists, and residents of Galápagos. The museum is part of a multipurpose site that includes two research labs and a church, which is located above the museum. Adjacent to the museum are classrooms of the 12-grade Loma Linda Adventist School, which enrolls more than 270 students on its two campuses. The museum stands at the site of the Adventists' famous, but now gone, billboard that quoted Genesis 1:1 ("In the beginning …").

Origins Museum of Nature includes interactive touchscreen monitors, tortoise shells, videos, virtual-reality headsets, and exhibits that feature nature, conservation, and the Adventist educational philosophy. That philosophy, according to Lisa Beardsley-Hardy, Director of the Adventist General Conference's education department, "seeks to restore people into the image of their Creator." Some of the exhibits focus on the unique wildlife of Galápagos, whereas others discuss such diverse issues as supposedly design-related aspects of DNA, the Fibonacci sequence (as manifested as, e.g., spirals in seashells), and blood clotting ("The probability of winning the lottery is 1 in 50 million and the probability of the reaction cascade [of blood clotting] happening is one in 6 billion").

Unlike most creationist museums in the United States, Origins Museum of Nature is not overtly religious.

argumentation doesn't really work. Unmoored by the constraints of consistent logic, they use supports in one criticism, while arguing against those very supports somewhere else.

GB: You teamed up with Richard Lenski and S. Joshua Swamidass to review "intelligent design" proponent Michael Behe's latest book* Darwin Devolves *(2019) for* Science*, writing that he "misrepresents theory and avoids evidence that challenges him." I assume that the review didn't win you any new friends at the Discovery Institute.

NL: It sure didn't. Behe himself, despite his reputation of being mild-mannered, issued a very uncharacteristic rant on the same day the review came out, and then the whole team began to issue rebuttals. They used the same tactic as always: long meandering articles that squirt as much squid ink as possible without actually rebutting the point. But they showed their true colors after my friend Art Hunt and I exposed just how badly Behe botched his opening example of so-called "devolution" (a term that makes no sense in the first place), the evolution of polar bears. The dishonesty and desperation with which they reacted left even some of their supporters ceding the point publicly (and admitting their embarrassment privately). But rule #1 at the Discovery Institute is to never admit a mistake.

GB: You favorably reviewed Swamidass's* The Genealogical Adam and Eve *(2019), which argues for the consistency of a historical Adam and Eve with the deliverances of evolutionary biology, and you've worked with Swamidass to promote the understanding of evolutionary biology among evangelical audiences. Why is this so important?

NL: As an atheist, I see the Adam and Eve story as myth, and the many parallels to other Mesopotamian myths throughout Genesis support that view. However, having grown up in the heartland, I know how important these stories are to millions of people. If they are forced to choose between adherence to their faith and acceptance of modern science, the majority will choose their faith. So Swamidass's proposal for reading Genesis in a way that is compatible with evolutionary theory could represent an important alternative to that choice. Importantly, this is not bending science to accommodate religion; it's reinterpreting religion to comport with science, which doesn't yield to anyone's sensibilities. The idea that Swamidass is defending is not a new one, but he is breathing new life into it after some surprising new data from population genetics taught us that you don't have to go back very far in history to find universal human ancestors. If this allows even some portion of the evangelical community to drop its resistance to evolutionary theory, a tremendous good will have come from this. When it comes to promoting a science-centered society, I favor an all-of-the-above approach. Jerry Coyne and others can fight religion head-on. I am trying a different and more compassionate approach, hoping to bring religious communities to a proper understanding of science without caring about their religious beliefs. If that happens—and trust me, it is happening—it will isolate the hard-core science deniers like Hovind and Ken Ham even more, and they will be left far outside the mainstream.

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

Photo Origins Museum of Nature

On February 29, 2020, the Seventh-Day Adventist Church opened its Origins Museum of Nature on Charles Darwin Avenue in Puerto Ayora, Galápagos.

The most explicit mention of religion is presented in the museum's final exhibit, which is titled "God's Fingerprints" ("Huellas Digitales del Creador"):

Wherever we look, nature reveals signs of planning and purpose. These are signatures of a great God that planned everything in detail. These fingerprints are scattered in the atoms and molecules, in the intricate network of biochemical mechanisms that govern living beings and even in the cosmic vastness that defies our comprehension. Great are the works of His hands, and infinite is His wisdom.

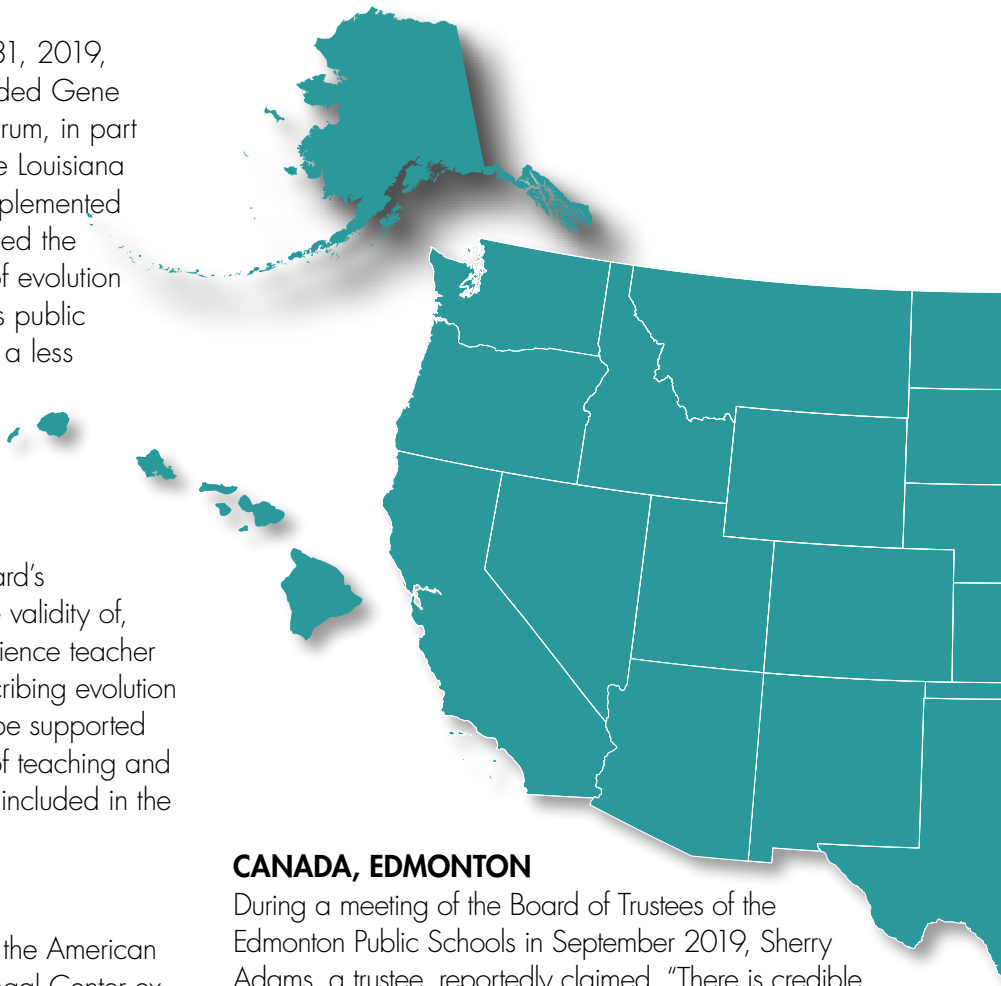
According to Erton Kölher, president of the Adventists' South American Division, the museum offers "an invitation to think about something different … viewpoints that perhaps [visitors] haven't seen. After visiting they might start to realize that a special hand must be behind the processes of nature."

Origins Museum of Nature is marked on Charles Darwin Avenue with a two-meter-tall giant tortoise, which complements the street's other statues of Galápagos animals. Admission to the museum is free.

Randy Moore is a biology professor at the University of Minnesota, Twin Cities. **Roslyn Cameron** is a Galápagos-based communicator. Their most recent publication is *Galápagos Revealed: Finding the Places that Most People Miss* (Galápagos Conservancy, 2019).

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.ngo.



LOUISIANA

Senate Resolution 224, introduced on May 31, 2019, and adopted on the following day, commended Gene Mills, the president of the Louisiana Family Forum, in part because "he was the driving force behind the Louisiana Science Education Act in 2008." The act, implemented as Louisiana Revised Statutes 17:285.1, opened the door for scientifically unwarranted criticisms of evolution and climate science to be taught in the state's public schools. The resolution passed the senate on a less than resounding 16–0–23 vote.

MINNESOTA, BRAINERD

At a September 9, 2019, meeting of the Brainerd School Board, during a presentation on the high school biology curriculum, the board's president Sue Kern expressed doubt about the validity of, and the benefits of teaching, evolution. The science teacher delivering the presentation responded by describing evolution as a cornerstone of biology that continues to be supported by overwhelming evidence, and the director of teaching and learning for the district added that evolution is included in the state science standards.

MISSISSIPPI, BAY ST. LOUIS

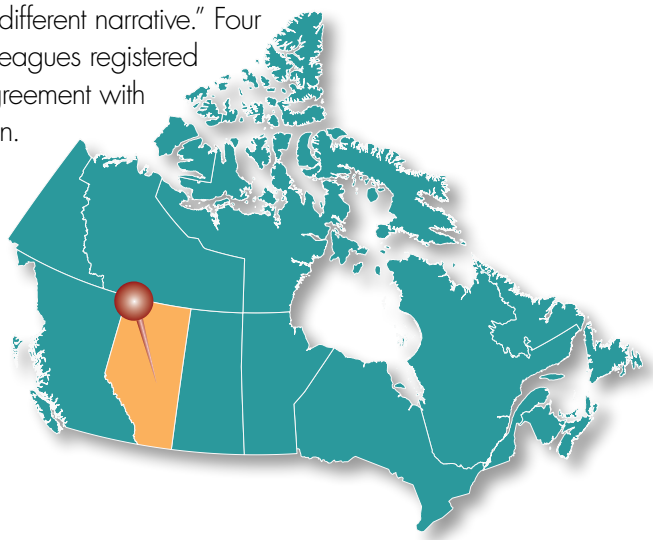
Prompted by a complaint from a local parent, the American Humanist Association's Appignani Humanist Legal Center expressed concern, in a letter sent in October 2019, to the Bay St. Louis Waveland School District about proselytization on the part of one of its high school teachers, who allegedly told students that the Big Bang theory is false "because God created life." The Center called for the district to ensure that there were no further infringements of the Establishment Clause.

MISSOURI, OAK GROVE

Prompted by a report from a local parent, the Freedom from Religion Foundation wrote in September 2019 to the superintendent of the Oak Grove R-VI School District to express concern about various unconstitutional practices in the district, including teachers using "a 'balanced' curriculum … regarding evolution and the biblical view of the creation of the world" and badgering students who accept evolution. A news story indicated that the district was assessing the letter and drafting a response.

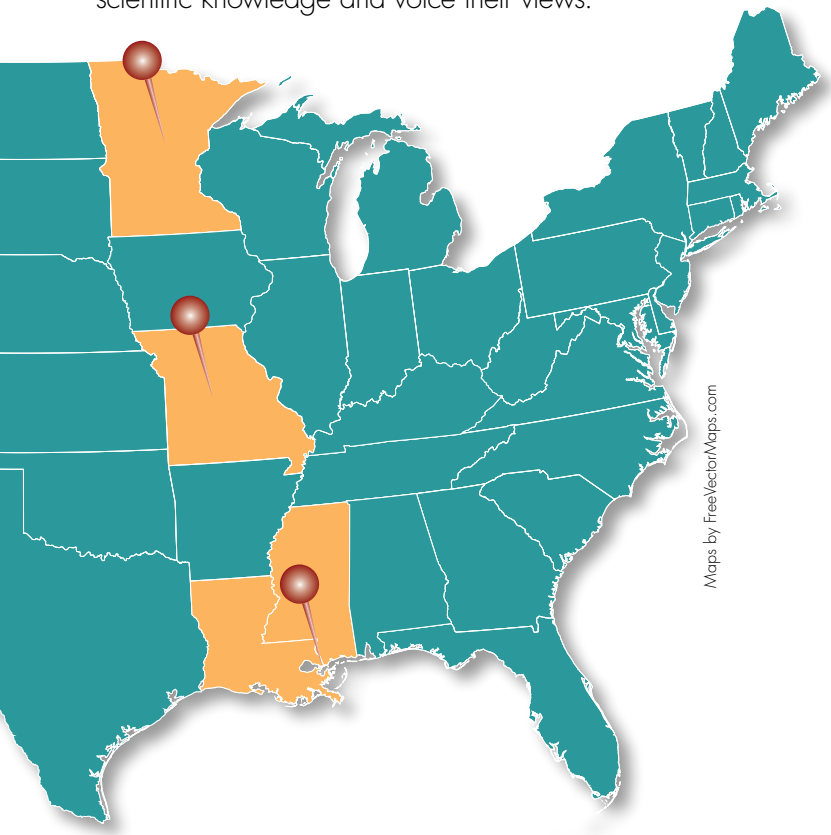
CANADA, EDMONTON

During a meeting of the Board of Trustees of the Edmonton Public Schools in September 2019, Sherry Adams, a trustee, reportedly claimed, "There is credible research conducted and reported by more than a few reputable scientists … who [say] that the science is not settled" on the causes of climate change, adding "I believe we're doing our students a disservice by not allowing them to hear a different narrative." Four of her colleagues registered their disagreement with her opinion.



IRAN

As of November 2019, books by the bestselling Israeli historian Yuval Noah Harari are no longer legal to buy or sell in Iran, according to the Associated Press. Publication of Harari's books in Iran was banned in May 2019, on the grounds that they promote the theory of evolution and fabricate history. On Twitter, Harari responded, "The Iranian regime fears free scientific inquiry. But I hope the Iranian people will find ways to obtain scientific knowledge and voice their views."



Maps by FreeVectorMaps.com

KOSOVO

In September 2019, Drilon Gashi was fired from his position as a village imam in Vitomirice in western Kosovo over his acceptance of evolution, which he espoused on social media and to the local press, according to Agence France Presse. Gashi was quoted as saying, "Living creatures are created by evolution, but this evolution is led by God." A spokesperson for the Islamic Community of Kosovo, the country's top clerical body, described Gashi's views as "contrary to the principles of Islam."

PHILIPPINES

House Bill 2069 would, if enacted, require "the reading of, and discussion and examination on, the Bible" in the public elementary and high schools of the Philippines. While the bill's text only mentions classes in English and Pilipino, not science classes, the explanatory note to the bill describes the Bible as teaching "creation, science, and history." The bill's sponsor is Bienvenido M. Abante Jr., a Baptist pastor who represents Manila's Sixth District and serves as the minority floor leader.

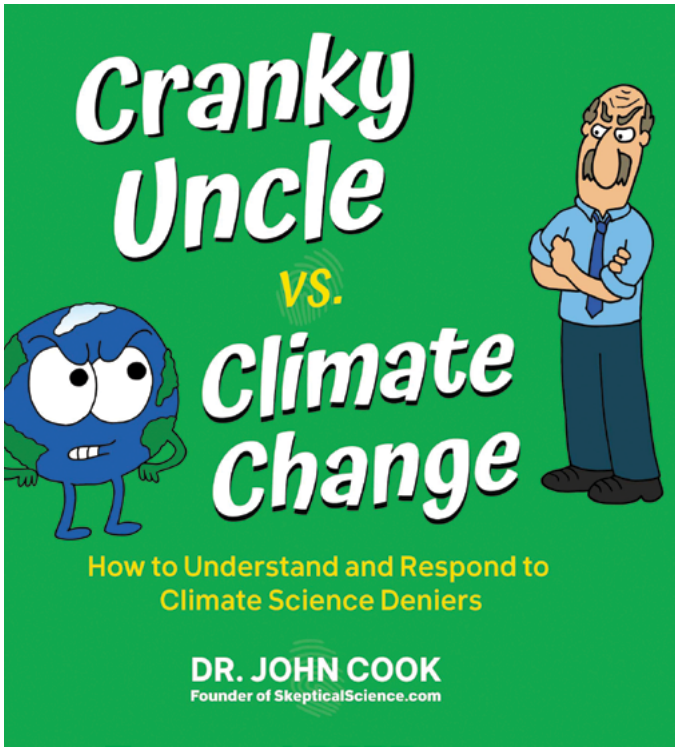
ITALY

"Italy will next year become the world's first country to make it compulsory for schoolchildren to study climate change and sustainable development," reported Reuters (November 5, 2019), explaining, "all state schools would dedicate 33 hours per year, almost one hour per school week, to climate change issues from the start of the next academic year in September" 2020. Education Minister Lorenzo Fioramonti said, "The entire ministry is being changed to make sustainability and climate the center of the education model."

TURKEY, ISTANBUL

The trial of Adnan Oktar, the controversial Islamic creationist who publishes under the name Harun Yahya, commenced in September 2019. The indictment, according to the *Daily Sabah*, "portrays him and his followers as a dangerous cult which exploited gullible recruits and built a criminal empire thriving on blackmail and other wrongdoings." Through the Scientific Research Foundation (Bilim Araştırma Vakfı), Oktar and his followers produce a steady stream of publications and audiovisual material aimed at dismissing evolution as baseless and pernicious.

NAVIGATING CONVERSATIONS WITH CLIMATE CHANGE DENIERS? READ THIS BOOK ▶

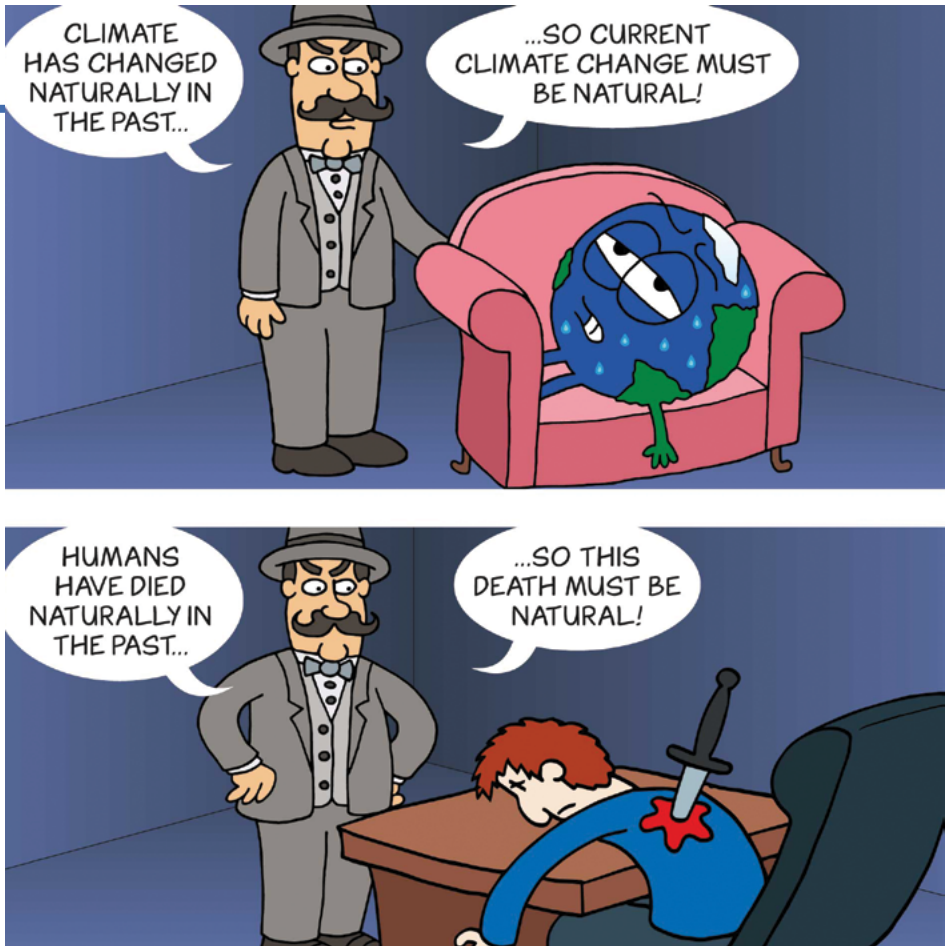


Picture this: You're at a gathering of friends and family—it might be a holiday or a celebration—but you're feeling pretty good and loving the moment, drifting from conversation to conversation on a gentle tide of interactions. A new eddy of conversation begins. Someone mentions the state of the environment and you're excited to share your knowledge on a subject you either teach or are quite passionate about—when it happens, out of nowhere: someone you have great affection for utters the dreaded words: "Climate change has been natural in the past, therefore, current climate change is not human-made."

Until now, such sentences could bring a family gathering to a standstill. Enter John Cook's new book *Cranky Uncle vs. Climate Change*, which might help end these awkward moments. This new (and greatly humorous) how-to book on responding to climate science deniers is a great, informative read for anyone trying to figure out how to navigate conversational landmines that often occur both in and out of the classroom. The book of cartoon illustrations, full of humor and insight, examines the plethora of basic misconceptions about climate change often expressed by our own versions of cranky uncles.

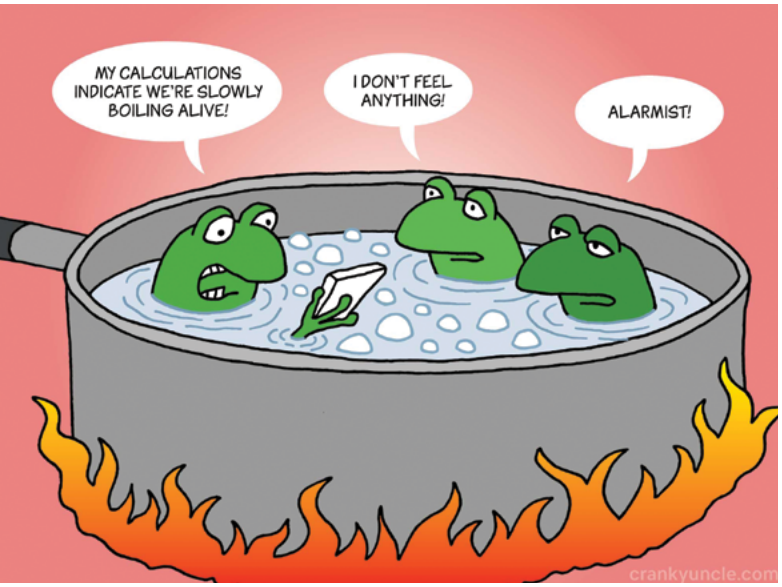
Since I work with Cook on a regular basis developing NCSE's misconception-busting lesson plans, I might be accused of bias. However, as a former teacher, I can objectively say that Cook's new book is an incredible educational resource for handling difficult situations that often arise when teaching about climate change, as I've met my own share of climate deniers throughout my career.

During a recent conversation with Cook, I asked him why he wrote *Cranky Uncle* in the first place. Cook answered by quoting statistics from his research on the psychology of climate denial: approximately 60% of people surveyed about climate change were concerned and alarmed but stayed fairly silent about the issue due to lack of knowledge; 30% were simply disengaged and uninterested in the topic; and the final 10% fell into the category of "cranky uncles," also known as climate deniers. In light of these data, Cook began to focus on the concerned and alarmed group, knowing that the climate denier group would be unlikely to pick up his book in the first place. In providing a guide for the concerned and alarmed, Cook wanted to ensure that they could initiate and engage in climate conversations with confidence and knowledge, rather than remain silent or rely on gut feelings.

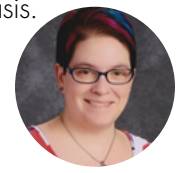


I also wanted to know if the Cranky Uncle character was a real person from his own life. Cook laughed in response and said that the character was more an amalgam of the types of climate deniers he has encountered throughout his life's work. He developed the Cranky Uncle character as a coping mechanism for all the negativity he often receives through his publications and research. As a teacher, I completely understand the need for coping mechanisms because educators are often questioned about our authenticity by both students and parents, as well as the occasional administrator. Cranky Uncle has the potential to help us all defuse these kinds of difficult situations with knowledge and just the right mix of humor.

Additionally, as we went to press, Cook was just about to release a Cranky Uncle app for iOS and Android mobile devices. The app allows students (or anyone with an interest) to work through a series of scenarios to understand how climate denial arguments can be overcome with a bit of simple logic and a great deal of scientific data. NCSE is excited about the release of this app and is working with Cook to develop ways for teachers to implement this resource in their classrooms.



In both his book and app, Cook continues to advocate for misconception-based learning, focusing on five techniques of science denial that he has identified: Fake Experts, Logical Fallacies, Impossible Expectations, Cherry Picking, and Conspiracy Theories (FLICC for short). These five core tactics have been and continue to be the basis for the majority of climate denial arguments. FLICC is depicted quite well in *Cranky Uncle* and readers will find the treatment very easy to understand. The numerous graphics and summary charts available in the book will provide teachers with an easy reference guide to hit any curveball a student might throw their way when teaching on the critically important topic of climate change. Thank goodness John Cook has given teachers an excellent tool to cope with the cranky uncles they sometimes encounter on a daily basis.



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EVOLVING BEYOND ADAPTATION

Here's an evolutionary puzzle to chew on.

"Hypsodonty" is a term used to describe molars that are high-crowned, with enamel that extends past the gum line. From a functional perspective, such teeth allow animals to eat tough, gritty food that wears down the teeth, like leaves and grass, efficiently. Hypsodonty is found in cows, horses, deers, and some marsupials, rhinoceroses, and rabbits. The trait exploded in abundance during the Miocene, at the same time as the expansion of more open habitats. In light of this evidence, it would be reasonable to conclude that hypsodonty is an adaptation for eating grass.

However, as is often true in evolution, this relationship becomes more complicated on further observation. First, many animals that eat grass don't have hypsodont teeth and some animals that have hypsodont teeth don't primarily subsist on grass, undermining some of the criteria for hypsodonty to be an adaptation. Then there are disagreements about the functional significance of hypsodonty, with some scientists arguing that it is adaptive to the properties of grass itself and others arguing that it is instead an adaptation for the amount of grit in open habitats (the "grit, not grass" hypothesis), regardless of diet. Finally, there are developmental constraints to take into consideration: hypsodonty typically evolves from already high-crowned teeth and persists for millions of years even if the taxonomic group adopts a different diet. If hypsodonty is neither necessary or sufficient for grass or grit, what is the evolutionary significance of this trait?

The underlying problem may be an over-reliance on adaptation as a framework. Criticism of an adaptationist approach, best exemplified by Stephen Jay Gould and Richard Lewontin's famous 1979 essay "The Spandrels of San Marco and the Panglossian Paradigm," is a well-established tradition in university education, but appears to be quite rare beyond the academy. According to a 2016 review of high school biology guidelines by Rebecca M. Price and Kathryn E. Perez, only Advanced Placement Biology discusses other mechanisms of evolution. So teachers often have to fill in other mechanisms as time allows. In the case of museums and other informal science learning centers, I've discovered, many avoid even any direct mention of natural selection, using the related concept of adaptation instead. While this may make sense for zoological or ecological exhibits—particularly those focused on content for children—the hypsodonty example reveals how limiting a simple adaptive explanation can be.

To understand what motivates the exclusion of other evolutionary mechanisms in museums, I've been working with three graduate students in our Graduate Student Outreach Fellowship to review evolution content within museum exhibits around the country. This is part of an ongoing project to develop accurate and evidence-based evolution content that can be used in rural museums across the country. In reviewing over 41 museums in rural areas with biology exhibits created within the last 15 years, we found only six that mentioned natural selection by name and only one that mentioned a mechanism of evolution other than natural selection. Through follow-up interviews with many of these curators, we've sought to understand the reason for the over-reliance on natural selection. Some curators said that they had previously installed panels and interactives on genetic drift or developmental constraints, and other mechanisms of evolution, but these rarely tested favorably among visitors. Others discussed the need to please funders of the exhibits, particularly biotech companies, which favor showcasing issues related to their products over basic evolutionary science. Still other curators, particularly those working at museums in areas where evolution remains a controversial social issue, mention adaptation in place of evolution with the hope that using alternative terminology will keep visitors from tuning out completely.

While all of these reasons are understandable, failure to include evolution content beyond adaptation can encourage many misconceptions about evolution. At the most basic level, it is misleading to say that evolution responds to what a species "needs" or is aimed at attaining the most perfect phenotype. Furthermore, visitors may come away with an assumption that all traits arise as adaptations resulting from natural selection. This may make it difficult for them to correctly understand trait loss or traits arising from genetic drift. For example, take the beetles in the figure at below. Although every beetle pair was equally reproductively successful (indicating that no selection has occurred), the ratio of alleles has changed, with a slight increase in brown alleles, by virtue of random assortment alone. While it is easy to see from the figure that this is the result

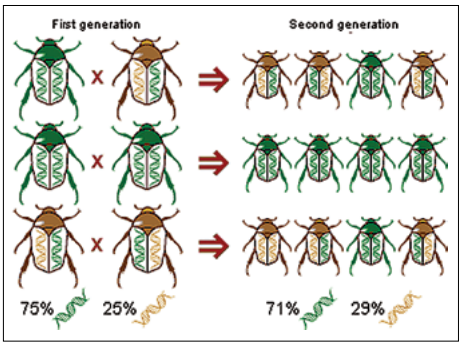

Photo courtesy of University of California Museum of Paleontology's Understanding Evolution

of chance, without the influence of other mechanisms of evolution, it is still tempting to try to explain this change as the result of selection. Overreliance on adaptationist thinking is especially dangerous applied to human evolution, since it can encourage conclusions that are unsupported, such as that certain human phenotypes are more adaptive than others.

It seems plausible that museums are in a good position to launch effective interventions to help the public overcome not only over-reliance on adaptationist thinking but also other common misconceptions about evolution. To that end, the ultimate goal of our museum research project is to help museums design exhibits that allow for deeper evolution engagement while respecting both the practical constraints and the cultural context of the institutions. Here are some emerging best practices based on our work.

1. **Create bridging analogies.** Bridging analogies take what visitors find familiar and intuitive to help scaffold more complex questions. For phylogeny, this can mean starting from a family tree and exploring how this relates to genealogical relationships among species. For adaptation, it may mean starting with a silly-sounding question about idealized structures ("If predators have eyes in front to help gauge depth and prey have eyes on the sides of their head to avoid predators, why don't animals that are both prey and predators have four eyes?") then slowly introducing the concept of developmental and evolutionary constraints.
2. **Don't design away "failures."** To show that evolution doesn't work towards "perfection," it is important to showcase the times when a phenotype fails. For animal adaptations, this can be showcasing how the trait works (or not) under various environments or during various seasons. By showing the consequences of a phenotype under varying conditions a species might face, visitors can begin to ask more complicated questions about why a trait might exist.
3. **Don't restrict evolution to one area**. Because evolution is key to understanding biology, evolutionary concepts can be featured, explicitly or implicitly, throughout the exhibits. Genetics exhibits can discuss how evolution shapes the frequencies of various human mutations within populations, for example, while natural history exhibits showcasing major events in Earth history can highlight the resulting drift-mediated speciation events.

Our research is taking place throughout the rest of 2020, with the goal to publish our findings in early 2021. We are also designing a series of museum exhibits, as well as a traveling exhibit, that will utilize these best practices for engaging audiences about the entire scope of evolution in a way that is culturally relevant while also scientifically accurate.

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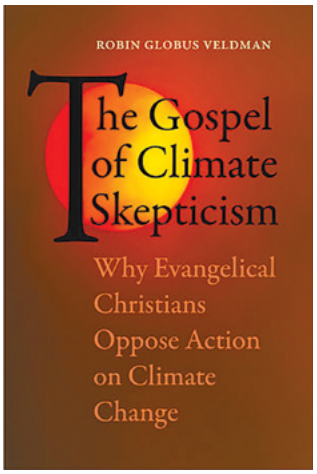
Inside Outreach: Pollinators on the Move

No one wants to be told their outreach activity stinks. However, Taryn Dunivant, a master's student in ecology and evolutionary biology at the University of Kansas and a 2019 NCSE Graduate Student Outreach Fellow, would take it as a compliment. As part of her fellowship, Dunivant designed an activity, Pollinators on the Move, which includes a giant red stink flower replica that gets pollinated by participants wearing fly goggles. The beautiful flower replicas, which Dunivant constructed by hand, attract the participants to the activity. But it's the foul scent that gets them to start asking nuanced questions about evolution, particularly about how the plant's odor of rotting meat may be an adaptation to attract scavenging insects. "One thing that I love about the activity is that you don't have to do much to get people engaged because it has such a visual presentation—it immediately draws people in," Dunivant notes.

Thirty-five percent of crop plants rely on animal pollinators, and there is strong selective pressure to help maintain plant genetic diversity. As a result, these plants have evolved some creative strategies for attracting pollinators. While playing Dunivant's activity, participants not only can pollinate a stink flower as a fly, but also can take on the role of a bat pollinating a funnel flower or wear UV "bee goggles" to pollinate an aster. Participants can find success as a pollinator in all these different roles. However, they also are helped to understand that the animals they represent don't know they are pollinators. Instead, the animals use the plants for food or shelter and the plants respond by developing traits as appealing as possible to their most efficient pollinator. Over time—in some cases, tens of millions of years—plants have developed highly specialized relationships with their pollinators. The close relationship between flowering plants and their pollinators also highlights the overlap between evolution and climate change, as small changes in range or emergence time in a specialist species can cause a cascade of negative impacts throughout the ecosystem.

Pollinators on the Move also includes a game about sphinx moths and orchids,



The Gospel of Climate Skepticism: Why Evangelical Christians Oppose Action on Climate Change

author: Robin Globus Veldman

publisher: **University of California Press**

reviewed by: **Antony Alumkal**

When I was researching the chapter on climate change denial for my book *Paranoid Science: The Christian Right's War on Reality* (NYU Press, 2017), I had plenty of documents from the Cornwall Alliance, the organization spearheading the Christian Right's anti-environmentalism efforts. I also had results from several surveys showing that evangelicals were more resistant to climate science than other religious groups, and that their resistance had grown over time. What I did not have was interview and ethnographic data from ordinary evangelicals that could shed light on how specifically leaders were influencing laypeople. Nor did any previous researchers on this topic have such data. Given my time constraints, all I could do was hope that some future researcher would provide what was missing.

The future has arrived. Veldman goes where no researcher has gone before to provide a nuanced picture of climate change denial among ordinary evangelicals—in this case, a sample of members from evangelical churches in Georgia—and a description of how the Cornwall Alliance's ideas were successfully transmitted to them. But first, she dismisses the "end-time apathy hypothesis," which explains evangelicals' lack of environmental concern by referencing their belief that Jesus is coming back soon, for being inconsistent with her data. Instead, she draws on the work of scholars of evangelicalism who depict this religious subculture as having an "embattled" mentality. Evangelicals, both leaders and laypeople, see themselves as marginalized in a culture dominated by secularists who aim to destroy America's Christian (meaning evangelical) heritage.

Most of the evangelicals that Veldman interviewed believed that environmentalists and climate scientists were among those at war with Christianity. "For [my informants], climate change was not only—as secular climate skeptics might say—a hoax based on weak science; it was also a tool wielded by secular elites to undermine the Christian worldview" (p. 88). Furthermore, Veldman found her informants using arguments created by climate denial leaders: any climate change is due to natural variation; there is no scientific consensus that human activity is responsible; Al Gore made it up; climate scientists are just trying to make money; etc. She emphasizes that such views are not merely individual traits, but rather part of the social dynamics of evangelical communities. "One of the things that

which provides hands-on experience of mutualistic, antagonistic, and competitive relationships as participants attempt to find the only moth capable of both drinking the orchid's nectar and collecting its pollen. "The result of playing this activity is that participants think about coevolution," Dunivant explains.

Originally working as a makeup artist and at a warehouse that sold small greenhouses, Dunivant came to love science later in life, returning to school for her master's degree. Thanks to her earlier experiences, her focus has always been on helping people explore science through attractive visual elements that lead to deeper engagement. Dunivant will graduate from the University of Kansas and start a Ph.D. program in plant biology at the University of California, Riverside, in the fall of 2021. Dunivant has created a highly engaging and aesthetically attractive activity kit to share her love of design and science, and NCSE is proud to have helped. Pollinators on the Move will be NCSE's next national release activity, distributed to all of our partners. If you want to teach your community about pollination and selective pressures, download the activity guide. https://ncse.ngo/pollinators-move.

—KATE CARTER

impressed me during my time in the field was the numerous ways in which my informants' climate change skepticism was woven into the social fabric of their lives" (p.114). Environmentalists represented a useful "out-group" against which evangelicals could define themselves.

> "Environmentalists represented a useful 'out-group' against which evangelicals could define themselves."

Did these informants get their denialist views directly from the Cornwall Alliance? No, none of them had heard of the organization. And a Cornwall Alliance staff member admitted to Veldman that its *Resisting the Green Dragon* DVD set and book only sold 1,000 copies each. Instead, Veldman found that Cornwall Alliance leaders and allies managed to spread their views through the evangelical mass media. This included the "Big Four" ministries headed by Pat Robertson, Chuck Colson, James Dobson, and Jerry Falwell, along with several other sizable ones. Collectively, these organizations were successful in reaching ordinary evangelicals. According to Veldman, they "transformed climate change into a religious issue, symbolically on par with abortion and religious liberty" and "explicitly presented skepticism as the biblical view on climate change" (p. 165). Thus, denialist evangelical leaders were able to outmaneuver those evangelical leaders who had embraced environmentalism, despite the latter's coverage by mainstream media.

If I had to identify a shortcoming in the book, I would say that Veldman defines "Christian Right" too narrowly, such that it includes evangelical leaders who are climate change denialists but excludes those who are climate change believers. It would be more accurate to see climate change as an issue that exposed a fault line within the Christian Right between its more extreme and somewhat less extreme branches. After all, evangelical leaders such as megachurch pastor Rick Warren and *Christianity Today* editor-in-chief David Neff, while embracing climate science, simultaneously embraced right-wing pseudoscience movements such as "intelligent design" and "ex-gay" therapy. Both camps can be further differentiated from "evangelical left" leaders such as Jim Wallis, who would be considered political moderates outside of the evangelical world, who generally steer clear of pseudoscience.

That quibble aside, I would highly recommend *The Gospel of Climate Skepticism* to anyone who wants to better understand how some American evangelists came to be so resistant to cli- mate science. Veldman appropriately offers no easy solution to changing the views of these evangelicals, only a clear picture of what climate science advo- cates are up against.

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WHAT WE'RE UP AGAINST
Blaming Evolution Education for Mass Shootings

Appearing on Fox & Friends on September 1, 2019, Tony Perkins attributed the frequency of mass shootings in the United States to a "decades-long march through the institutions of America, driving religion and God from the public square," citing in particular the teaching of evolution. "I mean, look, we've taught our kids that they … come about by chance through primordial slime, and then we're surprised that they treat their fellow Americans like dirt." Perkins continued, "I think we have to go back to the point where we instill in these children, at least give them the opportunity to know that they're created in the image of God." A cofounder of the Louisiana Family Forum, which promoted the creationism-friendly Louisiana Science Education Act of 2008, and a former state representative in Louisiana, Perkins is currently the president of the conservative Family Research Council. He also serves as chair of the U.S. Commission on International Religious Freedom.

Tony Perkins Family Research Center

—GLENN BRANCH

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