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Communicating Religiously and Culturally Sensitive Science Content

Mark A. Bloom
Dallas Baptist University

Ian C. Binns
University of North Carolina at Charlotte

Lee Meadows
Alabama STEM Council

ABSTRACT

In this manuscript, three science educators describe strategies used to effectively communicate about religiously and culturally sensitive science content and share lessons learned from their experiences. Mark A. Bloom (2019-2021 Fellow) describes the challenges he overcame in teaching climate change science at an evangelical university by creating an environment of trust and "speaking the language" of his audience. Ian C. Binns (2017-2019 Fellow) shares his experience, as a white person, learning to look at an issue from alternative perspectives when discussing environmental racism on the Down the Wormhole podcast with people of color. Lee Meadows describes his efforts to teach human evolution in the American South. His success derives from his emphasis on students acquiring understanding of evolution, rather than convincing them of its truth, created a safe and respectful environment for learning.

Keywords: climate change, evangelicals, environmental racism, human evolution, religiously sensitive, culturally sensitive

Editors' Comment

***Mark A. Bloom, Ph.D., (2019-2021 Fellow)**, is a Professor of biology and science education at Dallas Baptist Univeristy. **Ian C. Binns, Ph.D., (2017-2019 Fellow)**, is an Associate Professor of elementary science education in the Department of Reading and Elementary Education in the Cato College of Education at the University of North Carolina at Charlotte. **Lee Meadows** is an Associate Professor of secondary education at the University of Alabama and is the Executive Director of the Alabama STEM Council. While Lee has not participated in a Sinai and Synapses Fellowship (yet?), we wanted to bring his expertise in human evolution education in the American South to this article about teaching religiously and culturally sensitive science content.*

Introduction

Education is all about change – if one's understanding of the world is not growing, it is deteriorating (Wheatley, 2006). However, change is oftentimes difficult and human nature finds comfort in the familiar and is, therefore, often resistant to such change. Further, individuals' cultural values and accepted behaviors within a group are deeply important to how they operate (Kotter, 1996) – these too can impede their willingness to change. Haight (2012) metaphorically describes two

motivations that guide human behavior as an elephant with a human rider on its back. While the rider might appear to be guiding the direction in which the pair is moving, it is the elephant who truly has control - if you frighten the elephant, it really doesn't matter what the rider tries to do, the elephant goes where it wants. With regards to our motivating factors, the elephant represents our deep-seated, evolutionary-based, primal guiding mechanism that exhibits itself through gut-instincts and reflex responses. The rider, by contrast, is a much more recently derived motivating mechanism that operates from our rational brain and employs logic and critical thinking skills to justify our behaviors and beliefs. Haight (2012) asserts that too often, when attempting to influence others, especially when it relates to rethinking deeply-held convictions or social norms within a group, leaders are talking to the rider, who's very purpose is to justify the current behavior – in other words, to maintain status quo. In a world where '*we've always done it this way*' is comfortable and '*let's try something new*' can induce anxiety, talking to the rider is often the wrong strategy to influence change. Instead, Haight says we need to speak to the elephant and change the underlying powerful impulse.

When teaching religiously and culturally sensitive science content to religious communities, it is important to communicate in such a way that one can avoid *frightening their impulsive elephant* while, at the same time, helping the learner consider new perspectives with their *rational and logical rider*. For example, if a science teacher began her unit on evolution by saying something like *"Students, whatever you learned in Sunday school about Adam and Eve and all the animals really doesn't matter. It's time to learn the real origin of species."* you can be sure that a subset of her students are already shutting down and learning will not occur. Instead, if the teacher uses a more religiously-sensitive approach and says something like *"Students, while some may not agree with the biological theory of evolution, I think we should all at least understand what it is and what evidence scientists have by which it is supported."* then even religiously-conservative students who may have strong misgivings about evolution may be more willing to listen and learn the science behind the theory. From my personal experience, I have seen many students who are surprised to learn exactly what the theory of evolution is (and is not) - it often does not match what they have learned outside the science classroom. Once they learn the accurate science of evolutionary theory, they can then make their own determination of whether or not it can reconcile with their religious beliefs. In *Epistemology: The Justification of Belief*, Wolfe (1982) describes this process – once a person realizes that their present concept is insufficient (e.g. science is anti-Christian or scientists are atheists), the only honest thing to do is to discard the old idea completely or to make some big adjustments to it that incorporate the newfound understanding. Piaget (1980) describes this process as recognizing a contradiction and then, through assimilation or accommodation, creating a more authentic cognitive schema. This process is the existential challenge facing a science educator when teaching religiously sensitive content. In the present paper, we will describe our strategies for teaching religiously and culturally sensitive science content in three distinct settings. Mark will share his experiences teaching climate change science to conservative evangelicals at a Christian university. Next, Ian will talk about his experience addressing environmental racism on the *Down the Wormhole* Podcast. Finally, Lee will share his efforts teaching human evolution in the American South.

Teaching Religiously-Sensitive Content in Christian Higher Education [Mark Bloom]

My favorite class to teach is biology for non-science majors. In this class, I have students from all colleges on campus and I know that this is likely the last science class they will ever sit through. In this survey course we cover topics including human body systems, genetic medicine, ecology, evolution, and anthropogenic climate change and I consider this a last chance opportunity to clear up some misconceptions about science. My students are predominantly conservative, evangelical, Christians (from various denominations) and many have skeptical views of science - especially regarding topics such as physical and biological origins, biomedical advances, and climate change. To address this skepticism, I integrate nature of science (NOS) into my teaching throughout the course

and pay particular attention to students' religious backgrounds and the concerns I know they bring with them to the classroom (Bloom, 2021).

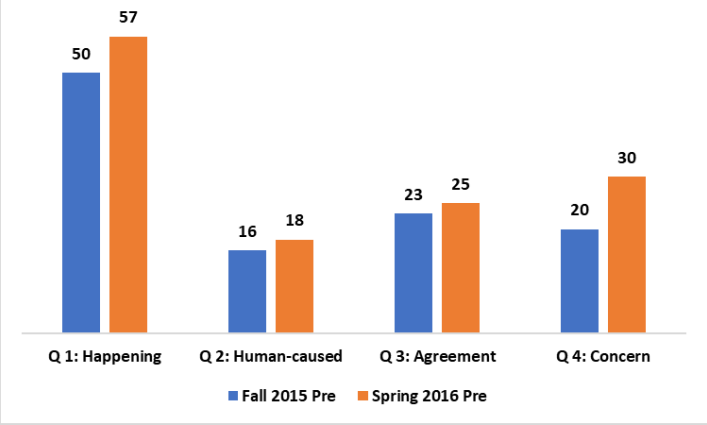
While many may not consider climate change a religiously-sensitive topic, evangelical Christians overwhelmingly reject the notion that human behavior is the driving force behind global warming (Branch et al. 2016, Arbuckle & Konisky, 2015). Renowned author and New Testament scholar, N.T. Wright asserted that many evangelicals deny scientific claims like climate change, "not because the evidence is wanting or because Christian theology requires it, but because they don't like its political implications" (Wright, 2015, p. 2). An example of this is seen with Richard Cizik, former vice president of the National Association of Evangelicals who, after publicly acknowledging human-induced climate change, was forced to step down from the position (Dudley, 2011). In addition to this prevalent negative view of climate change science among evangelicals, many of my students are from Texas, a state that produces much of the oil and gas in our country - indeed, climate change science can be a tough sell.

To address the climate change skepticism among my students, I first frame the discussion with a Christian-focus. Each weekly session begins with a devotion to integrate a Christian worldview with the science content. During the session on climate change, the devotion calls on Genesis 2:15 in which Adam is told that he is to tend and watch over the Garden of Eden. The devotion then goes on to explain that this creation mandate describes our relationship to the planet and justifies the need to care for the environment as extension of our Christian faith.

In the fall of 2015 and the spring of 2016, I tried out a new approach to teaching my students about climate change. Before teaching the lesson, I used a short questionnaire populated with questions taken from Global Warming's Six Americas (Leiserowitz et al., 2011) to pre-assess the students. Immediately after the lesson, I used the same questionnaire to post-assess their beliefs to look for growth. A subset of the survey questions assessed four areas of students' understanding of climate change: 1) confidence that climate change is occurring, 2) confidence that climate change is caused by human activity, 3) confidence that scientists agree about climate change, and 4) how concerned is student about climate change. Figure 1 shows the skepticism among my students regarding these three aspects of climate change. Only approximately half of the students were in agreement that climate change was even occurring. Less than 20% agreed that climate change was human-caused. A maximum of 25% of the students believed that scientists were in agreement about climate change. Finally, only 20% (fall 2015) and 30% (spring 2016) were personally concerned about climate change.

Figure 1

Students Initial Climate Change Skepticism

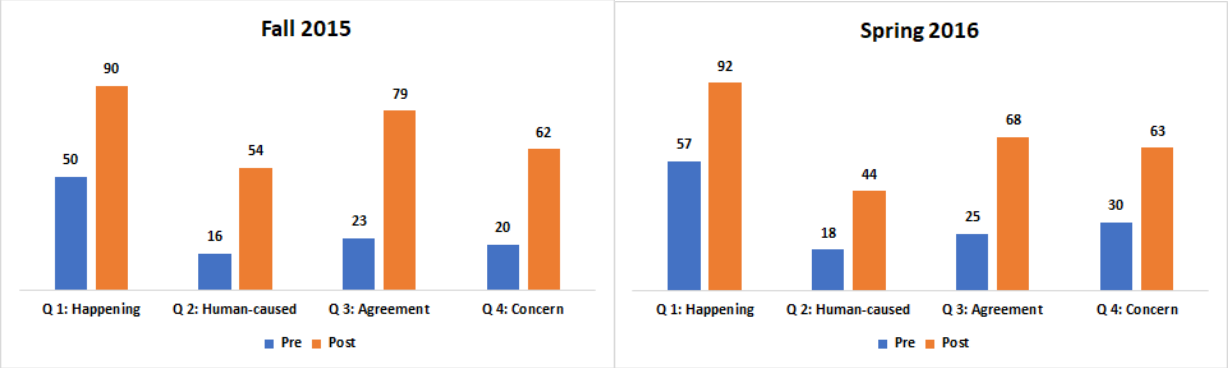


To address my students' skepticism towards climate change, I sought the expertise of Dr. Katharine Hayhoe, a climate scientist from Texas Tech University. I felt Dr. Hayhoe could have a positive influence on my students as she is, herself, an evangelical Christian and the wife of a church pastor. She and her husband co-authored *A Climate for Change: Global Warming Facts for Faith-based Decisions* (Hayhoe & Farley, 2009). Dr. Hayhoe provided a recorded lecture entitled *Climate Change: Facts, Fiction, and Faith*, which I showed my students in place of my traditional classroom lecture. In the video, Dr. Hayhoe grounds her concern over climate change in scriptural truths and encourages climate change action as an outgrowth of Christian stewardship to the Earth and as an act of loving our neighbors, particularly disadvantaged populations around the world who will be most impacted by climate change.

Figure 2 shows the change in students' beliefs after viewing the video lecture. A Wilcoxon signed rank t-test of significance showed all changes to be significant at the $p < 0.05$.

Figure 2

Belief Change After Video Lecture



While students reported how much they liked the Christian framework from which Dr. Hayhoe taught, a follow-up study was designed to measure its impact on the changing viewpoints. The video was edited to remove the portions that referenced bible verses and christian values and the name was changed to *Climate Change: Facts and Fiction*. One class was shown the original Christian-framed lecture and the other was shown the secularized version. The results surprisingly showed no significant difference between the two groups except with regards to how concerned the students were for others (higher concern post-assessment for those who watched the Christian-framed lecture)[1]. Perhaps this surprising discovery could be explained by the students' motivated cognition that Morgan (2021) shares in his manuscript also contained in this special issue. It is likely that the students believed the science presented in the lecture, with or without the Christian frame, to be trustworthy because of the setting in which it was delivered. Where I teach, all material, regardless of subject, is taught from a Christian worldview and all full time faculty are members of Baptist churches (aligned with the university). As such, students can trust that values and beliefs misaligned with Christian values and beliefs will not be taught. In other words, the students had greater trust in the university and their professor than they did on the guest evangelical scientist herself.

[1] For more information on both studies, see Hayhoe et al., 2019.

Communicating About Environmental Racism in the Public Space [Ian Binns]

The popularity of podcasts continues to grow each year. In their annual report, Edison Research (2021) found that 80 million Americans are weekly podcast listeners, a 4% increase from the previous year. This report also indicates that the podcasting audience is highly diverse in terms of listener backgrounds. Additionally, podcasts as an educational tool continue to be an important area of research. Sprague and Pixley (2008) argued for the use of podcasts in education as podcasting began to take hold. Research indicates that podcasts may play a valuable role in reaching students beyond school walls and have the potential to enhance children's literacy skills (e.g., vocabulary knowledge, storytelling techniques), engagement, and collaboration (Besser et al., 2021; Morgan, 2015; Putman & Kingsley, 2009; Smythe & Neufeld, 2010). Creating podcasts in the classroom also has the potential to provide opportunities to level the playing field and amplify the voices of children who are diverse with respect to academic achievement (O'Bannon et al., 2011). Furthermore, some even explore the role of podcasting for social justice in social work programs (Ferrer et al., 2020).

Podcasting is something that I began to explore a few years ago after participating in the Sinai and Synapses fellowship from 2017-2019. One of the goals of the second year of the fellowship was to focus on content creation. Podcasts were part of this effort. Near the end of the fellowship, Rev. Zack Jackson, the pastor of Community United Church of Christ in Reading PA as well as an adjunct professor of theology at Palmer Theological Seminary, and I approached each other about creating a podcast because we didn't want this to end. Three other fellows joined us: Rabbi Rachael Jackson, who was an analytical chemist before rabbinical school, Kendra Holt Moore, a Ph.D. candidate in Religious Studies at Boston College and Assistant Professor of Religion at Bethany College, and Dr. Adam Pryor, Associate Professor of Religion and Vice President for Academic and Student Affairs also at Bethany College. This led to the creation of our podcast in 2019, *Down the Wormhole*[2], where we explore the relationship between science and religion (Figure 3).

Figure 3
Down the Wormhole Podcast

Over the first two years we addressed a variety of topics related to science and religion. In several episodes we had discussions about challenging topics. They were always done in a respectful

[2] https://www.downthewormhole.com

manner. Our intent is to continue to have fruitful conversations. It's easy to argue that because we are all friends, respectful conversations about challenging topics are easy. That's a valid point and one I considered when coming up with an example of how we addressed challenging topics on a podcast. This is why I chose an episode from our series on race and racism.

In the summer of 2020, during the height of Black Lives Matters protests, we decided to record a series on race and racism in science and religion. We knew it was too important of a topic for us to ignore. This ended up being a four episode miniseries. The first episode focused on who we are as podcast hosts. We wanted to explicitly discuss who we are as individuals and our individual journeys focused on anti-racism. The second episode focused on the Bible. Our third episode focused on environmental racism. The last episode focused on racism and education. I want to focus on the third episode.

The third episode was a "crossover" episode with the *Color Correction podcast*, based in Philadelphia. *Color Correction* focuses on race and faith "from the perspective of a Black girl, an Asian guy, and a white guy too.[3]" Zack is friends with one of the hosts and we all agreed that a conversation on environmental racism was a good time to record with them.

Before we address the episode, it is important to first understand the phrase 'environmental racism.' The Climate Reality Project (2021) says the following about environmental racism:

> When we talk about environmental racism, we're talking about the disproportionate burden of environmental hazards placed on people of color. This oppression is often achieved systemically, through policies and practices that effectively place low-income and communities of color in close proximity to polluting facilities like power stations, plastics plants, and methane gas pipelines or to infrastructure like major highways (para. 3-4).

Environmental racism is not a new term. Over the last several decades studies have shown that communities of color are disproportionately affected by a multitude of environmental hazards compared to other communities (Climate Reality Project, 2021; Newkirk, 2018; Skelton & Miller, 2016). As recently as 2018, EPA researchers found that when it comes to air pollution from particulate matter, "results at national, state, and county scales all indicate that non-Whites tend to be burdened disproportionately to Whites" (Mikati et al., 2018, p. 484).

The recording date was the first time I met the hosts of *Color Correction*, Bethany, Andrew, and Kris. As mentioned, Zack and Kris have known each other since college. This was going to be a raw conversation on a very challenging topic and I did not know what to expect. Instead of going into detail on the full episode, I want to focus on a few exchanges that occurred throughout this conversation. You will see from these quotes that in some situations we did not hold back. Yet, we were honest and respectful to each other. The following themes emerged from our conversation: *United Church of Christ and environmental racism*, *economics and power*, *dehumanization of black and brown people*, and *appealing to white people*. It's important to note that while I present these themes as separate, each of them overlap throughout the episode. I encourage you to listen to the full episode.

United Church of Christ and Environmental Racism

After introductions Zack started us off with a brief history of how the United Church of Christ (UCC), in which he is a pastor, in essence started the environmental justice movement. I encourage you to look at Shaver (2021) for a more thorough explanation of this topic. Zack introduced us to a landmark 1987 study titled *Toxic Wastes and Race in the United States* that was conducted by the Commission for Racial Justice of the UCC (Commission for Racial Justice, 1987). Zack informed us

[3] https://www.colorcorrectionpodcast.com

that "of all the different factors that would predict where a toxic waste dump would be located, race was the overwhelmingly largest factor" (Binns et al., 2020, 4:30). In a report released 20 years later that was also commissioned by the UCC (Bullard et al., 2007), Zack pointed out that "not only had very little changed, but the things that had actually changed had gotten worse" (Binns et al., 2020, 5:15). Bullard et al. (2007) found that for the most part, policymakers were unwilling to address the issue of race when it comes to environmental disasters. Or as Zack put it,

> One of the reasons very little changed is on us, and by us, I mean *white climate activists* [emphasis added], who after realizing how important race was in this conversation, also realized that we're not going to get a broad coalition of Congress if we make that a central issue. ... We discounted the people that were affected by the environmental crisis, we told them their issues were secondary, that we need to fix the carbon problem now, and then we'll take care of your injustice issues later. I [Zack] have told people before that we need to fix climate change and that if we don't stop it, humanity will not exist and it won't matter if we have systemic racism or not. (Binns et al., 2020, 5:30)

This was honest of Zack. He followed this up with some important questions that we should all consider. "What am I preserving? What ideal society am I trying to save by ignoring the cries of the majority of people?" (Binns et al., 2020, 8:30). Of note, a recent study released after the recording of our podcast found these environmental racism disparities still persist (Mascarenhas et al., 2021).

Economics and Power

Throughout our podcast we addressed the role of economics and power with respect to environmental racism. We include many examples of the role of economics and politics. For example, early in the episode, Kris addressed the messaging around economics, saying "the intersection always seems to be about economics and what is good for the bottom line. That's the way it gets sold to people who are poor. 'We're going to put this in your neighborhood, but we're going to give you a good job. Even if that job slowly kills you'" (Binns et al., 2020, 13:18). In another example, Andrew talked about the lack of power that exists in communities of color, saying "there's a reason that you didn't build a gas plant in the middle of a suburb. That's because those communities have resources and are empowered. There's a reason why you go to places where people can't fight back" (Binns et al., 2020, 20:46). Finally, a third example brought it home to Philly when talking about economics and power. Kris talked about something that the city of Philadelphia decided to do to help with green space (Philadelphia Parks & Recreation, 2021). He told us "you can get a free tree in Philly if you own your home, but that is the catch. You have to own. That's where the wealth gap is" (Binns et al., 2020, 24:44).

It was during the conversation on the trees in Philadelphia program when I recognized that my perspective needed to shift. I initially thought that this program was a good thing. The city giving homeowners trees is a positive step in trying to increase green space. That was how I saw it and how I still see it, but with a caveat now. After this conversation I understood how even with a program like this, economic disparities still exist and need to be addressed.

The Dehumanization of Black and Brown People

Early in the conversation Bethany provided an important perspective for us to consider, namely, the dehumanization of black and brown people in our country:

> What I feel like we keep talking about is the inherent dehumanization of people and workers, when you have a system of capitalism. Does that mean racism cannot exist? Or capitalism cannot exist outside of a space where systemic racism is not at the right. So everything that we keep coming back to in this discussion really sounds like a lack of recognizing people's full humanity. So it's easy for environmental activists to distance themselves from the effects of industries that are causing harm to communities that they may not necessarily live in. Or it's easy for companies to say, 'well, we can't take our money or we can't invest more money in doing this better, cleaner. Our employees really need these jobs. You're willing to risk the lives of other people in order to make that happen. I feel like what we're saying over and over again really reinforces the dehumanization of black and brown bodies in this country under capitalism. (Binns et al., 2020, 19:01)

Later in the episode during an exchange on the water crisis in Flint, MI, Zack brought up the fact that the amount of money raised in the first day after the fire at Notre Dame Cathedral in 2019 could have easily fixed the water crisis, Bethany returned to the theme of dehumanization and why the Flint water crisis still exists. She said "That's your European icon, right? The value of it is inherently higher than a predominantly Black city. It's unspoken and I think even people listening to me will say 'it's Notre Dame!' But again, if you really break it down why Notre Dame feels more important than this city where currently people and children are suffering...the difference is black people" (Binns et al., 2020, 32:23).

As someone who was devastated when Notre Dame Cathedral burned down, I can understand how some may be offended by Bethany's statement. However, Bethany is right. The dehumanization of black and brown people continue to play a role in environmental crises like the Flint water crisis. This needs to be recognized and addressed if we hope to prevent crises like this in the future.

Appealing to White People

A final theme that emerged from our conversation was appealing to white people, how this has been used to address environmental problems, and if this is a good strategy. This came up in several parts of our conversation, including when we talked about the Flint water crisis and Notre Dame. After Bethany's comment about why people don't care about the Flint water crisis, Andrew returned to an earlier part of our conversation on the increased amounts of people with asthma in a part of Philadelphia that is made up of mainly black communities with the zip code of 19125. He speculated that "maybe that's why I sense a certain amount of tension with environmental activists, because appealing to white people, even though the brunt of the problem is in underprivileged communities, but appealing to white people as a way to get money in support...do people care if 19125 has asthma? I don't know. But people care if whales are dying" (Binns et al., 2020, 32:59).

We returned to this topic of appealing to white people several other times throughout our conversation. Near the end of the episode, I suggested that the reason why white people seem to not care about issues like the Flint water crisis is the mindset of "since it's not really impacting me, what's the point" (Binns et al., 2020, 46:11). In order to help us understand the problem with this mindset, Bethany pointed to a movie theme that is familiar to many of us: a dystopian future. She said "every dystopian story isn't about a dystopian future. It's about the moment in which it would affect white people" (Binns et al., 2020, 47:37). Using the film *The Day After Tomorrow* (Emmerich, 2004) as an example, Bethany said,

> That movie is about this white guy reckoning with years and years of environmental injustice and how it comes to totally destroy the world. But urban communities, urban black and brown communities, are already being destroyed in these ways...I think maybe that's been my issue

> with environmental justice folks is that they distance themselves from the black and brown community so often that are presently affected by it to talk about the distant future, that really that future is now for black and brown folks. (Binns et al., 2020, 48:46)

Later in our conversation I returned to this mindset of "not in our backyard." I said "people don't want to try to help distant island nations because it's not impacting them. But eventually it will impact all of us if we don't do anything about it" (Binns et al., 2020, 52:13). Bethany pushed back, saying

> but I also have trouble with white people framing things as 'okay, eventually this will affect me.' Instead you have to make yourself care about black people. When I was in a DEI training this white woman worked really hard to explain to white people that they should care about racism because it really does affect them eventually. I had to stop her and said 'you should actually just care about other people even if it doesn't affect you at all.' (Binns et al., 2020, 52:27)

This provided a powerful framework for all of us to consider. This helped all of us understand a better way to approach these types of conversations and can help others.

In each of the above examples there are painful realities that can be challenging to accept. Namely that those of us with privilege need to have our perspectives challenged in order to help make lasting change. With respect to environmental racism, we need to acknowledge the role of systemic racism in the development of environmental policies. As Zack pointed out, just targeting the scientific problem is not enough. We also need to focus on the underlying problem, i.e. systemic racism, that led to the construction of toxic industries in communities of color in the first place.

Evolution Education in the American South [Lee Meadows]

The teaching of evolution in American public schools is a perennially tough issue. I work in the American South and have worked across my career as a science educator to help teachers find traction on this issue. The approach I use (Meadows, 2009) is a focus on understanding evolution, but not believing it. In a nutshell, teachers using this approach ask their students to understand evolution and the evidence for it, but not necessarily accept either.

Religious affiliation is dropping across the U.S. (Pew Research Center, 2019), a trend I also see around me in the South, but many science teachers I talk to are still concerned about teaching evolution. Some are deeply concerned or even find evolution impossible to address, and the key factor seems to be the kinds of communities in which they teach. In Alabama where I live and work, teachers in diverse suburban communities have described to me the most freedom to teach evolution. Teachers in rural areas or small towns with high percentages of white Evangelicals have described the most concern about teaching evolution. So even though my work focuses broadly on public schools, the target of my work is helping biology teachers with the religiously sensitive science content of evolution who work in public schools serving religious communities.

Coupling this approach to teaching evolution with the elephant and rider metaphor helps us see why many traditional approaches to teaching evolution simply don't work. Messages like the following are speaking to the rider:

- *"This is a science classroom. We will not discuss religion."*
- *"I can't help you with your questions about religion. You need to go talk to your pastor."*
- *"Evolution is a fact. The scientific evidence is indisputable."*

Each of these messages has an essence of truth. Religion shouldn't be the focus of a science classroom, science teachers often don't have the background to address their students' religious concerns, and evolution is the theory that unifies biology. But these are rational messages that do very little to engage students with religious objections in learning about evolution. They miss the elephant in the room!

Public school teachers can use a different set of messages that speak to the elephant, and honor their religious students' deep beliefs and values:

- *"I know many of you are worried as we get started learning about evolution."*
- *"Your religious beliefs are important. One of my big goals as we learn about evolution is to support your faith."*
- *"If anything you hear during the evolution units sounds like an attack on your faith, please tell me. I might have said something wrong, or you might have misheard me. I want to clear that up quickly."*
- *"My goal is for you to understand what the theory of evolution says and the large amount of evidence for evolution. My goal is not for you to change what you believe about evolution."*
- *"If anything you encounter as we study evolution raises questions about what you were taught at church, feel free to ask me. But please make sure to talk to your parents, your pastor, or your priest about anything that concerns you."*

These kinds of messages speak to students' motivations and internal beliefs. For deeply religious students, they clearly communicate that their teachers value students' faith and work to uphold it. They communicate learning evolution can raise uncomfortable questions, and that teachers want students to find support with those. Most importantly, they communicate to students the focus is on them understanding evolution better without having to accept the evidence presented or the theory itself. They address the elephant in the room by ensuring students their teacher is not trying to steal their faith.

I know personally how difficult this territory is for many science teachers. I grew up in a fundamentalist Christianity as a young earth creationist. I knew then evolution was wrong because it went against the Bible. My views about science and my faith have changed significantly since then, but my faith is still central to who I am as a person. Also, I am sensitive to how difficult learning about evolution is for many Evangelical and fundamentalist Christians, and I believe the public school classroom should never be a place where teachers try to change their students' religious beliefs.

Recently, my religious beliefs and scientific understandings have been stretched in a new phase of growth about human evolution. Growing up in the South, I never had the opportunity to learn human evolution. Evolution was rarely taught or discussed because of its controversial nature, and human evolution certainly wasn't mentioned! This began to change for me when I was honored to join the Broader Social Impacts Committee, which advises the Human Origins Project at the Smithsonian's National Museum of Natural History. For the first time, I had the opportunity to gain an in-depth understanding of the evidence for human evolution, which launched yet another scramble in my religious understanding as I tried to make sense of all that I was learning in light of a Christian view of human origins. It's been another good journey with a pretty amazing set of surprises for my work on the teaching of evolution in Alabama.

Imagine for a moment teaching human evolution in Alabama public schools. You may be like I was, thinking something along the lines of, *"That's a really bad idea."* Teaching evolution is already controversial in the South. Teaching human evolution would be even worse, right? That's what I thought, and it's even what I said publicly. But then I began to see the results of the Human Origin Program's efforts to introduce human evolution into the high school curriculum.

With support from the National Science Foundation (NSF), they had already developed, field tested, and released a curriculum for Advanced Placement Biology (Pobiner et. al., 2018). A key component of this curriculum is the *Cultural and Religious Sensitivity* (CRS, Bertka, 2015) teaching

strategies resource, the purpose of which is to "both encourage and help equip high school teachers to promote positive dialogue around the topic of evolution in their classrooms" (p. 4). Data from the curriculum implementation indicated the AP curriculum was successful, but none of the field testing was done in the deep South. Also, since it was an AP curriculum, we don't have data for how this approach works with students in general biology. Could human evolution work in a regular biology in the South if it was taught with an emphasis on understanding, not belief change? Amazingly, we are currently finding out answers to that question! With NSF support, the Human Origins Program is leading Learning Unity and Diversity in Alabama (LUDA), a project comparing the effect in general biology of teaching evolution with human examples versus non-human examples.

Even more amazingly, human evolution looks to be working well in Alabama classrooms! The project has completed two years of curriculum pilot testing, collecting data on student learning and attitudes. Briana Pobiner, the project principal investigator (and 2019-2021 Sinai and Synapses Fellow), outlined the following as key findings (personal communication, August 5, 2021):

- Student understanding of evolution increases from pretest to posttest. Students of 9 of 12 teachers showed a significant increase.
- Student acceptance of evolution increases from pretest to posttest. Students of 6 of 11 teachers showed a significant increase.
- Students with creationist worldviews showed significant gains in understanding of evolutionary content.

These are pilot data from 12 teachers' classrooms, and the project was moving toward a full implementation in 40 classrooms across Alabama in spring 2020 when COVID-19 struck. Implementation is back on track now for spring 2022, with half the teachers implementing curriculum using human examples and half using non-human examples.

Two key factors appear to explain the success in the pilot classrooms. The first is teachers' use of culturally sensitive strategies in teaching evolution. Teachers were trained and supported in implementation of strategies very similar to the CRS strategies used in the AP curriculum with the game changing result of students realizing no one was out to attack their faith. The version of the CRS used in LUDA helped teachers understand and implement the following values in teaching evolution:

- Acknowledge how diverse religious and cultural viewpoints about the origin, diversity, and evolution of life have existed and continue to exist among human cultures and communities
- Respect students' and teachers' worldviews
- Encourage a supportive classroom environment focused on the goal of understanding the science of evolution, including human evolution, but without promoting any type of belief change

Interestingly, even pilot teachers who were initially hesitant to use the CRS strategies reported good success once they implemented them with their students.

The second factor seems to be simply that kids like learning about themselves! The pilot teachers reported a good level of engagement around the human examples because students saw themselves in what they were studying. A good example of this engagement was in the skin color lesson, which guides students, based on scientific evidence, to explain how allele frequency maps for alleles associated with skin color provide evidence for selection and adaptation in humans, and to construct an argument for natural selection on skin color in humans. Teachers reported this lesson as one of the most popular in the LUDA unit, with many students fascinated by the scientific explanations for variation in skin color based on the interplay of sun intensity, folate, and Vitamin D.

As readers familiar with the American South would suspect, the elephant in the room when teaching evolution is the religious sensitivity of the topic. Appeals to the rider, such as "*Just teach the science*," simply haven't worked. But acknowledgement of the elephant, that is students' deep motivations, religious belief, and even fears, give teachers a clear pathway toward success with this troublesome topic in many Southern communities. Furthermore, the LUDA project gives us good data that this approach actually works in real-world classrooms, even with the contentious topic of human evolution.

Lessons Learned in Communicating Religiously and Culturally Sensitive Science Content

There has been a lot of talk about metaphorical elephants in this manuscript, particularly how not to trigger their emotional reactions that can impede learning about science content that might be viewed as controversial due to religious or cultural implications. In *Virtues as Integral to Science Education* (Melville & Kerr), Ian and Mark both advocate for the inclusion of Aristotelian virtues such as honesty, courage, care, and honesty into science education (Bloom, 2021; Binns, 2021). We also emphasize the importance of establishing an *ethic of belief* (Socket, 1993) in science classrooms, so it is expected that content will be supported by evidence, and to create an environment of trust and respect. The examples presented in the current paper exemplify these needs quite well.

In Mark's example, teaching about climate change to evangelical students, he stayed true to the science of climate change (*honesty*) but found experts who would be viewed as trustworthy to conservative Christian students (*trust*, *respect*, and *care*). As Ian participated in communicating with people of color about environmental racism, he did so with honesty - even recognizing his own blind spots at times (*courage* and *respect*). When Lee taught human evolution to students in the American South, he did not try to convince them of the truth of evolution. Instead, he showed them the evidence for evolution (*honesty*, *courage*, and *ethic of belief*) and expected the students to understand the science - he left their beliefs up to them (*respect*, *trust*, *care*).

Many science and mathematics educators may have religious backgrounds that are quite different from their students or lack religious background altogether. Students come from diverse socioeconomic, racial, and cultural backgrounds and, as such, will hold diverse perspectives regarding religiously and culturally sensitive science content. We hope that the present paper will help educators reflect upon the importance of understanding our students' backgrounds to better perceive how they can carefully present their content to best achieve their goal of science literacy for all of their students. Now, this goal is more important than ever.

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Mark A. Bloom, Ph.D., (markb@dbu.edu) is a professor of biology and science education at Dallas Baptist University in Dallas, Texas. He is also co-executive director of the International Consortium for Research in Science & Mathematics Education and co-editor of the Electronic Journal for Research in Science & Mathematics Education. His research focuses on the philosophy of science, the intersection of science and religion, and citizens' understanding of religiously sensitive socio-scientific issues. His best friend is Ian C. Binns.

Ian C. Binns, Ph.D., (ian.binns@uncc.edu) is an associate professor of elementary science education in the Department of Reading and Elementary Education at the Cato College of Education at the University of North Carolina at Charlotte. His research focuses on the interaction between science and religion with the goal of helping people understand what makes science and religion unique and how they both benefit society. Specifically, his research looks at how preservice elementary teachers' scientific literacy and faith-based beliefs influence their perceptions of how

evolution, creationism, and intelligent design should be addressed in the classroom. Ian is also a host of the podcast Down the Wormhole, which explores the "strange and fascinating relationship between science and religion."

Lee Meadows, Ph.D., (pleemeadows@gmail.com) is a science educator and the Executive Director for the Alabama STEM Council. A teacher at heart, he has taught high school chemistry, physics, and physical science; college chemistry; and many teacher education courses, especially science teaching methods. He's the author of *The Missing Link: An Inquiry Based Approach for Teaching Evolution to All Students* and co-author of *Making Sense of Science and Religion: Strategies for the Classroom and Beyond.*

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