REDESIGNING THE EARTH SCIENCE CURRICUCLUM TO BETTER

EMPHASIZE THE PROJECTED CONSEQUENCES OF CLIMATE CHANGE

A Teacher Inquiry/Action Research Proposal

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**Introduction**

Having studied biology and geology as an undergraduate, I have come to truly appreciate the extensive interconnectedness of the earth, sea, air, and life that comprise the planet. The threat posed by climate change is mounting and its effects are already afflicting the planet, from the greater frequency of severe storms, drought, and wildfires, to sea level rise and mass extinction. This concerns me, as it should others. I care about climate education because it will negatively affect every realm of our lives— agriculture, infrastructure, human health, business, coastal areas, ecosystems, energy, governance, water resources, and even hygiene will all be worse for it.

As a result of climate change’s ever increasing impact and the fact that the effects of it will be felt most by subsequent generations, I think it is vital to rework the Earth Science curriculum to afford more time explaining the history, science, and forecast of climate change on the planet. Because of Earth Science’s status as an SOL course in Virginia, it is pertinent to reappropriate some of the curriculum within Earth Science to better educate the students on the reality they will come to endure (*Earth Science SOL,* 2010).

Climate change— a monumental dilemma, saddled upon them by prior generations —will continuously afflict our students’ lives. We will need a better informed and engaged citizenry to create the next generation of scientists who will help rein in the human impact on the planet and curb the effects of climate change before more damage to the planet and its inhabitants can occur.

In my redesigned climate unit, I would adopt aspects from the Next Generation Science System as a foundation for my teaching (NGSS, 2020). I would also accommodate flexibility to address the short comings my particular students’ possess as identified by a climate change assessment and survey that I will distribute to them at the start of the unit. Based on the Virginia Earth Science Standards there are lots of opportunities to tie-in climate change to earlier units. I will use these relevant opportunities the increase the amount of content I could normally teach about climate change. I will redesign my a number of my lessons to have incorporate the climate change theme.

During the sixth unit, when we begin to cover fossil fuels and the advantages and disadvantages of various energy sources, I will mention the relationship between fossil fuel consumption, the greenhouse gases they emit and how that has altered the planet’s climate. It is during this unit that I will give my student’s their climate change survey. During the eight unit, when we cover freshwater sources, I will emphasize the interconnectedness of abiotic and biotic systems. During the ninth unit, when we cover the history and evolution of Earth and life on Earth I will mention how we are in the midst of a sixth mass extinction due to human activities: hunting, habitat destruction, pollution, and the destabilization of the homeostasis of all ecosystems. During the tenth unit, when we cover oceans, I will mention the balance between the atmosphere and the oceans, that the oceans act as a heat and carbon sink, and as we release more CO2 from fossil fuels the oceans become more acidic. I will also mention that glaciers are melting and all that cold water enter the oceans, leading to sea level rise, and disrupting oceanic and atmospheric currents. I will conduct a brief assessment followed by a climate review. During the eleventh unit, I will go into greater detail about the origin of the atmosphere and the interrelationship of the geologic, biologic and human processes upon it. Then it will officially be climate unit, the twelfth unit. I will describe weather and climate, I will mention severe weather and their anticipated frequency, and will review how climate change affects so many different topics we covered in this course, the planet, and our lives. After this unit, I will conduct a full assessment (test) and will survey my students again to see if turning the climate unit into an overarching theme has informed and successfully convinced any students.

**Literature Review**

There are many factors that account for Americans’ having such a limited knowledge and acceptance of climate change, some of the most glaring are the misrepresentation and ideological partisanship of the evidence by politicians and corporate interests (Branch, 2016). These factors translate into misinformed administrators, misinformed teachers, misinformed parents, and, ultimately, misinformed students.

Since at least 2004 there has been a strong consensus among climate scientists that modern climate change is driven by anthropomorphic activity; in 2015 that number was 97% of climate scientists, and 87% of scientists in general (Branch, 2016). However, we often see on television even sided, one-on-one, debates. If television more accurately portrayed the scientific consensus on climate change and had 97 scientists arguing for and only 3 scientists arguing against, it would certainly influence the opinions of many of the scientifically uninformed and apathetic. This false equivalence has become so detrimental that only 21% of registered voters correctly guessed that 80-100% of climate scientists were in consensus on climate change (Branch, 2016). High school science teachers performed better, but the results were still surprisingly low at 45% (Branch, 2016). These statistics highlight a sad reality where opinion has been permitted to be comparable to fact.

Unfortunately, we live in a world where science is being misused as a partisan device to sow division within our country. Maria Ojala (2015) identified a number of factors she believed influenced the perceptions of climate change skeptics, such as: “Values, political orientation, knowledge, gender, trust in societal institutions, environmental efficacy, tolerance toward immigrants, and social influence from parents and peers also seem to matter.” The results of Ojala’s study found that much of this skepticism was rooted in the feelings of societal powerlessness. In order to curb this sense of powerlessness, there needs to be a greater emphasis on scientific knowledge, as well as for increasing young people’s action competence. For example: discussing different possibilities for solving societal and environmental problems, working with visions for the future and with motivation, and giving the students action experiences (Ojala, 2015).

 Kathryn Lee et al. found that income level of a country, an additional, rather unique factor, affected the likelihood for there to be skepticism over the acceptance of climate change. In Lee et al.’s study (2019), “upper income” countries were more likely to be skeptical of climate change than “upper middle income” and “lower middle income.” Students from upper income countries tended to be more individualistic and thought of climate change as a global issue rather than a local one (Lee et al, 2019). This is one of the key educational tools that Lee (2019) highlights, the need to make the issue of climate change more personally relevant. This personal tie-in in conjunction with other proven techniques will be the most effective format teaching adolescents thus far developed. Stevenson (2014) found individualist to be 16.1% less likely to accept climate change

This ‘global’ versus ‘local’ misconception may be due to climate change having previously been popularly referred to as ‘global warming,’ a relic still incorrectly in use by climate scientists and researchers (and references for this paper). The main downside to the popularization of the phrase “global warming” is that it only tells a part of the story; it misrepresents the effects as simply the planet is getting warmer, when in reality it will reshape how climates around the world will act. Many, in fact, have used the term derisively in order to cast additional scorn on the climate change debate.

Lee (2019) and Ojala (2015) both also note the pivotal role that adults, particularly parents, play in shaping a child’s viewpoint on climate change and that these viewpoints become more entrenched as people get older. Stevenson et al. (2014), however, believed that adolescents were still forming their views and thus were still a receptive audience. According to Leiserowitz et al (2012), only 54% of high schoolers believe in climate change. And Surveys by Branch (2016), Ballew et. al (2019), and Howe et al. (2019) found that 67% of the U.S. participants accepted climate change, but only 53% attributed it to human activity.

Branch (2016) is optimistic about our youth; he thinks it is easier now to teach students in a “warming world,” citing increased reflection in standards and textbooks, online resources for teachers, and engaging mediums like cartoons and games. But like many people of his generation, there seems to be a sense of laisse faire-ness about it, as if like what we’re seeing now is an acceptable amount of progress. It is not. Climate change will have catastrophic effects on the planet and generations to come.

**Methodology**

**Research Questions**

Science educators, particularly those versed in earth/environmental science, have a responsibility to increase student understanding, concern, and readiness to act about climate change. Due to the need to prepare students for the chaotic future they will inherit, I propose the following research question and sub-questions:

* How can I redesign the Earth Science curriculum to better emphasize the real-world consequences of climate change and the projected, worsening, outcomes?
* What strategies should teachers implement in order to convince more skeptical students?
* What are the views of our students in relation to the causes, expected impacts, and proposed solutions of climate change?

This study aims to increase teachers’ and students’ understanding of the connection between human activity, climate change, and the impacts they have on the Earth.

**Context**

The study focused on Gloucester High School in Gloucester County, Virginia. Being on the middle peninsula, Gloucester is adjacent to the York River, the Rappahannock River, and the Chesapeake Bay, making this community particularly vulnerable to the effects of climate change. While much of Virginia is politically split, I chose Gloucester High School because individuals from rural areas were statistically more likely to be skeptical of climate change (Branch, 2016).

**Innovation**

The revised curriculum will teach grade 9th students at Gloucester High School about Climate Change and provide a more a comprehensive set of lessons for science department educators. Students will demonstrate an improvement in their information and working knowledge related to Climate Change as evidenced by a pre- and post-semester survey. I will issue a pretest Survey at Unit 6 to establish a base-line measure for each of the attending students. After Unit 10 I will conduct a review of the Climate topics we’ve already touched on, assess for knowledge gaps and target soft areas in need of review. Students will be retested at the end of unit 12 students will be issued a full assessment and will retake the survey. I will compare the data from the pre- and post-survey reports and scale the findings on a linear graph chart marked for change over time. The pre and post surveys will demonstrate an increase in the student’s knowledge on Climate Change as a result of the modified curriculum.

**Data Collection and Analysis**

The two major data collection methods I would look to utilize are testing and surveying, before and after the unit.

I will give a survey that catalogs their opinions to create a baseline for my later results. The survey was constructed by the Yale Program on Climate Change Communication (Howe et al, 2019). [See references for full survey] Then I will give an identical YPCCC survey to determine whether my students’ opinions had changed over the semester after my teachings (Howe et al, 2019).

 I will give a short assessment to gauge their knowledge on climate change at the end of the tenth unit, this questionnaire was constructed by Seroussi et al. (2019). There will be a full assessment (exam) at the end of the twelfth unit. These will both be able to provide me with percentages that I directly can compare to each other to check for progress and compare to the class to ensure that the extended unit was a usefulness education method.

Sample Questions – Assessment

“For the next few decades, the majority of climate scientists expect...”

1.) ...an increase in extreme events, such as droughts, floods, and storms.

8.) ...the climate to change evenly all over the world.

Sample Questions – Survey

How much do you think global warming will harm plants and animal species?
When do you think global warming will start to harm people in the United States?

**Discussion**

In order to share my findings and conclusions with a larger audience I would

contact the NSTA and NESTA about distributing the Yale on Program Climate Change Curriculum survey and the findings from my inquiry. I would like to collaborate with the NSTA, NESTA, and YPCCC to conduct citizen science/teacher inquiries by distributing the survey that the YPCCC developed. We would supply these to science teachers across the country to gather data on a demographic this currently does not target.

I could also write an article for the National Education Association, the largest labor union in the United States, to try to inform and influence the opinions of the science teachers who misteach climate change. Not all of these teachers misteach maliciously; rather, many do not realize they are teaching the subject matter incorrectly and that the method in which do so may be perpetuating the notion that climate change is controversial.

 One thing this research paper has helped make abundantly clear is that redesigning the Earth Science curriculum is just one of many hurdles needed to address our nation’s deficient understanding and acceptance of climate change. The Clock is ticking, and much remains to be done.

(2200 words without references or citations)

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