Global Warming in Schools: An Inquiry about the Competing Conceptions of High School Social Studies and Science Curricula and Teachers

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Abstract

Despite the scientific consensus supporting the theory of anthropogenic (human-induced) global warming, whether global warming is a serious problem, whether human activity is the primary cause of it, and whether scientific consensus exists at all are controversial questions among the U.S. lay-public. The cultural theory of risk perception (Schwarz and Thompson, 1990) serves as the theoretical framework for this qualitative analysis in which I ask the question how do U.S. secondary school curricula and teachers deal with the disparity between the overwhelming scientific consensus and the lay-public’s skepticism regarding global warming? I analyzed nine widely used social studies and science textbooks, eight sets of supplemental materials about global warming produced by a range of not-for-profit and governmental organizations, and interviewed fourteen high school teachers who had experience teaching formal lessons about global warming in their content area.

Findings suggest: 1) the range of global warming content within social studies and science textbooks and supplemental curricula reflects the spectrum of conceptualizations found among members of the U.S. public; 2) global warming curricula communicate only a narrow range of strategies for dealing with global warming and its associated threats; and 3) social studies and science teachers report taking a range of stances about global warming in their classroom, but sometimes the stance they put forth to their students does not align with their personal beliefs about global warming.

The findings pose a troubling conundrum. Some of the global warming curricula treat the cause of global warming--a question that is not scientifically controversial--as a question with
multiple and competing “right” answers. At the same time, much of curricula position how we should address global warming--a question that is legitimately controversial--as a question with one correct answer despite there being many reasonable responses. Finally, I present the implications this conundrum has for teaching about global warming in a politically polarized atmosphere.
# Table of Contents

## Abstract

## Table of Contents

### Chapter One: Introduction
- U.S. Public Opinion about Global Warming
- Controversies in Climate Change Education
- Research Questions

### Chapter Two: Literature Review and Theoretical Framework
- Cultural Theory and Beliefs about Global Warming
- Review of the Climate Change Education Literature
  - Global warming in the U.S. science and social studies classrooms
  - Global warming as a controversial socioscientific issue
- Description of Conceptual Framework
- Chapter Summary

### Chapter Three: Methods
- Selection of Data Sources and Data Generation
- Data Analysis
- Positioning Myself in the Study
- Chapter Summary

### Chapter Four: The Scientific Case for Global Warming
- Chapter Summary

### Chapter Five: Conceptualizing Global Warming in the Formal Curriculum
- The Adherent Curriculum
  - Is global warming a problem?
  - Is human activity causing global warming?
  - Is there scientific consensus about global warming?
- The Dissenting Curriculum
  - Is global warming a problem?
  - Is human activity causing global warming?
  - Is there scientific consensus about global warming?
- The Hesitant Curriculum
  - Is global warming a problem?
  - Is human activity causing global warming?
  - Is there scientific consensus about global warming?
- Chapter Summary
Chapter One: Introduction

At first glance the two lessons from two different sets of supplemental curriculum about the topic of global warming appear to be moving students in the same direction. A learner objective from the lesson included in *An Inconvenient Truth in the Classroom (AITC)* curriculum states that, by the end of the lesson, students will be able to “create and explain the carbon cycle” (p. 33). According to the lesson from the other set of materials, titled *Understanding Climate Change*, students should come away with a “basic understanding of carbon sources and exchanges” and be able to “analyze data regarding various stocks and flows [of carbon]” (p. 34). Students exposed to either curricula explore the movement of carbon through the hydrosphere, atmosphere, lithosphere, and biosphere. They learn that various forms of carbon collect in different “sinks”--the oceans, the atmosphere, plants and animals--and that carbon flows from one sink to another. They learn that carbon flows through the various parts of the cycle at different rates, and they learn that human activity, like the burning of fossil fuels, influences one particular carbon flow within the greater carbon cycle.

Despite sharing similar learner objectives and content knowledge the two sets of supplemental materials draw significantly different conclusions about why learning about the carbon cycle matters. The lesson from the *AITC* materials emphasizes that human activity is fundamentally altering the carbon cycle and therefore accelerating global warming. In contrast, the lesson from *Understanding Climate Change* highlights something known as the “missing sink”--the phenomenon that the amount of carbon remaining in the atmosphere is less than what scientists expect given the quantity of total carbon dioxide emitted to the atmosphere due to
human activity.\(^1\) According to the authors of *Understanding Climate Change*, the purpose of this lesson is “to demonstrate that our lack of understanding concerning the carbon cycle diminishes the reliability of carbon tracking and climate modeling.” The disparity between these intended outcomes cannot be understated: while students who engage with the *AITC* lesson are supposed to learn that human activity plays a major role in global warming, students using the *Understanding Climate Change* materials are supposed to question the evidence supporting the scientific theory of anthropogenic (human-induced) global warming.

The two sets of supplemental materials share a host of other goals and content. Both want students to understand how science evolves through the scientific method, both encourage students to critically assess scientific data, and both present students with content about the cause of global warming. Still, the way these supplemental materials conceptualize what the theory of anthropogenic global warming is and what it means for society are highly contradictory. For instance, one of the learning objectives in the *AITC* materials is to help students “recognize misuse of scientific terms--specifically understand the meaning of scientific theory” (p. 25) especially as it pertains to the scientific theory of global warming. These materials distinguish between how the term “theory” is commonly used in the English language--to “have a hunch that something is true or an opinion about something” (p. 25)-- from how science uses the term: “In order for something to be a scientific theory, thousands of tests must have been done to support a phenomenon....You don’t get to call something a theory until it’s been subjected to a rigorous

\(^1\) The difference between emissions of carbon flowing into the atmosphere and the amount of carbon flowing from the atmosphere is about 5.8 gigatonnes. In other words, basic mathematics indicate that 5.8 gigatonnes of extra carbon should remain in the atmosphere each year. However, observations show that the net flow to the atmosphere is only 3.2 gigatonnes. The difference, 2.6 gigatonnes, is referred to as the “missing sink.” Research since 2007 suggests that the missing sink in largely accounted for in the vegetation of tropical forests—a larger sink than previously hypothesized.
amount of scientific study” (p. 25). On the other hand, *Understanding Climate Change* proposes that “scientific knowledge advances when scientists have the courage to question conventional ideas and to propose new theories supported by all the available evidence” (p. 4). Moreover, on one visual-aid, students are reminded in bold print that “Our history is full of examples where ‘common knowledge’ was discarded in favor of more correct hypotheses” (p. 5). This lesson uses the example of Galileo--convicted of heresy in the 17th century for arguing that the earth was not at the center of the solar system--as an individual scientist who challenged, correctly as it turns out, the mainstream scientific thinking of the time.

One sees a similar conceptual divide concerning the cause of global warming and whether climate science experts agree about what is happening. *AITC* notes that “The strong warming trend of the past 30 years has been attributed to the effect of increasing human-made greenhouse gases” (p. 15). The authors distill this point later in the materials when they remind students that “The important thing to remember is that humans have caused [global warming]” (p. 21). Furthermore, *AITC* insists that “Consensus has emerged among the majority of scientists and experts” (p. 17) regarding the existence and human-induced cause of current global warming. *Understanding Climate Change* conveys an entirely different message: “Whether carbon dioxide emissions resulting from human actions have contributed to climate change is a matter of intense debate” (p. 22) and that “despite the popular media conception of consensus, the issues are far from settled” (p. 3).

What is going on here? How do curricula purported to be about the same topic--even sharing a number of learner objectives--come to convey such disparate messages about what global warming is, what causes it, and what experts think about it? In order to begin to
comprehend the disconnect, it is important to understand three unique trends in U.S. public opinion about global warming.

**Putting Global Warming in Context: U.S. Public Opinion**

The first notable trend is that a significant portion of the U.S. lay public *disagrees* with what climate experts believe to be true about global warming. More than 97 percent of climate scientists actively publishing research about climate change agree that global warming is a real phenomenon and that it is driven largely by human activity (Anderegg et al., 2010). Curiously, of the countries with populations that have some knowledge of global warming the number of U.S. residents who believe global warming is a consequence of human activity is relatively low. Ninety-two percent of South Koreans, 81 percent of Brazilians, 63 percent of French, 61 percent of Canadians, and 58 percent of Chinese believe that global warming is the result of human activity, yet only 49 percent of the U.S. population shares this belief (Pelham, 2009). A more recent poll by the Pew Research Center suggests that 63 percent of Americans feel that there is solid evidence for global warming, though only 38 percent feel that human activity is to blame. Over a quarter of those surveyed believe that there is a dearth of strong scientific evidence supporting the existence of global warming at all (Pew Research Center, 2011).

A second noteworthy trend in U.S. public opinion is that what the public believes about global warming is fluid. Polling data from 1998 to 2008 indicates a yearly increase in the percentage of the U.S. public who agreed with the statement “most scientists believe that global warming is occurring.” In 2008 that trend quickly reversed and a growing percentage of the population reported either being unsure what scientists believe or believing most scientists *did not* believe global warming was occurring. Similarly, until 2008 a growing segment of the
American public felt that global warming represented a threat to them. This trend, too, reversed itself (Newport, 2010). Other research corroborates these patterns. According to the Pew Research Center (2011), 71 percent of Americans surveyed in 2008 felt that there was solid evidence that global warming was occurring while just 59 percent believed the same by 2009. The same poll indicates that what Americans believe is once again changing: since 2009 there has been a sharp increase in the number of people who agree that there is “solid evidence” the earth is warming. Interestingly, this shift is most notable among those identifying as moderate Republicans (Pew Research Center).

A third trend in the U.S. public opinion about global warming, and perhaps the most striking, is that what one thinks about global warming is highly correlated to one’s political ideology. For example, research indicates that 79 percent of Democrats believe that there is solid scientific evidence that global warming is occurring and 59 percent believe that human activity is a primary cause. On the other side of the aisle, just 38 percent of Republicans agree that there is strong scientific evidence for global warming and 18 percent believe humans are to blame. The emergence of the Tea Party brings the liberal-conservative discrepancies into even sharper focus. Of registered Republicans who agree with the Tea Party, 23 percent believe that there is solid evidence for global warming and only 8 percent believe it is because of human activity (Pew Research Center, 2010).

Likewise, evidence from Leiserowitz, et al. (2011a) reveals 48 percent of those whom are most concerned about global warming, most likely to believe that global warming is occurring as a result of human activity, and most likely to believe that scientific consensus exists about global warming consider themselves somewhat or very liberal. In contrast, 84 percent of those
surveyed that are least concerned about global warming, least likely to believe human activity is to blame, and least likely to think scientists agree on the matter identify as somewhat or very conservative. Forty-two percent of this group consider themselves members of the Tea Party movement.

Importantly, the ideological divide is not tempered by education but instead appears to be amplified by a college education. Of people polled who did not graduate from college, 32 percent of Republicans and 52 percent of Democrats believed global warming was happening as a result of human activity. Of college graduates, 23 percent of Republicans and 75 percent of Democrats believed the same (Pew Research Center, 2007).

**Recent Controversies in Climate Change Education**

U.S. schools are fast becoming the arena where these ideological divisions surface. In early 2008 Bobby Jindal, the Republican governor of Louisiana, signed into law the Louisiana Science Education Act (LSEA) “to promote students’ critical thinking skills and open discussion of scientific theories…being studied including, but not limited to, evolution, the origins of life, global warming, and human cloning” (LSEA, 2008). Next door in Texas, the State Board of Education approved new language in the science standards that requires more time be spent in the science curriculum to evaluate “different views on the existence of climate change” (Harte, 2010), essentially forcing teachers to cast doubt on the scientific evidence supporting the theory that human activities are causing global warming. Don McLeRoy, then the chairman of the State Board, rationalized the Board’s action by arguing, “Conservatives like me think the evidence (for human contributions to global warming) is a bunch of hooey” (Price, 2009).
One thousand miles to the north, a staunchly conservative South Dakota legislature harbored similar sentiments when it passed House Concurrent Resolution (HCR) 1009 urging “all instruction in the public schools relating to global climatic change be presented in a balanced and objective manner…” (HCR 1009, 2010).² On the west coast, the Los Alamitos (California) Unified School District school board unanimously voted for a new rule requiring that the district’s A.P Environmental Science teachers give an annual presentation to the school board outlining how they teach the class. In particular, the board was concerned that teachers would not present students with a politically balanced view of global warming. Jeffrey Barke, a self-identified conservative board member and “not a big fan of global warming,” claimed that, “Most teachers are left to center, and if we leave it to teachers to impose their liberal views, then it would make for an unbalanced lesson” (Pagaza, 2011).

Opponents of policies requiring teachers to teach “both sides” of global warming are equally vociferous and have their own notions about how schools should teach the topic. In May 2011, Louisiana legislators attempted (though ultimately failed) to repeal LSEA on grounds that it was opening up the possibility for teachers to teach creationism in the classroom or otherwise spread doubt about phenomena scientists have strong empirical evidence for. Among the supporters of the repeal of LSEA were more than 40 Nobel-prize winning scientists (Delatte, 2011) and the Rev. Welton Gaddy, the president of the national organization Interfaith Alliance

² The law as quoted in the text above is the amended version, necessary because the original version of the law was poorly written and researched. For example, the law as originally written referred to carbon dioxide not as a pollutant but as a necessary “gas of life,” implying that it was unproblematic in any amount. Furthermore, the original law pointed that a high degree of speculation exists concerning how a number of factors, including astrological [the study of divining human and natural events based on the position of celestial bodies] and thermological [the study of human body heat] dynamics, interact to “effect [sic] world weather phenomena” (HCR 1009, 2010).
Likewise, there exists stiff opposition to the Texas State Board of Education’s “balanced” approach policy. For instance, a senior scientist at the Environmental Defense Fund proclaimed, “…the board appears to be supporting its own ideological views rather than those of proven science” (Price, 2009). Moreover, anecdotal evidence suggests that the board’s mandate has not changed how science teachers in Texas teach about climate change (Harte, 2010).

Research Questions

Given the polarizing nature of global warming among the U.S. public, my research is guided by the broad question, **How do U.S. secondary school curricula and teachers deal with the disparity between the overwhelming scientific consensus and the lay-public’s skepticism regarding global warming?** More specifically, I ask:

- How do U.S. textbooks and supplemental materials conceptualize global warming?
- What messages do the curricula convey about how societies should respond to global warming?
- How do U.S. high school social studies and science teachers personally conceptualize global warming and how are they making sense of the stance they take in their classrooms?

Defining Global Warming

Before going any further, I need to define exactly what I mean by the term *global warming* in the context of this study. I use the term global warming to refer to both the human-induced rise in average global surface temperatures observed over the past century and the current and ongoing consequences this rise temperatures has on physical and biological systems.
worldwide. This second part-- the effects of rising temperatures-- is what scientists generally refer to as *climate change*. Importantly, then, in this research I use the terms global warming and climate change synonymously which from a scientific standpoint is technically incorrect.

Much of the public opinion research (cf. Maibach, Roser-Renouf, and Leiserowitz, 2009) that informs my theoretical framework uses the term global warming in its surveys and polls of the American public; however, such research is often asking respondents what they believe about ideas that scientists would refer to as climate change. In using “global warming” and “climate change” interchangeably, then, I am mirroring the discourse within the U.S. public.

Within the education literature, curriculum and instruction about the processes of global warming and climate change is usually referred to as *climate change education*. When I discuss teaching and learning about global warming I will sometimes use the term climate change education with the understanding that this encompasses the process of global warming. In fact, from the position of the lay-public, climate change education could just as easily be labeled “global warming education.” When a distinction between global warming and climate change is necessary, I will clearly signal that I am referring specifically to one or the other.

**Layout of This Work**

The seven remaining chapters are organized as follows. In chapter two I offer a review of the relevant literature in climate change education and controversial issues education that frame this study. I conclude chapter two with an explanation of the theoretical framework undergirding this study. Next, chapter three lays out the methodology I used to conduct this

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3 For a more in depth discussion on the use of “global warming” versus “climate change,” see Conway’s (2008) brief feature on the NASA website.
study. Chapter four provides a brief overview of the major findings about global warming that climate scientists have come to agreement on. Understanding what climate scientists have come to know and believe about global warming serves as important context for the subsequent three chapters. In chapter five, I identify three conceptual categories that curriculum about global warming fits into, adherent, hesitant, and dissenting curricula, and I discuss the critical attributes of each conceptual category. Chapter six investigates the types of strategies to address the problem of global warming highlighted within global warming curricula and draws particular attention to differences between social studies and science curricula in this regard. Chapter seven explores the conceptual categories of global warming that high school social studies and science teachers present to their students and how these teachers make sense of the stance they take in their classrooms. Finally, chapter eight synthesizes the previous chapters through a discussion of the implications of this work and provides recommendations for educators who teach, or hope to teach, their students about global warming as well as for researchers who are interested in building off of this work.
Chapter Two: Literature Review and Theoretical Framework

In this chapter I review the relevant literature that undergirds my study and informs my theoretical framework. I begin by discussing the cultural theory of risk perception as a way to understand the disparity between what experts and the lay-public have come to believe about global warming. My literature review continues with a look at some of the empirical work from the emerging field of climate change education, the literature exploring the relevance of global warming as a topic in science and social studies classrooms, and the literature about the teaching of controversial issues. I conclude the chapter with a description of the conceptual framework which guides my thinking about how formal global warming curricula takes shape.

Cultural Theory and Beliefs about Global Warming

Among the world’s foremost climate experts, it is incontrovertible that global warming exists, that it is caused primarily by human activity, and that it is responsible for substantial and rapid changes to climates, ecosystems, and human societies worldwide. Still, many in the American lay-public remain unconvinced. A collaborative effort between the Yale Project on Climate Change and the George Mason University Center for Climate Change Communication yielded a series of studies collectively called Global Warming’s Six Americas that offers a nuanced view of U.S. public opinion concerning global warming. These studies break down the U.S. population into six distinct categories based on one’s degree of belief in global warming, level of concern about global warming, and level of motivation to respond to global warming. Bookending the population are the alarmed, the 12 percent of the population who believe global warming is happening now and is or will soon affect them and their way of life, and the

dismissive, the ten percent of the population who reject the notion that human activity is contributing to global warming or deny that global warming exists at all. The remaining 78 percent of the population falls somewhere between these positions (Leiserowitz, Maibach, and Roser-Renouf, 2011a; Leiserowitz, Roser-Renouf, and Maibach, 2010; Maibach, Roser-Renouf, and Leiserowitz, 2009). Recent polling indicates that of the 59 percent of those surveyed who believe there is “solid evidence the earth is warming,” 34 percent attribute the warming to human activity, yet 18 percent attribute it to natural patterns. Thirty-two percent feel there is no solid evidence that global warming exists in the first place. Moreover, 63 percent of Americans believe global warming is a “very serious” or “somewhat serious” problem while 34 percent consider the matter “not too serious” or “not a problem” (Pew Research Center, 2010). The upshot is that significant portions of Americans fundamentally disagree with each other about the nature and cause of global warming.

How do scholars explain why Americans hold such disparate thoughts about global warming? Research rooted in the cultural theory of risk perception, theorized by Douglas and Wildavsky (1982) and extended by Schwarz and Thomson (1990), demonstrates that beliefs about climate change may stem more from worldview than any empirical knowledge of the phenomenon. The cultural theory of risk perception begins with the assumption that humans lack complete knowledge about the environment and their interactions with it; therefore, a degree of uncertainty and risk accompany any action towards the environment. Given our incomplete knowledge concerning the risks of altering the natural environment, why do different groups of people choose to focus on the risks that they do? Douglas and Wildavsky (1982) concluded that people perceive risk based on how society is organized and the degree to which society imposes
external rules on individuals or groups. Douglas and Wildavsky conceptualize social organization as falling on a spectrum from individualist (weak ties to others; decisions bind only themselves) to collectivist (strong ties to others; decisions bind the whole group). A second dimension, external control, runs from high external control (based on tradition, regulations, and defined positions in society) at one end and low external control (equality, few rules regulating behavior or preventing social mobility) at the other. The end result is four quadrants, or “ways of life” (Douglas and Wildavsky) that delineate particular worldviews: individualist, hierarchist, egalitarian, and fatalist. Figure 2.1 provides a visual of Douglas and Wildavsky’s framework.

To better understand the lively policy debates about environmental issues among these four worldviews, Schwarz and Thomson (1990) superimpose a version of ecologist C.S. Holling’s theoretical work on Canadian foresters’ perceptions of ecosystem stability onto Douglas and Wildavsky’s (1982) framework. Holling (1986) employed three “myths of nature” – Schwarz and Thompson added a fourth—to describe cultural interpretations of environmental reality: nature benign, nature ephemeral, nature tolerant, and nature capricious. To understand the myths of nature it is useful to visualize each scenario as a marble seeking stability on a specifically shaped landscape. The marble represents the natural world in its current form—or at least what society recognizes as a desirable, balanced state of nature particularly among living organisms. The bowl represents the stability of the environment, writ large. Environmental disturbances (e.g. global warming) cause the plate or bowl to tilt: the greater the disturbance, the greater the tilt. A tilt severe enough to push the marble over the edge represents large-scale, catastrophic environmental collapse. See Figure 2.2 for an illustration of the myths of nature.
Figure 2.1. Four “ways of life” as theorized by Douglas and Wildavsky (1982). Adapted from Schwartz and Thompson (1990) and O’Riordan and Jordan (1999).
Different myths of nature hold different conceptions about the shape of the landscape and the amount of disturbance necessary to cause the marble to plummet over the edge. For instance, in the myth of nature benign the landscape has infinitely tall sides and the marble sits at the bottom; therefore, nature returns to equilibrium no matter the amount or type of disturbance it endures. In contrast, in nature capricious the landscape is flat. Slight disturbances can send the marble rolling one way or the other, and possibly over the edge. Here, the environment is unpredictable and humanity has no control over its randomness. Nature tolerant presupposes that nature can put up with a measure of disturbance and still remain intact. Too much disturbance, though, causes environmental collapse. Finally, nature ephemeral balances the marble precariously atop a landscape dropping steeply on all sides. According to this myth, the environment is unforgiving: slight environmental disturbances will be met with irreversible catastrophic outcomes.

Figure 2.2. Representations of the four myths of nature. Adapted from Schwarz and Thompson (1990).
Schwarz and Thompson’s (1990) merged framework sheds light on how our institutions legitimatize the myths about nature and thus helps us understand how groups adhering to different worldviews frame the risk of global warming (See Figure 2.3). Said differently, individuals acting in specific social contexts construct corresponding interpretations, or rationalities, concerning environmental reality (Dake, 1992; Schwarz and Thompson, 1990; Scott and Gough, 2003). For example, hierarchists espouse the myth of nature tolerant. This view necessitates strong social controls, in the form laws like the Clean Air Act, to make certain that the level of greenhouse gases does not disrupt the environment enough to cause irreparable damage. Hierarchists turn to experts to determine the threshold of “dangerous” levels of greenhouse gases and bureaucracies for managing that boundary line. The urgency to address climate change is related to the stability of the status quo: the more global warming threatens the stability of the bureaucracy, the greater the sense of urgency supporters of the bureaucracy feel to mitigate it. On the other hand, the myth of nature benign—that no amount of disturbance can upset the environment to the point of collapse—serves as moral justification for the actions of individualists. Individualists believe that entities should not be encumbered by top-down regulations and instead favor the invisible hand of a fair market to bring about the best environmental outcomes; therefore, individuals acting in a market will determine how to best use natural resources. According to this worldview there is little urgency to address global warming. If it is a problem at all, it is a problem for future markets to address.
Figure 2.3. The merged cultural theory of risk perception framework put forth by Schwarz and Thompson (1990). Adapted from Hulme (2009) and O’Riordan and Jordan (1999).

The connection between worldview and beliefs about global warming is clearly evident within the *Six Americas* studies. Consider, for instance, the differences in political ideology. Of those classified as alarmed, 48 percent self-identify as either somewhat or very liberal while just 16 percent consider themselves somewhat or very conservative. On the other hand, of those classified as dismissive, 84 percent self-identify as either somewhat or very conservative and only three percent identify as somewhat or very liberal. Furthermore, 42 percent of dismissives consider themselves part of the Tea Party movement (Leiserowitz, et al., 2011a). Moreover,
Maibach, et al. (2009) suggest, while the demographic differences between the six groups tend not to be large, there are also profound differences in values, religious beliefs, and political ideology between the segments. In short, the more concerned a particular segment of the population is about global warming, the more likely members of that segment will be politically liberal and hold strong egalitarian and environmental values. Conversely, members of less concerned segments tend towards political conservatism, strong individualist values, anti-egalitarian values, and evangelicalism or other strongly held traditional religious values.

One reason why understanding the various myths of nature is important is because it gives us insight about one’s policy preferences regarding global warming. In a sample of California residents, Dake (1991) found that those holding a hierarchical worldview are more likely to also have a conservative orientation and those taking up an egalitarian worldview tend to be liberal in orientation. Similarly, research indicates that liberals, women, and minorities perceive climate change as a greater risk and are more likely, along with egalitarians, to support national global warming policies. This stands in contrast to males, conservatives, and registered voters whom are less likely to perceive climate change as a risk and, along with hierarchists and individualists, less likely to support national policies mitigating the risks of global climate change. Furthermore, hierarchists and individualists are more likely to oppose raising taxes on gasoline and fuel-inefficient vehicles; egalitarians, on the other hand are more likely to support such measures (Leiserowitz, 2006). Clearly, what one thinks about global warming has practical policy implications. Since schools help shape what people think it is critical to understand what schools are teaching youth about global warming.
Review of the Climate Change Education Literature

Climate change education--teaching and learning about the causes and consequences of anthropogenic global warming--is a recent phenomenon; consequently, the literature about the field is just beginning to take form. Wise (2010) identifies three broad categories addressed in the literature: studies exploring the misconceptions people hold regarding climate and climate change, studies investigating the link between instruction and students’ knowledge and/or attitudes concerning global warming, and studies examining the patterns of global warming instruction.

Misconception studies document the misunderstandings people hold regarding global warming including its causes, its impacts, and potential methods of “solving” it (Students’ Concepts, 2008). Misconceptions appear at primary and secondary levels (Boyes and Stanisstreet, 1993, 1998; Koulaidis and Christidou, 1999; Gowda, Fox, and Magelky, 1997; Rye, Rubba, and Weisenmayer, 1997) as well as the undergraduate level, including those in teacher education programs (Dove, 1996; Groves and Pugh, 1999; Papadimitriou, 2004; Gautier, Deutsch, and Rebich, 2006). People appear generally confused about basic scientific concepts important for understanding climate change such as the greenhouse effect (Pruneau, Liboiron, Vrain, Gravel, Bourque, and Langis, 2001; Pruneau, Gravel, Bourque, and Langis, 2003; Andersson and Wallin, 2000), types of radiation and the role of radiation in the greenhouse effect (Koulaidis and Christidou, 1999), and the difference between weather and climate (Gowda, et al.,
One misconception found repeatedly in the literature is a perceived relationship between the depletion of ozone in the atmosphere with the greenhouse effect.¹

Studies show that much confusion exists about the effects of global warming. For instance, a sizable number of teenagers and adults do not believe that they will see any effects of global warming within their lifetime while others remain unsure of the range of effects brought on by global warming (Pruneau, et al., 2001, 2003). In addition, people harbor confusion about the estimated temperature rise due to global warming (Gowda, et al., 1997). Others attribute an increased possibility of getting skin cancer to the greenhouse effect, conflating the impacts of global warming with that of ozone depletion (Boyes and Stanisstreet, 1998). Misconception studies also demonstrate that participants lack an understanding of the complexity involved in mitigating global warming (Andersson and Wallin, 2000). For instance, many link pro-environmental behavior of any sort as helping to address the consequences of global warming (Pruneau, et al., 2003).

Middle school and high school level U.S. science textbooks have done a poor job of addressing these misconceptions. Choi, Niyogi, Shepardson, and Charusombat (2010) explored the global warming content within seven common science textbooks. In particular, the researchers were interested whether textbooks covered 18 scientific concepts related to global warming that, if present, would help students formulate a more accurate understanding of climate change. The authors conclude that nearly half of the 18 concepts go unaddressed in the texts, consequently the textbooks miss a valuable opportunity to curb students’ misconceptions.

¹ To be sure, many of these misconceptions are mirrored in the general public (Pruneau, et al., 2001). For instance, 73 percent of Americans believe that the hole in the ozone layer is at least partially to blame for global warming, and many adult Americans confuse weather with climate (Leiserowitz, Smith, and Marlon, 2010).
Moreover, they found that the textbooks conveyed information inconsistent with current scientific understanding about global warming and failed to communicate the complexity of the global climate system. For example, texts often misattribute the rise in sea level—one effect of global warming—only to melting ice. In reality, much of the rise in sea level recorded thus far is due to thermal expansion of the water caused by warmer temperatures. The textbooks Choi, et al. (2010) analyzed were published between 2002 and 2006, before the 2007 release of the latest Intergovernmental Panel on Climate Change (IPCC) climate change assessment. It is possible that more recent textbooks may reflect the updated IPCC information. Furthermore, Choi, et al.’s study is limited in that it explores only one pedagogic tool—textbooks—for communicating information to students. Given the amount of information about global warming on the worldwide web and the number of curriculum workshops producing climate change lessons for teachers to use, research investigating global warming content delivery mechanisms other than textbooks seems prudent.

A second branch of studies within the climate change education literature are those exploring the relationship between climate change education and student knowledge and/or pro-environmental attitudes and behavior. One troubling finding from this line of research is that many participants either lack a sense of efficacy about addressing global warming, feel they can not affect the climate, or feel that people in general are not willing to adopt more pro-environmental behavior (Pruneau, et al., 2001). More recent studies, however, suggest certain types of interventions may help remedy this.

Research demonstrates that students engaging in hands-on activities about climate change obtain a clearer understanding of the phenomenon. For instance, Cordero, Todd, and Abellera
investigated the link between action-oriented learning activities and climate change literacy in undergraduate non-science majors. They found that when students participated in an out-of-class activity requiring them to calculate their ecological footprint and hypothesize ways to reduce it, they outperformed those students who did not engage in the out-of-class activity on a post-course questionnaire about energy conservation. Ultimately, the authors suggest that instruction about global warming should include methods which engage students in activities that help them to make a personal connection to energy and climate change. Pruneau et al. (2003) and Taber and Taylor (2009) developed educational interventions about climate change grounded in constructivist theory. Findings from both studies indicate students have significant gains in knowledge about climate change if given the opportunity to participate in student-centered activities like researching energy sources, participating in role playing scenarios, and constructing models that predict the impacts of climate change.

Aside from increasing knowledge about climate change, exposure to learning about climate change affects students’ attitudes towards global warming as well as their willingness to take action to address it. For instance, the Australian youth who engaged in the hands-on activities noted above showed gains not just in knowledge about climate change but also in their level of concern about climate change (Taber and Taylor, 2009). Lester, Ma, Lee, and Lambert (2006) studied 5th grade students in the U.S. and noted that as their scientific knowledge about global warming increased, so did the likelihood that they express in writing their ideas for global warming-related environmental activism. Findings from a study of 9-12 year old U.K. youth involved in an outdoor organization called Woodcraft Folk suggest that a multi-generational cooperative learning environment influences the beliefs youth hold about global warming.
Compared with non-members, Woodcraft Folk children demonstrated an increased level of personal awareness and self-efficacy toward the problem of global warming (Devine-Wright, Devine-Wright, and Fleming, 2004).

A fascinating piece of research from Australia links secondary students’ perceptions of actions that they felt were useful to mitigate global warming to those actions they reported most willing to actually take up (Boyes, Skamp, and Stanisstreet, 2009). It turns out students in this study were more willing to take action on those environmental actions that they believed were least useful, such as turning out lights and recycling. Conversely, they were less willing to act on those events that they believed were most helpful at reducing global warming, such as taking public transportation. The authors argue that teachers wishing to instill pro-environmental actions in students will have the most impact if they focus on actions that students have a low natural willingness to act on but that a gain in knowledge creates a strong potential for behavior change. For example, eating less meat is an action that few students were willing to naturally take up, yet learning about the environmental impacts of the beef industry had significant potential to change their behavior.

The third branch of climate change education literature happens to be the least researched area, though it is the most relevant to my work. This area of research examines patterns of climate change education instruction including the messages about climate change that are communicated to students (Chambers and Rowell, 2005), the extent to which students are exposed to the topic of climate change (Wise, 2010), and the challenges teachers face in implementing climate change curricula (Gayford, 2002; Wise, 2010). Chambers and Rowell (2005) analyzed how climate change is presented within curricula written by the federal
government, the provincial government, and nongovernmental organizations for secondary science students in Alberta, Canada—a province that is heavily invested in the mining and refinement of fossil fuels. In particular, the researchers were interested in how the authors managed the recurring theme of uncertainty, both in the science of climate change and how society should respond to it. This research suggests that discursive practices within Canadian curricula result in vastly different conceptualizations of climate change. For example, the federal curriculum and some of the curricula from nongovernmental organizations framed the science behind climate change as relatively settled and advanced the precautionary principle as a rationale for wide-spread action in response to global warming. Conversely, curricula from the provincial government and some of the nongovernmental organizations framed the science behind climate change as uncertain and that action to mitigate change should be focused on personal, voluntary actions and technological solutions.

Other studies pay particular attention to how teachers engage with the topic of climate change. For example, Wise (2010) conducted a survey of high school science teachers in Colorado (n=628) to gather data about patterns of global warming instruction. Teachers showed high levels of support for teaching about climate change, but this support did not necessarily translate into formal global warming lessons. Considering the various science classes typically offered in schools, this research demonstrated that Earth Science classes were most likely to include content about global warming. Wise further notes that “barrier experiences” hinder the inclusion of the topic into teachers’ curriculum. Teachers widely cite structural factors—

\[\text{Generally speaking, the precautionary principle is akin to the aphorism “better safe than sorry.” It follows that uncertainty about the potential harm caused by a policy or action is not grounds for advocates of the potentially harmful policy to proceed. Rather, potentially harmful actions and policies should be prohibited or somehow regulated until advocates prove the action or policy is safe for humans and the environment.}\]
global warming doesn’t fit into their curriculum or the standards, for instance—as an impediment to teaching about global warming. Interestingly, few teachers surveyed noted pressure from the community or students as a barrier experience for inclusion of global warming material. On the other hand, Wise’s findings suggest that science teachers are aware of the public controversy surrounding the validity of global warming science and that this may affect the content that gets taught. About 70 percent of teachers surveyed advocate using a balanced approach to teaching about the human causes of climate change, meaning they present students with evidence supporting the theory of anthropogenic global warming in addition to perspectives espousing that natural cycles are causing the recent warming trend; however, about 80 percent of these same teachers personally agree to some extent with the statement “recent global warming is caused mostly by things people do.”

**Global warming in the U.S. science and social studies classrooms.**

Wise’s work discussed above focuses only on science teaching, yet global warming need not be a topic of interest just for teachers and students in the sciences. Fortner (2001) recognizes this in her astute question: “If we choose to include global climate change in the curriculum, where would it fit?” (p. 24). At the high-school level, a compelling case can be made for global warming to “fit” within either of the core areas of science or social studies. Fortner argues that the abstract and complex nature and content of climate change makes it a topic well suited for many of the science disciplines found at the secondary level, though she makes a special case for restructuring science curriculum around Earth Systems Education.³ As noted above, Wise’s

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³ Fortner’s (2001) conceptualization of Earth Systems Education is that science is ultimately about the Earth, therefore much of science education can be taught using a common theme—in this case, global warming.
(2010) conclusion that the topic of global warming is most often covered in Earth Science classrooms indicates that Fortner is not off the mark.

The topic of global warming may fit within a range of subjects but attention to global warming within the standards that guide those subjects is lacking. For instance, the topic of global warming is absent altogether in the National Science Education Standards (NSES). Moreover, in a review of states science standards Kastens and Turrin (2008) found only 30 of 49 states with science education standards mention any aspect of anthropogenic global warming. Of these states they note global warming standards most often attend to the impacts of global warming including warming of the air or unspecified changes to the climate. On the other hand, few state standards about global warming cover either the causes of global warming or prevention measures.

Despite the absence of standards directly mentioning global warming within the NSES or the Wisconsin Model Academic Standards for Science (the state where I conducted my study), the language contained in both national and Wisconsin standards touches on ideas that are closely connected to the phenomenon. For example, according to the NSES students in grades 9-12 should develop an understanding that:

> Human beings live within the world’s ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected. (National Academy Press, 1996, Content Standard C, p. 186)

Similarly, the Wisconsin Model Academic Standards for Science standard F.8.10 proposes that students be able to “Project how current trends in human resource use and population growth
will influence the natural environment, and show how current policies affect those trends” (Wisconsin Department of Public Instruction, nd).

Science education need not be the sole location in the curriculum for climate change education. Some scholars make the case that social studies courses provide a rich context to learn about global warming. Bisland and Ahmad (2008) advocate for the inclusion of environmental topics, specifically climate change, within social studies education on grounds that learning about such topics is essential to helping prepare citizens, a primary goal of social studies education. Furthermore, the interdisciplinary nature of global warming makes it an exceptionally suitable topic to cover from the multiple social science disciplines that fall under the auspices of social studies.

The ten “strands” of social studies identified by the National Council for the Social Studies (NCSS) do provide several obvious entry points for content about global warming (McKeown-Ice and Dedinger, 2000; Rye, Strong and Rubba, 2001), as do the Wisconsin Model Academic Standards for Social Studies. For example, Strand Nine (Global Connections) of the national social studies curriculum standards calls for high school students to “develop skills in addressing and evaluating critical issues such as peace, conflict, poverty, disease, human rights, trade, and global ecology” (NCSS, 2010, p. 22). Strand Three (People, Places, and Environments) recommends that high school students should:

...understand the relationship between human populations and the physical world. [...] They study the causes, patterns and effects of human settlement and migration, learn of the roles of different kinds of population centers in a society, and investigate the impact of human activities on the environment. This enables them to acquire a useful basis of

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4 According to the National Council for the Social Studies (NCSS), “The primary purpose of social studies is to help young people make informed and reasoned decisions for the public good as citizens of a culturally diverse, democratic society in an interdependent world” (2010, p. 9).
knowledge for informed decision-making on issues arising from human-environmental relationships. (NCSS, p. 16)

Likewise, the Wisconsin Model Academic Standards for Social Studies concerned with the discipline of geography appear a natural fit for global warming content. To meet standard A. 12.6, for example, students must gather and interpret geographic information in order to investigate how “the effects of environmental change in one part of the world such as...air pollution, [and] deforestation...have on other parts of the world” (Wisconsin DPI, nd).

Despite the potential these entry points offer for the inclusion of specific global warming content in the formal social studies and science classrooms, the topic is largely ignored or trivialized in both disciplinary areas. Neither the term “global warming” nor the term “climate change” appear within any of the standards documents noted above. The leading professional organizations for both disciplines (the National Science Teachers Association (NSTA) and the National Council for the Social Studies (NCSS)) also officially pay scant attention to global warming as a topic of instruction. For instance, at the time I wrote this dissertation neither NSTA nor NCSS offered an official position statement concerning teaching about climate change.

Since global warming is largely ignored by discipline specific documents and educational organizations, it should come as no surprise that classroom instruction about the topic is lagging. Wise (2010) found that 63% of the science teachers participating in her survey either ignored climate change as a topic or marginalized it by only informally talking about it in class. By far the most oft cited reason in her survey for not teaching about climate change was that it did not
fall within the content standards of a teacher’s particular science course.\(^5\) Hauser’s (2009) comprehensive review of three major social studies journals, *Theory and Research in Social Education*, *Social Education*, and *The Social Studies*, between 1996-2008 demonstrates research in the field of social studies rarely considers environmental topics. One plausible explanation for Hauser’s findings is that social studies teachers simply are not teaching about environmental topics to begin with. Risinger (2009) points that one reason social studies teachers do not teach about climate change is that “…many of the best resources [for teaching about climate change policy] seem to be oriented towards K-12 science teachers…” (p.279).

Lest I paint too bleak a picture of climate change education, some trends indicate that the topic is receiving more attention from practitioners. Recent editions of *Social Education*, the most widely read publication for social studies educators, have devoted time to global warming and teaching about global warming (cf. Bisland and Ahmad, 2008; Beedle and Calhoun, 2009). Furthermore, in 2012 the National Academies Press released *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* as the first step to creating new K-12 science education standards designed to reflect the most current scientific research on topics important for students to know. In this document the term “climate change” appears regularly and the notion that human activity is a primary driver of the recent changes to climate systems is considered a “core idea” in several of the new standards.

Contributing to the momentum of climate change education are efforts to create frameworks that help conceptualize what climate change education in the United States should

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\(^5\) Gayford (2002) found a similar trend among secondary level science teachers in the U.K. Focus groups of science teachers who teach about climate change revealed they prefer fidelity with their particular discipline rather than engaging in interdisciplinary work.
entail (cf. Shepardson and Niyogi, 2009; American Association for the Advancement of Science, 2007). A particularly comprehensive framework titled *Climate Literacy: The Essential Principles of Climate Sciences*, drafted by an amalgamation of federal agencies, private organizations, and universities collectively known as the U.S. Global Change Research Program (USGCRP), outlines the principles and concepts deemed essential for understanding climate science and works to foster climate literacy among the American public (USGCRP, 2009). According to this framework one is/becomes “climate literate” when she comprehends the influence individuals and societies have on the climate and vice versa. A climate literate person understands not only the basic scientific aspects of the Earth’s climate system but is also capable of assessing scientific claims about climate change, communicating about topics and issues related to climate change, and making wise choices regarding global warming policy.

The *Climate Literacy* framework offers guiding principles commensurate with the core areas of social studies and science. What might social studies and science classroom instruction look like if the NSTA and NCSS adapt some of the principles of the framework? Theresa Eastburn (cited in Palmer, 2010), the education coordinator at the University Corporation for Atmospheric Research, offers some clues:

> Science isn’t about sides or rhetoric, it is about evidence. There is a misconception that the science of climate change is up for debate. Now, politics has entered how science is taught, but [politics] certainly doesn’t belong in the science class…I could see that it could be a part of a social studies course, about what to do about climate change. Social studies is where teachers grapple with politics, economics, and some of society’s issues.

Evidence and common sense suggest what students learn about global warming, and how they learn about it, would be markedly different in a science classroom and in a social studies classroom.
Science classrooms privilege content gained through scientific experimentation and a positivist epistemology. For example, The National Science Teachers Association takes the position that “science, along with its methods, explanations and generalizations, must be the sole focus of instruction in science classes to the exclusion of all non-scientific or pseudoscientific methods, explanations, generalizations and products” (NSTA, 2000). While the NSTA has yet to publish an official statement about global warming, one could reasonably assume it would echo its official position on the teaching of Evolution which reads in part:

Parental and community involvement in establishing the goals of science education and the curriculum development process should be encouraged and nurtured in our democratic society. However, the professional responsibility of science teachers and curriculum specialists to provide students with quality science education should not be compromised by censorship, pseudoscience, inconsistencies, faulty scholarship, or unconstitutional mandates. (NSTA, 2003)

The explanation of NSES Content Standard G (History and Nature of Science) drives home the point that science, and by implication science education, has a particular epistemological stance that must be adhered to: “Explanations on how the natural world changes based on myths, personal beliefs, religious values, mystical inspiration, superstition, or authority may be personally useful and socially relevant, but they are not scientific” (National Academy Press, 1996, p. 201). From the perspective of science education outlined above, one would reasonably conclude students in science classrooms should learn about the best and most accurate scientific evidence supporting the theory of anthropogenic global warming.6

6 Interestingly, some science education scholars believe it is not necessarily the science content of climate change that is most important for science students to learn. Rather, it is the content-transcending knowledge about the process of science, aptly demonstrated by the building of consensus among climate scientists, that is important for students to understand because it is knowledge of the process of science that helps non-experts formulate policy decisions (Kolsto, 2001).
In contrast to science instruction—which positions scientific knowledge as the “truth”—the National Council for the Social Studies endorses content that includes multiple perspectives and instructional methods that utilize controversial issues discussion. For instance, Strand 1 (Culture) of NCSS’s framework for social studies education reads:

The study of culture examines the socially transmitted beliefs, values, institutions, behaviors, traditions and way of life of a group of people...In a multicultural, democratic society and globally connected world, students need to understand the multiple perspectives that derive from different cultural vantage points.... (2010, p. 14)

Concerning the teaching of controversial issues, the NCSS official position on academic freedom and social studies teachers reads in part:

Controversial issues must be studied in the classroom without the assumption that they are settled in advance or there is only one "right" answer in matters of dispute. The social studies teacher must approach such issues in a spirit of critical inquiry exposing the students to a variety of ideas, even if they are different from their own. (NCSS, 2007)

The same document lists four skills and attitudes students are expected to learn from the study of controversial issues including:

- The ability to study relevant social problems of the past or present and make informed decisions or conclusions;
- The ability to use critical reasoning and evidence-based evaluation in the study and analysis of significant issues and ideas; this includes development of skills of critical analysis and evaluation in considering ideas, opinions, information, and sources of information;
- The recognition that differing viewpoints are valuable and normal as a part of social discourse;
- The recognition that reasonable compromise is often an important part of the democratic decision-making process.

Unlike science education, these documents suggest that Social Studies is a venue for exploring multiple perspectives in pursuit of understanding.

One would expect myriad differences between versions of climate change education as implemented in a social studies and science classrooms. Still, few studies exist which compare
how environmental topics are taught in social studies and science courses. Hepburn, Shrum, and Simpson (1978) investigated the effect that learning about water quality and population growth in different core areas of instruction had on the development of students’ pro-environmental attitudes, defined as showing support for controlling pollution and population. Students exposed to both science and social studies modules of instruction showed a larger increase in pro-environmental attitudes than did students exposed to the modules in just one core area of instruction. The authors were quick to point out, though, that this effect may not have been due to interdisciplinary connections, but simply to increased time on the topic.

More recent work by Kumler (2011) compares the action outcomes for social studies students and science students that had learned about sustainable land use issues during a two week Environmental Education curriculum unit. Kumler’s found that social studies students demonstrated a broader range of knowledge about actions that promote sustainable land use than did science students exposed to the same curriculum. For example, social studies students were more likely to list non-ecomanagement strategies like taking political action, changing patterns of consumption, and sharing information with others. However, these actions were limited mainly to individual actions: neither group of students showed a preponderance for collective action.

Science and social studies classrooms offer students divergent ways of understanding the world. The upshot is that if the topic of global warming receives any coverage at all, there is reason to believe that youth may encounter very different messages about what global warming is and how societies and individuals might respond depending on whether they learn about the topic in science class or social studies class.
**Global warming as a controversial socioscientific issue “in the tip.”**

Whether global warming is covered in a social studies classroom or a science classroom, many in the general public consider aspects of the topic to be controversial. Some science-related topics embroiled in public controversy, like human-cloning or the use of nuclear power, focus on how science is applied. In other words, the public debates about such topics revolve around the types of policies society should enact concerning the technology developed by scientists. Wise (2010) notes that the topic of global warming is different because the public debates about it include policy questions but also “involve questions about the validity of the science itself” (p. 305). In this study, then, I consider global warming to be a controversial socioscientific issue. As Kolsto (2001) elegantly summarizes:

> Controversial socioscientific issues often include disagreements related to various actors’ diverging evaluations of the validity or trustworthiness of the science-related claims involved. Typical examples of such knowledge claims concerns whether some specific human practice involves a risk to health or to the environment. The consequences of the risk evaluations and of the collective decision making often has far-reaching consequences, making paramount an adequate interpretation of the science-related knowledge claims involved. (p. 292)

Controversial socioscientific issues contain two distinct yet highly related dimensions of controversy: a policy dimension and a scientific dimension. Creating policy without having absolute certainty of the problem is difficult because policy makers are required to establish a course of action before the science behind the problem is fully understood (Kolsto, 2005). The task is made infinitely more challenging when different stakeholders have fundamentally
different beliefs about the science of global warming, not least of which is whether or not global warming is a risk at all.\textsuperscript{7}

The way in which a society answers questions about controversial issues, and whether they are considered to be controversial in the first place, changes with “the ebb and flow of the ideological struggles of society at large” (Camicia, 2008). Correspondingly, school curriculum, (which is embedded within society’s ideological struggles) changes as competing ideologies subsume more or less power. Drawing from Malcolm Gladwell’s book *The Tipping Point*, Hess (2009) uses the term *tipping* to refer to the shifting nature of controversial issues.

Hess (2009) maintains that teaching about global warming is similar to teaching about same-sex marriage in that it is a prime example of *teaching in the tip*. According to Hess:

> Tipping refers to a number of processes by which topics (which have managed to get into the curriculum in the first place) shift back and forth between their status as open questions (for which we want students to engage in deliberating multiple and competing answers) and closed questions (for which we want students to build and believe a particular answer). (p. 113)

Teaching in the tip occurs when an educator teaches about a topic that is in the process of moving from an open question to a closed question, or vice versa. Questions at the heart of the controversy over global warming—Is global warming a concern? Is human activity responsible for global warming? Do scientists agree about global warming?—are in the process of tipping within the U.S., though which direction they are tipping and how long they will “be in the tip” is more difficult to ascertain.

\textsuperscript{7} See *Why We Disagree About Climate Change: Understanding Controversy, Inaction, and Opportunity* (Hulme, 2009) for a thorough yet accessible treatment of the many reasons why different groups dispute what global warming is and what it means for the future of the planet.
As discussed earlier, American public opinion about issues concerning global warming is fluid. During the first decade of the 21st century, the question of whether or not global warming is a serious threat was in the process of tipping from an open question to a closed question. In 1998, 25 percent of Americans surveyed in a Gallup Social Series Environmental Poll believed that global warming would pose a serious threat to them or their way of life during their lifetime, compared to 69 percent who believed that it would not pose a threat. From 1998-2008, the two points slowly converged as those who felt global warming would pose a threat increased and those who felt no threat from global warming decreased (Newport, 2010). Public opinion was tipping, and the question of whether or not global warming was a threat was becoming a closed question with the agreed upon answer being “yes.” In 2008, however, the convergence stopped and was replaced by a sharp divergent trend. It now appears that the question of whether or not global warming is a serious threat is in the process of tipping back to an open question.

Teaching about topics “in the tip” presents special challenges for teachers. First, no matter how pedagogically sound the teaching is, teachers teaching topics in the tip will have a segment of the population who fundamentally disagree with what they are doing (Hess, 2009). Second, as with all controversial issues, the controversies related to global warming are socially constructed—different ways of thinking about global warming exist depending on one’s position and place. What is a teacher to do? Should aspects of global warming be taught as a legitimate controversies or a settled questions? Which side of the tip should a teacher privilege—that of the climate science experts or that of climate science skeptics? somewhere in the middle? all of these?
The answers teachers arrive at concerning these questions have profound implications for what students learn. For example, middle school science teacher Jana Dean ponders how to best teach about global warming to her 8th grade students in rural, auto-dependent “truck country” (Dean, 2005). In her classroom, Dean decided to teach the existence of global warming and the human-induced causes of global warming as closed questions—according to her curriculum, global warming is happening and it is caused by human activity. As she explains it, her motive to teach the science behind climate change is to get her students to “reflect on their own lives and consider how their own behavior could change to become more ‘climate friendly’” (p. 35). Subsequently, the activities she plans for students in her class reflects her beliefs.

Hess (2007, 2009) reminds us that not all teachers consider the cause of global warming to be a closed issue, as Dean does. In an exchange within the “Letters” section of Social Education, Michael Laviano, a high school social studies teacher, criticizes Hess for writing an article discussing the classroom use of the documentary An Inconvenient Truth. The film, an ideological lightning in the public debate about global warming, is the brain-child of Al Gore and explains the scientific evidence supporting the human role in global warming. Laviano considers the cause of global warming to be an open question; therefore, he was troubled that Hess failed to mention a competing documentary, The Great Global Warming Swindle, a film which questions the validity of current scientific evidence supporting anthropogenic global warming. Laviano recommends teachers show both films as a way of providing students with alternative viewpoints.
Mr. Laviano seeks to engage his students with sources that make competing claims about global warming and the validity of the empirical evidence supporting climate scientists’ assertions in an effort to balance the messages students hear. Ms. Dean, on the other hand, presents just one perspective—that of mainstream climate science—to her students. It is not a stretch to believe that their respective students take away decidedly different accounts of what global warming is, whether or not it is a threat, and what individuals and societies might do about it, if anything.

It is clear that Mr. Laviano endorses taking a balanced approach when teaching about controversial issues. Less clear is whether he takes a neutral approach; that is, whether he discloses his personal beliefs about global warming to his students. Research indicates that neutrality, or at least an attempt at neutrality, may be more the norm than the exception when it comes to teaching about controversial environmental topics. Research by Gayford (2002) and others sheds light on why teachers choose to take a neutral stance in their classrooms. In some cases, teachers feel the purpose of science education is not to promote their own beliefs and values about climate change, but to provide a learning experience whereby students develop their own beliefs about global climate change in a rational way (Gayford). All three of the secondary geography teachers Cotton (2006) interviewed believe that using a balanced approach towards controversial environmental issues is more appropriate than advocating for a particular position; however, observations of their classrooms revealed that each had significant difficulties maintaining a neutral position. Wise (2010), discussed at length above, found that 70 percent of the teachers in her study advocate for taking a balanced approach when teaching about global warming even though this approach might run counter to what their personal belief about it.
Hess (2002) contends that teachers’ personal views strongly influence what they consider to be a controversial issue in their curriculum. In her investigation of three secondary teachers who are particularly skillful in their use of controversial issues discussion in the classroom, she found that all three teachers chose to not include gay rights as a controversial issue open for discussion in their classrooms, albeit for different reasons. One teacher equated gay rights with human rights, and claimed that there was a “right answer” he wanted his students to believe. Another teacher decided against using gay rights as a topic for discussion due to the possibility that students may voice opinions that could be construed as hurtful to those students in her class who were gay. Still another did not use gay rights as a topic given the conservative context of the community her school was located in.

As implied by the third teacher noted above, the decision to treat a curriculum as controversial (or not) is not just made at the level of individual teachers: it is also influenced by the complex sociocultural contexts in which schooling is situated (cf. Binder, 2002; Zimmerman, 2002; Evans, 2010). For instance, Camicia (2008) investigated a curriculum controversy over whether to teach the internment of Japanese American citizens during World War II as a controversial issue. The school district where he conducted his research used a curriculum unit called Leaving Our Homes (LOH) to teach 6th grade students about the WWII internment of Japanese Americans. The curriculum took the position that the internment was wrong and treated this position as uncontroversial; however, a small number of curriculum activists disagreed with this stance. Instead they advocated for the curriculum to present the internment as a matter of military necessity. In the end, Camicia suggests that how stakeholders frame their arguments for treating a topic as controversial (or not) matter. LOH challengers were relatively
successful in changing the *Leaving Our Homes* curriculum (but not the school’s claims about the Japanese American internment) by aligning their frames with the frames of curriculum supporters.

**Description of Conceptual Framework**

I draw on the work cited above to inform the conceptual framework guiding my study. From the cultural theory of risk perception literature, I use the *Six Americas* studies (e.g. Maibach, et al., 2009) to think about the aspects of global warming the U.S. public considers controversial. Furthermore, I consider teaching about global warming to be an instance of “teaching in the tip” (Hess, 2009). As such, there are a number of acceptable stances (or at least acceptable to large segments of the U.S. population) regarding controversial aspects of global warming. The particular stance which gets presented to students is the result of the interaction between several factors including a teacher’s personal beliefs about global warming and about teaching in general, the differing goals of social studies and science education, and the context of the community or school. In this section I provide specific details and a visual representation of my conceptual framework.

I borrow Schwartz and Thompson’s (1991) useful analogy of a ball on a landscape to illustrate my conceptual framework. In this case, the ball represents a particular case of global warming curriculum and the landscape upon which the ball travels denotes a particular type of global warming curriculum. Figure 2.4 illustrates my conceptual framework.
Let me begin by describing the landscape. In the process of analyzing global warming curricula for this research, I developed three categories of global warming curriculum that I labeled dissenting, adherent, and hesitant. Consequently, the landscape I envision is divided into three regions: two plains separated by a mountain. Each region represents a different category of global warming curriculum: dissenting, hesitant, and adherent. Dissenting materials occupy the plain to the left of the mountain. These curricula dispute what experts in the field of climate science have come to believe about global warming--particularly that it is human-induced--and advance the idea that scientific consensus about global warming is nonexistent. Thinking about
the Six Americas spectrum (Maibach et al., 2009), dissenting materials take a view similar to those who are doubtful and dismissive of global warming. On the plain to the right of the mountain sits the adherent curriculum. Adherent materials support the conclusions about global warming as put forth by the IPCC and align closely with those whom Six Americas studies label concerned and alarmed. Finally, hesitant curricula are situated on the mountain itself. Hesitant curricula offer the conceptualization of global warming most closely associated with the cautious segment of Six Americas research. These curricula present global warming as a problem (though not a particularly urgent one), that there are multiple and competing theories about what is driving global warming, and that climate scientists have yet to reach consensus about such matters.

The categories are based on the stance the curriculum takes concerning three questions prevalent in the U.S. public’s debate about global warming: 1) Is global warming a problem? 2) Is human activity responsible for global warming? and 3) Is there scientific consensus about global warming? Using Hess’ (2009) terminology, the adherent curricula treat all three of these questions as closed. In other words, there are right answers to these questions that we want students to take away. Adherent curricula support the position that global warming is a serious and immediate problem, that human activity is to blame, and that experts in climate science are in agreement about the major findings advanced by the IPCC. Likewise, dissenting curricula consider answers to these questions as closed; however, the answers that dissenting materials have “tipped” (Hess, 2009) towards are very different than those endorsed in the adherent curricula. In dissenting curricula global warming is not a serious problem, it is not caused by human activity, and scientists do not agree about why global warming is happening. Finally, the
hesitant curricula treats one or more of these questions as open, or unsettled. Typically, the hesitant curriculum takes the position that global warming is a problem (though not an immediate problem) and conveys uncertainty about the cause of global warming and whether scientists have reached consensus on the matter. Chapter five explores the distinctions between the three categories of global warming curriculum in greater depth.

So far I have discussed the landscape, but what of the ball? How does it come to occupy a particular spot on the landscape and what qualities define it? Again, in my conceptual framework the ball represents a specific case of formal global warming curriculum as presented in high school classrooms. A teacher’s personal beliefs about global warming (or the beliefs endorsed by an organization developing global warming curriculum) is one factor that conceivably influences why a curriculum takes an adherent, dissenting, or hesitant stance. Research discussed above from the field of risk perception suggests that one’s worldview plays an integral role in the way people think about global warming (Dake, 1991; Hulme, 2009; Maibach et al. 2009). Said differently, different stakeholders within environmental debates champion contradictory certainties8 (Schwarz and Thompson, 1990) about what global warming is and which policies to pursue in light of it. Moreover, work by Hess (2002), also discussed above, suggests that teachers’ personal beliefs influence what they consider to be controversial in their classroom.

A teacher’s (or curriculum author’s) personal beliefs might influence how global warming is presented to students, but it is not the only influential factor. A number of other elements help shape the conceptualization of global warming that is ultimately presented in classrooms. For

8 Schwarz and Thompson (1990) define contradictory certainties as the competing narratives, or myths, which form one’s fundamental beliefs about environmental events.
instance, whether the global warming lessons are taught in a social studies or science classroom could alter the messages sent to students about global warming. The disciplines that comprise social studies education (history, political science, geography, economics, anthropology, sociology, and psychology) are markedly different from those that comprise science education (biology, chemistry, physics, earth and space science); therefore, a science teacher approaches her teaching about global warming from a different disciplinary lens than that of a social studies teacher. As discussed earlier in this chapter, social studies education privileges introducing students to multiple perspectives, while the science education promotes the idea that there is a truth to be discovered and that the scientific method is the tool for doing so. Kumler’s work (2011) indicates that students do in fact take away different messages about environmental topics depending on if it is presented in science or social studies classrooms. Part of chapter six investigates the similarities and differences in global warming lessons designed for social studies and science instruction.

Also important are a teacher’s beliefs about, and larger goals, for teaching. Does she believe that controversial issues should be taught using a balanced approach? What does she believe the purpose of education to be? Work by Cotton (2006) and Hess (2009) suggests how a teacher answers these questions plays a role in how they present controversial material, and there is no reason to think that presenting the topic of global warming would be any different.

Still another element crucial in shaping where the ball sits on the landscape is the context of the school community. For instance, are teachers challenged by others in the school community for taking a particular stance on global warming? If so, how do they respond to this challenge. Teachers surveyed by Wise (2010) face little if any challenge to the inclusion of
global warming into the curriculum. Still, much has been written about how challenges to a
curriculum alter its content once it makes it into the curriculum (cf. Binder, 2002; Zimmerman,
2002). The recent curriculum challenges in Texas, South Dakota, Louisiana, and Alameda,
California discussed in chapter one highlight this phenomenon.

In summary, the forces acting on the ball influence where the ball sits on the landscape.
In other words, where global warming lessons occur within the core discipline areas, a teacher’s
overarching goals, and the challenges to curriculum from other stakeholders in the school
community work in conjunction with his or her personal beliefs about global warming (or those
of the organization producing the curriculum) to inform the stance towards global warming
ultimately presented to students. A science teacher, for example, may personally conceptualize
global warming in a manner closely aligned with the adherent stance. These beliefs, in
combination with a community that supports teaching about global warming in this way and his
belief that as a science teacher he must impart the best available scientific understanding about
global warming to students may guide him to take an adherent stance in the classroom.
Alternatively, another teacher might personally believe that global warming is not happening, or
not caused by human activity; however, she may also feel that the act of teaching requires her to
take a neutral position when discussing publicly controversial issues. Furthermore, she may
have received strong input from the parents of her students admonishing her to take a balanced
approach. Consequently, this teacher may choose to present a hesitant stance to her students
despite the fact that such a stance does not align with her personal beliefs about global warming.
Chapter seven explores how teachers make sense of the particular stance towards global
warming they present to their students.
Chapter Summary

I began this chapter with a review of the pertinent literature that informs my study. I have highlighted theoretical and empirical work in the areas of risk perception, climate change education, and the teaching and learning of controversial issues in the classroom. Additionally, I have put forth a conceptual framework, informed by my review of the literature, to help me think through how curriculum and teachers approach teaching about global warming. In the next chapter, I discuss the research methods I used to select, obtain, and analyze my data.
Chapter Three: Methods

Broadly speaking this study is a qualitative inquiry into the phenomenon of teaching in the tip (Hess, 2009). The term qualitative “implies an emphasis on the qualities of entities and on processes and meanings that are not experimentally examined or measured (if measured at all) in terms of quantity, amount, intensity, or frequency. Qualitative researchers stress the socially constructed nature of reality...” (Denizen and Lincoln, 2000, p. 8). Teaching in the tip, according to Hess (2009), occurs when the curriculum includes a topic whose status as an open or closed question is unsettled within public discourse. More specifically my study seeks to describe how global warming, a topic currently “in the tip” (Hess), is conceptualized in U.S. high school curriculum and classrooms.

This dissertation is inspired by previous curriculum analysis work that explores how textbooks and supplemental materials convey messages about controversial public issues (cf. Hess and Stoddard, 2007; Hess, Stoddard, and Murto, 2008; Chambers and Rowell, 2005). Hess and Stoddard (2007) and Hess, et. al. (2008) investigated how materials designed for social studies classrooms dealt with the concept of terrorism in light of the 2001 attack on the World Trade Center. Chambers and Rowell (2005) examined how messages about global warming, particularly those related to the various uncertainties inherent in the science of global warming, are portrayed in supplemental curricula developed by different organizations. In addition to utilizing textbooks and supplemental materials as sources of data, I feel it is important to also include the perspective of teachers--who often modify existing curricula or create their own--in order to provide a more complete understanding of global warming in U.S. high school curriculum. Therefore, in this model of inquiry I chose to interview in-service high school social
This chapter will describe my research design and data analysis in more depth. The first section describes how I selected the textbooks, supplemental curriculum, and teachers that served as the sources of my data. The second section explains how I gathered data from these sources, and the third section outlines the process of data analysis.

Selection of Data Sources and Data Generation

I used data from three types of sources to answer my research questions: nine high school level textbooks published by major textbook companies, eight sets of supplemental curriculum\footnote{When I talk about “supplemental curriculum” or “supplemental materials” I am referring to curriculum produced by not-for-profit organizations and governmental institutions and designed to be used by high school educators in a formal classroom setting.} about global warming developed by a variety of organizations, and 14 semi-structured interviews with high school teachers who teach about global warming in one or more of their courses. I also collected examples of global warming curricular materials that the teacher-participants deployed in their classrooms. In the following three paragraphs, I will explain the general parameters I used to select sources of data. Then, I will provide some specifics relevant to the selection of textbooks, supplemental materials, and teacher participants.

All sources of data needed to meet three general criteria in order to be considered for inclusion in this study. First, all sources and participants needed to focus on, or work with, high school level students. I chose to concentrate on curricula at the high school level for personal and practical reasons. My personal interest, experience, and expertise, is in working with teachers and students at the secondary level; therefore, choosing to work with and think about...
high school level curricula is simply an extension of this. Moreover, given the complex nature of global warming as a topic of study, I felt I would have more success finding sources and teacher-participants that addressed this complexity with students at the upper secondary level rather than earlier grade levels.

Second, all sources needed to be published in 2007 or later. Likewise, potential teacher-participants needed to have taught at least one formal lesson about climate change since 2007, and had to be planning to teach at least one formal lesson about climate change during the upcoming academic year (2011-2012). Information regarding the causes and effects of global warming is regularly updated as scientists continue to investigate the phenomenon. In 2007, the Intergovernmental Panel on Climate Change (IPCC) released its latest report highlighting the most up-to-date, internationally agreed upon scientific understanding of global warming. While not all textbook and supplemental material authors and all teacher-participants may have accessed the content of this report directly, the conclusions of the report were widely publicized in a variety of media outlets. In selecting textbooks, materials, and teacher-participants who taught after the report was published in 2007, it was my hope that the authors and teacher-participants had at least been exposed to, if not influenced by, relevant findings from the report.

The third general requirement for sources to be considered for inclusion was that they relate to one (or more) of the disciplines within social studies or science content areas. As discussed in chapter two, global warming is a suitable topic for science and social studies content areas; therefore, I wanted to include textbooks and supplemental materials that drew from these content areas. Moreover, given my hunch that social studies and science teachers approach teaching about global warming differently, I wanted all teacher-participants to hold certification
from the Department of Public Instruction in Wisconsin (the state where I conducted this research) to teach either secondary social studies or secondary science courses. This served as a signal that they had completed formal coursework in science or social studies teaching methods as well as higher education in a discipline related to the content area which they taught.

State social studies standards in Wisconsin are categorized into five disciplines: geography, history, political science and citizenship, economics, and behavioral sciences. Wisconsin state standards for science fall into disciplinary clusters including physical science (e.g. chemistry, physics), life and environmental science (e.g. biology, environmental science), and earth and space sciences (e.g. astronomy, geology). Determining the core content area of the textbooks and teachers is straightforward. Textbooks usually contain a particular discipline within its title. Moreover, they are marketed as resources for “Social Studies” or “Science” on their websites. Teachers are licensed by the State in particular content areas and affiliate with a particular discipline-based department within their school. On the other hand, determining whether a set of supplemental materials was meant for social studies or science courses is less straightforward.

Of the sets of supplemental materials that I selected, most make explicit mention of national guiding frameworks in both science and social studies (among others). In one case, the only guidelines mentioned referred to Environmental Education standards. A quick review of the Environmental Education Guidelines for Excellence (available at www.naeee.org) reveals that these guidelines are highly applicable to both social studies and science courses. More problematic, though, is that two sets of supplemental curricula included in my study make no mention of standards or discipline areas. Reviewing the global warming content of these two
sets of materials revealed that both could feasibly be used, at least in part, in both social studies and science classrooms.

In summary, the curricula that I was interested in investigating was geared towards high school students, published (or taught) since 2007, and designed, though maybe not exclusively, with social studies or science classrooms in mind. Next, I explain the specific process I used to select the textbooks, supplemental materials, and teacher-participants and I clarify how I generated data from each type of source.

Textbooks: There is little doubt that both science and social studies textbooks are highly utilized instructional tools. It is estimated textbooks are used in 75 percent of the instruction occurring in science classrooms (Blystone, as cited in Lumpe & Beck, 1996). Likewise, 70-90 percent of social studies instructional time is textbook based (Wade, 1993). A number of publishers provide textbooks for secondary level instruction; however, a relatively recent series of mergers within the publishing industry enables three large publishing houses—Pearson-Prentice Hall, Houghton Mifflin Harcourt (which also owns McDougal Littell), and Glencoe/McGraw Hill—to dominate the high school social studies and science niches. Of these, Pearson-Prentice Hall and Glencoe/McGraw Hill dominate the high school social studies and science niches, according to one expert in textbook marketing research (Resnick, personal communication). I used information from the 2010 Education Market Research report to identify the top two selling textbooks in the various social studies and science content areas and I used WorldCat to locate and procure the most recent edition available of each.

After my review of the literature, I suspected that any significant coverage of global warming, or at least any textbook with enough information about the topic to analyze, would
most likely be in Geography and Earth Science textbooks. This hunch turned out to be accurate. With the exception of one Biology and one World History text, Earth Science and World Geography textbooks are the primary textbooks for delivering content about global warming. Consequently, I included the three top-selling Earth Science and Geography textbooks in my analysis (Education Marketing Research, 2010). In addition to these mainstream textbooks, I selected two Advanced Placement textbooks to analyze—one AP World Geography text and one AP Environmental Science text—recommended by the College Board as appropriate texts for each respective AP class. Due in part to the competitive nature of textbook publishing business, I was not able to obtain any specifics about the number of students who are exposed to these textbooks. See Table 3.1 for a list of nine textbooks that I analyzed for this study.

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I also searched textbooks in other social studies and science disciplines including those designed for Civics, Government, Economics, U.S. History, Physical Science, Physics, and Chemistry; however, none of these contained a sufficient amount of global warming content to analyze.
Table 3.1. Selected Social Studies and Science textbooks, Listed by Subject and Content Area

<table>
<thead>
<tr>
<th>Content Area</th>
<th>Textbook Title</th>
<th>Year of Publication</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOCIAL STUDIES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>World History</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Modern World History: Patterns of Interaction</em></td>
<td>2009</td>
<td>McDougal Littell</td>
</tr>
<tr>
<td>World Geography</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>World Geography: Building a Global Perspective</em></td>
<td>2009</td>
<td>Pearson Prentice Hall</td>
</tr>
<tr>
<td></td>
<td><em>World Geography and Cultures</em></td>
<td>2012</td>
<td>Glencoe/McGraw-Hill</td>
</tr>
<tr>
<td>A.P. Human Geography</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCIENCE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Biology</em></td>
<td>2008</td>
<td>Pearson Prentice Hall</td>
</tr>
<tr>
<td>Earth Science</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Earth Science</em></td>
<td>2009</td>
<td>Pearson Prentice Hall</td>
</tr>
<tr>
<td></td>
<td><em>Earth Science: Geology, the Environment, and the Universe</em></td>
<td>2009</td>
<td>Glencoe/McGraw-Hill</td>
</tr>
<tr>
<td></td>
<td><em>Earth Science</em></td>
<td>2010</td>
<td>Holt McDougal, Houghton Mifflin</td>
</tr>
</tbody>
</table>
Upon obtaining a copy of a textbook, I reviewed the table of contents to understand the layout of the book and looked for key words and phrases indicating content about global warming including climate, climate change, global climate change, global warming, and greenhouse effect. Next, I searched the index for the same key terms as well as other terms that may have signified discipline-specific information about global warming including the terms Kyoto Protocol, Intergovernmental Panel on Climate Change or IPCC, environment, carbon cycle, and cap-and-trade. I scanned and printed all relevant pages as well as the pages immediately surrounding the content of interest. Additionally, I made copies of the end of section and chapter review questions, the table of contents, and the relevant glossary entries from each text.

**Supplemental curricula:** Adopting new textbooks is an expensive and time-consuming process for school districts to undertake. As a result, classroom teachers often utilize the same textbook for a period of years. This is especially problematic given the amount of new information that becomes available about global climate change on a regular basis. No doubt that textbooks remain an important teaching resource used by many social studies and science teachers; however, teachers also make use of supplemental curriculum as important sources of up-to-date information. As Hess and Stoddard (2007) point out, analyzing supplemental curriculum is important for several reasons. First, supplemental materials are often easy for teachers to procure: many supplemental materials are easily accessible via the internet, often at little or no cost. Second, the content included in supplemental resources may be more prone to
implicitly or explicitly promote particular frames or ideologies than textbooks because the content is not held up to the same scrutiny as that of textbooks.

In addition to meeting the three general criteria discussed above, I was looking for supplemental curricula to meet several other standards. First, the materials I selected contained content explicitly about global warming as a central part of the lesson(s). Not included, for example, were materials that dealt primarily with energy education even though such content is highly related to the topic of global warming. Second, because I was interested in exploring what students encounter about global warming within their classrooms, I included only those supplemental materials intended to be used by teachers in a social studies or science classroom. Excluded from this study, then, are supplemental materials consisting of essays and general resource guides about climate change designed only for teacher consumption as well as sets of lessons collected in one central repository but developed independently by teachers who are not expressly commissioned to design curricula for an organization’s global warming education initiative. To meet this requirement, supplemental curricula needed to include some form of lesson plan designed for a teacher to follow that would last for at least one 45-minute class period worth of instruction (though many were designed to span multiple days or weeks). Nearly all of the supplemental materials included in my study offer comprehensive lesson plans including teaching rationales, learning objectives, links to standards, suggested assessment activities, background readings and handouts for students.

I used three avenues to locate supplemental materials: 1) recommendations from experts and practitioners in the field of social studies education, science education, and environmental education, 2) recommendations found within discussion forums on the Inspiring Climate Change
Excellence (ICEE) organization website and the “Private School Teachers” forum on Teachers.net, and 3) a thorough search of websites hosted by climate change curricula clearinghouses and educational organizations espousing a range of ideological perspectives. This strategy yielded 16 potential sets of supplemental materials to analyze. I purchased or downloaded the 16 sets of supplemental curriculum, many of which are available online for free.

I asked an expert in social studies education and an expert in science education to rate the 16 sets of materials on its developmental appropriateness, coherence, feasibility for use in a classroom setting, and overall quality. Finally, I used purposeful sampling (Patton, 2002) to select supplemental curricula materials from those still under consideration. The goal of purposeful sampling is to select cases that will likely be rich sources of information regarding the aims of the study (Gall, Gall, and Borg, 2007). I sought to include supplemental materials produced by an ideologically diverse range of organizations and materials that represented the content areas of social studies and science. See Table 3.2 for a list of the eight sets of supplemental curricula I selected for analysis.

<table>
<thead>
<tr>
<th>Curriculum Title</th>
<th>Organization</th>
<th>Year of Publication</th>
<th>Content Standards Explicitly Referenced</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>An Inconvenient Truth in the Classroom</em></td>
<td>National Wildlife Federation</td>
<td>2008</td>
<td>EE</td>
</tr>
<tr>
<td><em>Global Warming 101</em></td>
<td>Will Steger Foundation</td>
<td>2009</td>
<td>Social Studies, Science, EE</td>
</tr>
<tr>
<td><em>Climate Change: A Wisconsin Activity Guide</em></td>
<td>Wisconsin Department of Natural Resources</td>
<td>2009</td>
<td>Social Studies, Science, EE</td>
</tr>
<tr>
<td><em>Climate Change: Connections &amp; Solutions</em></td>
<td>Facing the Future</td>
<td>2007</td>
<td>Social Studies, Science, EE</td>
</tr>
<tr>
<td><em>Deliberating in a Democracy: Global Climate Change</em></td>
<td>Constitutional Rights Foundation- Chicago</td>
<td>2009</td>
<td>Social Studies c</td>
</tr>
<tr>
<td><em>Global Environmental Problems: Implications for US Policy</em></td>
<td>Choices for the 21st Century (Brown University)</td>
<td>2009</td>
<td>Social Studies</td>
</tr>
<tr>
<td><em>Understanding Climate Change: Lesson Plans for the Classroom</em></td>
<td>The Frasier Institute</td>
<td>2009</td>
<td>none d</td>
</tr>
<tr>
<td><em>Unstoppable Solar Cycles</em></td>
<td>Izzit.org</td>
<td>2008</td>
<td>none d</td>
</tr>
</tbody>
</table>

*Note.*

- These are the content areas explicitly referred to within the materials. Several sets of supplemental materials also referenced content areas in addition to the three listed within this chart.
- Environmental Education Guidelines for Excellence. Elements of Environmental Education standards compliment both science and social studies standards.
- Despite no explicit mention of social studies standards, *Deliberating in a Democracy* materials are clearly designed to be used in social studies classrooms.
- While not referencing any particular set of standards or disciplinary guidelines, this curriculum appeared to be designed for use in either Social Studies or Science classrooms.
As is the case with the textbooks, it is difficult to ascertain how widely used the supplemental materials are. Despite repeated attempts to contact those who have access to such data, I only obtained hard numbers about the dissemination of their materials from four of the eight organizations, and even with the information they provided it is impossible to know how many teachers are actually using the materials or how many students are engaging with them. That being said, the frequency that I encountered links from various webpages to many of the supplemental materials I selected and the fact that several teacher-participants who I interviewed made reference (or used) some of these same materials I selected leads me to believe that these supplemental materials are being implemented to some degree.

Given their nature as stand alone lessons (or units) specifically about global warming, I needed to do little “gathering” of data at all once I obtained a physical copy of the supplemental materials. In the case of the two sets of materials based on videos (An Inconvenient Truth in the Classroom and Unstoppable Solar Cycles), I watched each video and located and downloaded transcripts of each.

**Teacher-Participants:** Based on my experience teaching high school social studies I know that teachers constantly create new curricula and modify existing curricula to best fit the needs of their students; therefore, I felt that interviewing teachers would provide a more nuanced understanding of how global climate change is depicted within curricula than an analysis of textbooks and supplemental materials alone would yield. According to Seidman (2006), two criteria indicate that one has interviewed enough participants: saturation and sufficiency. While Seidman notes the difficulty of knowing exactly how much data collection is needed to reach saturation, having fewer than eight to ten participants runs the risk of not reaching saturation at
all. The sufficiency criterion is met when there are “sufficient numbers to reflect the range of participants and sites that make up the population so that others outside the sample might have a chance to connect to the experiences of those in it” (2006, p. 55). With this advice in mind, I conducted 14 semi-structured interviews with in-service high school educators—seven social studies teachers and seven science teachers—who teach formal lessons about global warming.4

Selecting a sample was a multi-stage process. First, I used snowball sampling (Gall, Gall, and Borg, 2007) to identify potential teacher-participants in the state of Wisconsin.5 In snowball (or chain) sampling, a researcher asks well-situated people to recommend potential participants who might contribute highly pertinent information relevant to the research questions. I sought professional recommendations from a variety of social studies, science, and environmental education experts in the state of Wisconsin, from personnel in leadership positions at the Wisconsin Council of Religious and Independent Schools, the Green Charter School Network, and the Wisconsin Charter School Network, and from teacher-participants and potential teacher-participants. Snowball sampling yielded a list of 29 potential teacher-participants.

Next, I contacted all 29 teachers via their publicly available school email addresses. I used this initial email contact to briefly introduce myself, outline the purpose of the study, verify

4 I define a formal lesson about global warming as one that is pre-planned to help students learn content specifically about global warming. In other words, a formal lesson about global warming is not a spontaneous event such as mentioning global warming during class or fielding questions about the topic at the end of a lesson. For this study, a formal lesson must be the equivalent of at least one 45-minute class period in length.

5 For the sake of this study, there is nothing unique about teachers in the state of Wisconsin. Interviewing “local” teachers was a purely practical decision based on my own time-constraints, financial resources, and living situation.
that they meet the three criteria discussed above, and gauge their interest in participating in the study. The message asked those interested in participating in the study to complete and return (via email) a six-question questionnaire asking for some basic information about their global warming curriculum and their personal beliefs about global warming. See Appendix A for a copy of the initial email message and questionnaire.

Initially I intended to use the responses to the questionnaire to engage in purposeful sampling (Patton, 2002). I was interested in including teachers who espoused a range of personal beliefs about global warming (as theorized by Maibach, et al., 2009), taught in a variety of social studies and science courses, and worked in a range of school contexts (i.e. public, religiously affiliated private, charter). Unfortunately, this was not possible using only the responses I received from my original solicitations. Eleven of the 29 teachers initially contacted through snowball sampling expressed interest in participating, and while these teachers did embrace a range of personal beliefs about global warming and taught a range of courses in social studies and science content areas, they all taught in traditional public school settings. At this point, I focused on enlisting teacher-participants who worked in charter schools, particularly those with an environmental focus, and religiously-affiliated private schools. These efforts were rewarded as two teachers who did not teach in traditional public schools volunteered to participate.6 Table 3.3 provides an overview of the teacher-participants selected for this study.

6 This statement is not entirely accurate. One of the three teachers did work in a traditional public school at the time of our interview; however, he spent a number of years as a teacher in an environmentally-focused charter school, operated by the same district. A lack of funding forced the charter school to close for the 2011-2012 school year. Our interview focused on his experiences teaching at the charter school.
### Table 3.3. Selected Teacher Participants: Teachers Listed by Subject Areas

<table>
<thead>
<tr>
<th>Teacher Participant</th>
<th>Course addressing global climate change</th>
<th>Years of experience</th>
<th>School Context by type&lt;sup&gt;a&lt;/sup&gt; and locale&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social Studies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. Allen</td>
<td>Citizenship</td>
<td>10</td>
<td>medium public; large city</td>
</tr>
<tr>
<td>Ms. Evans</td>
<td>Environmental Studies</td>
<td>1</td>
<td>large public; urban fringe of midsize city</td>
</tr>
<tr>
<td>Ms. Diaz</td>
<td>Contemporary World Problems</td>
<td>18</td>
<td>large public; urban fringe of large city</td>
</tr>
<tr>
<td>Mr. Griffin</td>
<td>World geography &amp; history</td>
<td>4</td>
<td>medium public; small town</td>
</tr>
<tr>
<td>Mr. Lewis</td>
<td>A.P. Human Geography</td>
<td>13</td>
<td>large public; large city</td>
</tr>
<tr>
<td>Mr. Martin</td>
<td>Environmental Issues &amp; Action</td>
<td>15</td>
<td>small charter; small town</td>
</tr>
<tr>
<td>Mr. Richardson</td>
<td>Geography</td>
<td>20</td>
<td>large public; small town</td>
</tr>
<tr>
<td><strong>Science</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. Bell</td>
<td>Environmental Science</td>
<td>31</td>
<td>medium public; large city</td>
</tr>
<tr>
<td>Mr. Carlson</td>
<td>Weather and Climate</td>
<td>2</td>
<td>large public; small town</td>
</tr>
<tr>
<td>Ms. Foster</td>
<td>Environmental Science</td>
<td>31</td>
<td>large public; midsize city</td>
</tr>
<tr>
<td>Ms. Hamilton</td>
<td>Environmental Science</td>
<td>9</td>
<td>large public; urban fringe of midsize city</td>
</tr>
<tr>
<td>Mr. Powell</td>
<td>Earth Science</td>
<td>30</td>
<td>religious; midsize city</td>
</tr>
<tr>
<td>Mr. Taylor</td>
<td>Earth Science</td>
<td>19</td>
<td>religious; urban fringe of large city</td>
</tr>
<tr>
<td>Mr. Williams</td>
<td>Earth and Space Science</td>
<td>17</td>
<td>large public; midsize city</td>
</tr>
</tbody>
</table>

*Note*. Teacher-participant names are pseudonyms.

<sup>a</sup> As classified by the Wisconsin Interscholastic Athletic Association (wiaawi.org)

<sup>b</sup> According to the Wisconsin Department of Public Instruction (http://dpi.wi.gov/lbstat/pubdata2.html)
Each teacher-participant took part in one semi-structured interview designed to last about one hour. (See Appendix B for the interview protocol). I wanted the interview to be as convenient and comfortable as possible for teacher-participants. With this in mind, most interviews occurred in the teacher-participant’s classroom either shortly after school dismissed for the day or during a break in their day. When this was not possible, we met in a public setting like a library or coffee shop. I created digital audio recordings of all interviews for later review and transcription.

Part of the interview protocol called for teachers to talk through a lesson they created or modified that best encapsulates the learning objectives they have for students regarding global warming. I asked that teacher-participants provide me with a copy of this lesson and the accompanying materials. In most cases teacher-participants graciously shared their materials with me, including student-handouts, assessments, and powerpoint presentations, but none had formal, written lesson plans to share. In combination with their interviews, I used the collected materials as a means to understand the particular conceptualization of global warming they present to their students.

As a time-saving measure, I hired a transcriptionist to transcribe the interviews. As I received completed transcripts I proofread and checked each for accuracy, correcting errors as necessary. To provide a measure of validity I gave teacher-participants the opportunity to read and edit the completed transcript of our interview. Most teacher-participants accepted the transcript “as is” though two made slight modifications.

7 Before I interviewed any of the teacher-participants, I conducted a pilot interview with a social studies educator who had experience teaching about global warming. I made several slight modifications to the protocol based on his post-interview feedback and our subsequent discussion.
As the process of analysis unfolded, I found it necessary to conduct brief follow up interviews with all of the teacher-participants in order to ask additional clarifying questions and gather some contextual information. With two exceptions, I conducted the follow up interviews over the phone and, in most cases, they rarely exceeded 10 minutes in length. I was able to reach 12 of the 14 teacher-participants. I was unable to reach two teacher-participants despite repeated attempts.

**Data Analysis**

In the following section I explain how I used inductive and deductive coding strategies to answer each of my research questions. Again, those questions are:

- How do U.S. textbooks and supplemental materials conceptualize global warming?
- What messages do global warming curricula convey about how societies should respond to global warming?
- How do U.S. high school social studies and science teachers personally conceptualize global warming and how are they making sense of the stance they take in their classrooms?

My analysis began with a careful reading of the passages about global warming in the textbooks and a thorough reading of the supplemental materials. With the textbooks, I performed a sentence count of the global warming content and noted the location of the content within the text. For both the textbooks and the supplemental materials I made special note of any images, graphs, charts, maps, and tables that appeared. Next, I used structural coding (MacQueen, 2008) to sort the global warming content of each source into three broad categories: causes of global warming, effects of global warming, and means of addressing global warming. Structural coding...
serves to both code and initially categorize the data and is “appropriate for virtually all qualitative studies, but particularly for those employing multiple participants, standardized or semi-structured data-gathering protocols, hypothesis testing, or exploratory investigations to gather topics lists or indexes of major categories or themes” (Saldaña, 2009, p. 67).

The conceptual framework served as a starting point for more in-depth code development and analysis of the textbooks and supplemental materials. Here, I used inductive and deductive coding to sift through the data line-by-line. For instance, I used a preliminary coding scheme to explore how the data treated aspects of global warming as open or closed questions (Hess, 2009). At this point, I enlisted the help of two other researchers who analyzed brief sections of text with me using the preliminary codes I had developed. Our subsequent discussion regarding what textbooks were treating as open and closed questions refined and sharpened my coding scheme.

I refined, combined, deleted, and added to codes as I compared data across sources and across content areas. As analysis progressed, emerging patterns suggested global warming curricula varied in how they approach three publicly controversial questions: 1) is global warming a problem? 2) is human activity responsible for global warming? and 3) is there scientific consensus about the nature and cause of global warming? Table 3.4 illustrates the coding scheme used to analyze how the curricula address these questions. Note that these are not the only codes used to analyze the data in my study. I highlight these codes here because the patterns that emerged from this part of the analysis grew into the three conceptual categories of global warming curriculum (discussed in much greater detail in chapter five) interwoven throughout my findings.
Table 3.4. Partial Coding Scheme

<table>
<thead>
<tr>
<th>Code (+ subcode)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Is global warming a problem?</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Problem codes</strong></td>
<td></td>
</tr>
<tr>
<td>Climate Change   (temperature, precipitation,</td>
<td></td>
</tr>
<tr>
<td>extreme weather events, sea level)</td>
<td></td>
</tr>
<tr>
<td>content about changes in earth systems due</td>
<td></td>
</tr>
<tr>
<td>to accelerated global warming</td>
<td></td>
</tr>
<tr>
<td>Impacts and Vulnerabilities (food security,</td>
<td></td>
</tr>
<tr>
<td>water security, human health, human society/settlements,</td>
<td></td>
</tr>
<tr>
<td>ecosystem-physical, ecosystem-flora/fauna)</td>
<td></td>
</tr>
<tr>
<td>content about aspects of human and earth</td>
<td></td>
</tr>
<tr>
<td>systems that will be impacted by changing</td>
<td></td>
</tr>
<tr>
<td>climate</td>
<td></td>
</tr>
<tr>
<td><strong>Urgency codes</strong></td>
<td></td>
</tr>
<tr>
<td>who</td>
<td></td>
</tr>
<tr>
<td>content about specific human populations</td>
<td></td>
</tr>
<tr>
<td>threatened by global warming</td>
<td></td>
</tr>
<tr>
<td>when (now, near future, deep future,</td>
<td></td>
</tr>
<tr>
<td>indeterminate)</td>
<td></td>
</tr>
<tr>
<td>temporal information regarding the impacts</td>
<td></td>
</tr>
<tr>
<td>of global warming</td>
<td></td>
</tr>
<tr>
<td>where (close, far, indeterminate)</td>
<td></td>
</tr>
<tr>
<td>content about specific locations that are or</td>
<td></td>
</tr>
<tr>
<td>will be threatened by global warming</td>
<td></td>
</tr>
<tr>
<td><strong>Is human activity responsible for global warming?</strong></td>
<td></td>
</tr>
<tr>
<td>Drivers (anthropogenic, natural)</td>
<td></td>
</tr>
<tr>
<td>content that attributes cause of global</td>
<td></td>
</tr>
<tr>
<td>warming</td>
<td></td>
</tr>
<tr>
<td><strong>Have scientists come to consensus?</strong></td>
<td></td>
</tr>
<tr>
<td>Consensus (consensus, no consensus)</td>
<td></td>
</tr>
<tr>
<td>content indicating whether or not scientists</td>
<td></td>
</tr>
<tr>
<td>agree upon current best understanding of</td>
<td></td>
</tr>
<tr>
<td>global warming as put forth by IPCC</td>
<td></td>
</tr>
</tbody>
</table>

I applied the relevant codes developed during my analysis of the textbooks and supplemental materials to teacher-participant interviews, but I also created new codes as patterns emerged. For instance, I noticed that not all teachers’ personal conceptualization of global warming matched the conceptualization they reported presenting to their students. Therefore, I began coding for “personal conceptualization” and “presented conceptualization.” Throughout the process of data analysis, I wrote conceptual memos about emerging patterns and points of
interest. In addition, I used constant comparison (Corbin and Strauss, 2008) to explore the similarities and differences of how global warming is conceptualized among the sources of data (textbooks, supplemental curricula, and interviews) and the similarities and differences between the core areas of social studies and science.

**Positioning myself in the Study**

Being someone who has enjoyed pursuing outdoor activities since my earliest days, I feel a connection to the natural environment and am largely sympathetic to environmental causes. Before delving into this study, the topic of global warming was certainly “on my radar.” I was (and continue to be) receptive to climate scientists’ findings regarding global warming. Still, I also recognized my naiveté concerning many aspects of the phenomenon including (but certainly not limited to) the scientific evidence supporting the theory of anthropogenic global warming, the nature of the scientific process, the workings of the Intergovernmental Panel on Climate Change (IPCC), and the policy debates concerning how to address global warming.

One of the benefits of working closely with one curricular topic is that it forced me to learn about the subject in depth. To fully analyze and understand how teachers and other writers of curriculum conceptualize global warming, I felt I needed to have a strong grasp on the science that supports the theory of human-induced global warming as well as the evidence marshaled by those who refute the mainstream scientific viewpoint. In addition, I felt I needed to understand the “life and times of climate change” (as my dissertation advisor put it). Among other sociological aspects of global warming, then, I set about to understand how global warming came to be identified as a “problem,” why climate change means different things to different
people, the process by which the IPCC makes climate scientists’ findings “official,” and how policy-makers at various levels have attempted to address global warming.

Over the course of my study I have immersed myself in numerous books, articles, and research about global warming, regularly visited several blogs and websites about the topic, paid close attention to how policy-makers and political candidates talk about global warming, and engaged in many informal discussions with a range of people about climate change, from academics with expertise on the nature of science to ranchers in central Mexico who are suffering economically from prolonged drought conditions.

As a result of my learning, I have developed a particular conceptualization of global warming that is important to reveal as it positions me within the greater public debate. I agree with the overwhelming majority of climate scientists that anthropogenic global warming is occurring. I believe global warming is causing rapid climatic change, and that these relatively fast changes present myriad threats that challenge the stability of human and non-human systems. I believe that those with less access to resources and capital, particularly those in the global south, will be disproportionately affected; however, no region on Earth will be spared significant changes. I believe that societies around the globe are already beginning to see the affects of global warming and those people in my generation (at the cusp between Generation X and the Millennials) and our immediate descendants will be subjected to still more rapid and dramatic climatic changes in the decades to come. Finally, I believe that in order to stem the most dramatic disruptions to life on planet earth, societies around the globe must do two things. First, we must set in motion immediate and wide-spread efforts to mitigate the release of greenhouse gases. Second, we need to initiate serious discussions establishing concrete steps to
help societies adapt to the inevitable long-term disruptions to food production, settlement
patterns, human health, trade, and security (among other things) brought about by climate
change.

**Chapter Summary**

This chapter explained the methodology I employed to answer my research questions. I
discussed how I selected the sources of data for this study, how I collected data from these
sources, and how I analyzed the data. In the next chapter I briefly outline what climate scientists
currently hold to be true about global warming. Then, in chapters five, six, and seven, I present
my answers to the research questions at hand.
Chapter Four: The Scientific Case for Global Warming

With all of the hysteria, all of the fear, all of the phony science, could it be that man-made global warming is the greatest hoax ever perpetrated on the American people? It sure sounds like it.

Senator James Inhofe, July 29, 2003

One would hope that when high-ranking U.S. policy makers express such immense doubt in anthropogenic global warming, like Senator Inhofe above, they do so because the empirical evidence is lacking. This is not the case. Instead, climate science experts from around the world marshaling decades of empirical work offer compelling evidence that global warming is happening, that human activity is largely to blame, and that climates, ecosystems, and human societies will continue to be affected as the average global temperature rises. In this chapter I share some of the major findings put forth by the United Nations Intergovernmental Panel on Climate Change (IPCC). Knowing the most current scientific understanding of global warming is important because I use the IPCC’s conclusions as a reference point for creating the adherent, hesitant, and dissenting categories of curriculum alluded to in previous chapters and discussed in depth in the remaining chapters.

***

The IPCC was created in 1988 by the World Meteorological Organization and the United Nations Environment Program for the purpose of providing the world’s governments with a scientific viewpoint about climate change (IPCC, 2012). The organization has since published regular, comprehensive reports documenting the findings of climate scientists. The latest comprehensive report, known as the Annual Report 4 (AR4), was published in 2007: the findings within its pages represent the best scientific understanding of global warming to date. A
more manageable document (and the one I draw my information from) is the Synthesis Report, an executive summary of AR4. The Synthesis Report represents the agreed upon key findings and uncertainties adopted by the IPCC from the contributions made by three Working Groups. Each Working Group compiles the latest scientific findings dealing with a particular aspect of climate change including the observed changes in climate, the effects of observed changes on biological and physical systems, the causes of observed changes, and projections of future climate change and its effects (IPCC, 2007).

One of the more powerful claims of the Synthesis Report reads, “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level” (IPCC, 2007, p. 30). Multiple lines of evidence support the claim that the average temperature of the Earth’s atmosphere is increasing--a trend that has become more prevalent in the latter half of the 20th century. For example, records of surface temperatures reveal that eleven of the twelve years from 1995-2006 were the warmest years on record since 1850.¹ Records indicate that temperatures in the Northern Hemisphere are very likely higher than any other 50-year period in the last 500 years, and likely higher than any 50-year period in the last 1,300 years. Moreover, the rate of warming is increasing. When viewed graphically, the trend line for temperatures is steeper between 1956-2005 than from 1905-2005 (IPCC).

¹ Since publication of the AR4 in 2007, nine of the ten warmest years in the instrumental record occurred since 2000. The only year from the 20th century included in the top ten is 1998 (Lynch, 2012). http://www.giss.nasa.gov/research/news/20120119/

² The IPCC uses several approaches to indicate levels of certainty. The statistical likelihood of specific outcomes occurring is assessed using the following ranges: virtually certain (>99%); extremely likely (>95%); very likely (>90%); likely (>66%); more likely than not (>50%). Where likelihood is assessed by expert judgement on the correctness of data, models, and analyses, the following terminology applies: very high confidence (at least 9 out of 10); high confidence (8 out of 10), medium confidence (5 out of 10).
Indirect evidence in the form of rising sea levels, retreating glaciers, and diminishing snow cover and polar ice also are consistent with what scientists would expect to happen as temperatures rise. Global sea levels rose an average of 1.8 mm per year between 1961-2003. Similar to the rising temperature trend, the rate is increasing--from 1993-2003 sea levels rose an average of 3.1 mm each year (IPCC, 2007). Furthermore, there has been a decrease in the extent of snow and ice coverage in recent decades. For instance, the extent of Arctic ice has shrunk by an average of 2.7 percent per year since 1978 and mountain glaciers and snow cover is declining in both the Northern and Southern hemispheres (IPCC). In September, 2012, the National Snow and Ice Data Center reported a record minimum for Arctic sea ice extent (NSIDC, 2012).

Melting ice and rising sea levels are not the only changes occurring as temperatures rise. Empirical evidence also indicates changes in long-term climate patterns. The Synthesis Report notes, “At continental, regional and ocean basin scales, numerous long-term changes in other aspects of climate have also been observed...” (IPCC, 2007, p. 30). One long-term change scientists around the world are studying is the shifting patterns of precipitation. Precipitation patterns at the continental scale have changed since 1900 with more precipitation falling in certain regions (eastern North and South America and northern Asia, for example) and less precipitation falling in other regions (such as the Mediterranean, southern Africa, and parts of southern Asia). It is likely that many extreme weather events, including prolonged heat waves and instances of heavy rainfall, have changed in both frequency and intensity over the last 50 years. Additional evidence suggests an increase in intense hurricane activity in the North Atlantic since 1970; however, a lack of accurate data prior to 1970 limits scientists’ current ability to detect long-term trends of hurricane frequency and strength (IPCC).
Scores of studies capturing tens of thousands of data series indicate the anthropogenic warming witnessed over the last 30 years has likely resulted in a host of changes in physical and biological systems worldwide (IPCC, 2007, p. 41). For example, there is high confidence that systems related to snow, ice, and frozen ground are affected by anthropogenic warming. Scientists note that the top layer of permafrost in the Arctic has been increasing 3°C per decade since the 1980s resulting in increasingly unstable ground as the permafrost melts. Moreover, warmer temperatures have brought about changes in the Arctic ecosystem, the popular example being the difficulty some populations of polar bears are having obtaining food as sea ice melts. There is equally high confidence that warming is shifting the timing of natural events like the budding of plants in spring-time, growing seasons, and annual migrations of some species. Some plant and animal species are altogether shifting their range poleward; and this shift is not limited to terrestrial species. Experts have high confidence aquaculture is changing too. Algae growth is increasing in warming oceans, and the range of some ocean species is shifting. There is medium confidence that anthropogenic warming is altering the health of forests through an increase in forest fires and pests able to survive the less extreme winters in addition to affecting the health of humans due to an increase in heat waves and the spread of disease vectors.

Aside from empirical studies describing current changes in physical and biological systems around the world, a number of studies the IPCC draws from to formulate its reports include projections of what might happen given a range of greenhouse gas emissions scenarios. In terms of changes, experts assert that it is very likely changes in temperature and sea level will be larger during the 21st century than they were during the 20th century should the rate of greenhouse gas emissions remain the same or increase. Regardless of the rate of future
emissions, experts expect the average global temperature to increase 0.36°F each decade for the next 20 years due to the greenhouse gases already accumulated in the atmosphere. In fact, the best estimate based on a number of computer models using a variety of emissions scenarios is that the average global temperature will increase between 2.2-7.2°F over the 1980-1989 global average by the end of the century (IPCC, 2007, p. 45). Models indicate that sea levels will rise 7.1-23.2 inches from 1980-1989 levels by 2100. Importantly, warming and sea level rise due to past and current emissions will continue for more than a millennium (IPCC).

The Synthesis Report notes the changes in temperature and sea level will have impacts on a number of biological and physical phenomena (IPCC, 2007). For example, based on the virtual certainty that most land areas will experience warmer and more frequent hot days and nights, some projected impacts include an increase in crop yields in colder environments and a decrease in yield in warmer environments, an increased outbreak in pests, changes in patterns of winter tourism, a decrease in disruptions to transportation due to snow and ice, an increase in the demand for cooling, and a decline of air quality in cities. It is very likely that the number and intensity of heat waves will increase, affecting the number of wildfires, the demand for water, and the number of heat-related deaths. It is very likely that most land areas will be subject to more frequent heavy precipitation events that could lead to crop damage, soil erosion, a decrease in water quality, and disruptions to society due to flooding. Furthermore, it is likely that the number of areas affected by drought will increase, thereby decreasing crop yields, creating more water stress, and pushing populations of humans and non-humans to migrate. It is also likely that the intensity of tropical storms and hurricanes will increase resulting in disruptions to societies, damage to crops, and loss of property. The incidences of extremely high sea levels is
likely to increase which could affect the quality and quantity of freshwater resources, the
movement of populations and infrastructure away from current coastlines, and increased deaths
due to flooding. Finally, experts express medium confidence that 20-30 percent of plant and
animal species are likely to be at an increased risk of extinction should average temperatures
exceed 2.7-4.5°F (IPCC). Practical limitations of publication and the lack of scientific evidence
from every specific sub-region limit a more fine-grained analysis of the impacts of global
warming, still the evidence contained within AR4 establishes global warming as a truly global
problem that will affect all regions of the world.

In addition to providing evidence for the existence of global warming and offering
scientifically grounded predictions of likely effects, the AR4 also addresses the likely cause of
global warming. The temperature of earth’s atmosphere changes when the balance of energy
within it is altered. There are two basic ways this balance can be altered: the atmosphere can be
exposed to more or less solar radiation (either through a change in the shape of earth’s orbit or
through a change in the energy coming from the sun) or the atmosphere can be altered so that it
traps more energy radiating from the earth or reflects more energy radiating from the sun. The
shape of earth’s orbit, the amount of energy coming from the sun, and volcanic activity that
spews energy reflecting particles into the atmosphere account for natural changes in the average
global temperature. Indeed, fluctuations in the earth’s orbit account for many past global climate
changes including the various ice-ages. That being said, scientists have concluded that over the
past 50 years the variation of energy from the sun in combination with volcanic activity on earth
would likely have resulted in a cooling trend. Consequently, it is extremely unlikely that the
global warming witnessed over the last 50 years can be explained without considering the impacts of human activity—primarily the burning of fossil fuels and deforestation (IPCC, 2007).

For well over 100 years scientists have understood the phenomenon known as the greenhouse effect, whereby certain atmospheric gases—including water vapor, carbon dioxide, and methane, among others—“trap” heat radiating from the Earth. Higher concentrations of these gases, collectively called greenhouse gases, result in elevated atmospheric temperatures. According to the IPCC the current levels of carbon dioxide and methane far exceed those that have naturally existed in the atmosphere over the past 650,000 years (IPCC, 2007). Before the dawn of the Industrial Revolution in the mid 18th century, the concentration of carbon dioxide in the atmosphere hovered around 280 parts per million (ppm). By 2005 the concentration of carbon dioxide had reached 379 ppm and it continues to climb by an average of 1.9 ppm each year. Consequently, even though climate models have demonstrated a minor role of natural causes in the latest warming trend, the IPCC concludes the observed increase in global average temperature over the last 50 years is due mainly to human activity (IPCC). With this evidence in mind, the AR4 puts forth “Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic [greenhouse gas] concentrations” (IPCC, 2007, p. 39).

That the United Nations bestows scientific authority to the IPCC regarding global warming gives weight to the empirical findings it reports, yet these findings come from just one organization (albeit a large one). What have other experts in the field come to believe about global warming? Several recent studies suggest there is indeed widespread agreement among climate science experts that the global average temperature has been on the rise since the
Industrial revolution and that human activity is a significant contributing factor. A survey of over 3,000 earth scientists indicates over 90 percent believe the earth is warming and 82 percent believe the temperature rise is caused by human activity. Of those earth scientists included in the survey who specialize in climate science and are actively publishing (n = 79), however, 96 percent believe that “global temperatures have generally risen” in comparison to pre-1800s levels and 97 percent believe that “human activity is a significant contributing factor in changing mean global temperatures” (Doran and Zimmerman, 2009, p. 22). Likewise, Anderegg, et al. (2010) found over 97 percent of the most actively publishing climate researchers support the tenets of human-induced climate change as outlined by the IPCC.

Another indicator of scientific consensus regarding global warming is the endorsements the IPCC reports receive from major scientific organizations from across the globe. Looking only within the borders of the U.S., numerous well-respected scientific bodies such as the American Association for the Advancement of Science, the National Research Council, the American Geophysical Union, the Geological Society of America, the American Meteorological Society, and the American Institute of Biological Sciences support the tenets of human-induced global warming. The overwhelming consensus among climate scientists and respected scientific organizations makes it difficult, if not impossible, to credibly refute what climate experts have come to understand about the causes and effects of global warming.

Chapter Summary

In this chapter I have introduced some of the salient scientific evidence supporting the theory of anthropogenic global warming and the projected affects rising average temperatures will have on a variety of planetary and biological systems. Despite what Senator Inhofe might
think, empirical evidence supporting the theory of anthropogenic global warming is robust. In the following three chapters I consider how high school level textbooks, supplemental curricula, and teachers conceptualize global warming in light of the claims made by the IPCC in AR4, the most comprehensive scientific report on the matter.
Chapter Five: Conceptualizing Global Warming in the Formal Curriculum

All global warming curricula are not created equal. Like the range of beliefs concerning global warming within the U.S. public, the formal global warming curricula I analyzed expresses significant differences in what they hold open as genuinely controversial, their level of content specificity, and, to a lesser degree, their use of extreme claims and language to describe the phenomenon. Importantly, not all global warming curricula accurately portrays the current scientific understanding of the phenomenon. In fact, some curricula teach students to doubt the findings of climate science experts altogether.

As I discussed in chapter four, the Intergovernmental Panel on Climate Change (IPCC) conveys what climate science experts have come to believe about global warming: that global warming is occurring, that it is caused in large part by human activity, and that climate systems, ecosystems, and human societies around the world are already feeling the effects. Some textbooks and supplemental materials consider the IPCC’s conclusions, and the scientific consensus supporting these conclusions, as non-controversial. In other words, they adhere to the viewpoint of the IPCC--I call these curricula adherent. With few exceptions, the content included in adherent curricula contains more detail regarding the effects of global warming than the other two categories of global warming curriculum. The adherent curriculum is also more prone to using extreme, even alarmist, language to describe global warming. A second category of global warming curriculum, the hesitant curricula, may offer the IPCC’s conclusions as one conceptualization of global warming; however, hesitant curricula offer this interpretation tentatively and with room for competing explanations of global warming. Furthermore, the hesitant curricula implies that their is uncertainty within the field of climate science regarding the
cause of global warming. Finally, what I call dissenting curricula put forth a starkly different picture of global warming than that endorsed by the IPCC (and adherent curricula). At first glance, dissenting curricula treat the cause of global warming as an unknown and as an area of lively disagreement among climate science experts; however, the underlying message these curricula promote suggests natural cycles, not human activities, drive current global warming. Compared to the adherent curricula, neither the hesitant nor the dissenting materials provide as much content about the predicted effects of global warming. See Table 5.1 for a list of textbooks and supplemental materials organized by conceptual category.

In the remainder of this chapter I illustrate how the adherent, hesitant, and dissenting curricula conceptualize and present global warming differently. To do so, I use three questions prevalent in the US public’s debate about global warming to draw out the curricular distinctions discussed above. Those questions are: 1) Is global warming a problem? 2) Is global warming caused by human activity? and 3) Is there scientific consensus about global warming?
<table>
<thead>
<tr>
<th>Supplemental materials</th>
<th>Data source</th>
<th>Conceptual Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>An Inconvenient Truth in the Classroom</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Climate Change: A Wisconsin Activity Guide</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Climate Change: Connections and Solutions</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Deliberating in a Democracy: Global Climate Change</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Global Environmental Problems: Implications for US Policy</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Global Warming 101</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding Climate Change</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Unstoppable Solar Cycles</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Textbooks</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Geography: Landscapes of Human Activity, 11th Ed.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Prentice Hall Biology (2008)</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Glencoe World Geography (2012)</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Note.*  
*a* References social studies education standards  
*b* References science education standards  
*c* References Environmental Education Guidelines for Excellence  
*d* References Mathematics, English-Language Arts, and/or Art-Design standards
The Adherent Curriculum

I consider six of the eight sets of supplemental materials and three of the eleven textbooks to be examples of the adherent global warming curriculum. I explore these materials in depth in the subsequent three sections. My analysis suggests adherent textbooks and supplemental materials consider global warming to be an immediate and serious problem caused by human activity--primarily the burning of fossil fuels and deforestation--and purport consensus for this perspective among climate science experts.

Is global warming a problem?

While the existence of rising average temperatures was not up for debate in the materials I analyzed, whether a curriculum treated the rise in temperature as a problem did vary and thus served as a notable feature distinguishing the categories of global warming curriculum. It is important to note that the natural sciences are not equipped to determine what constitutes danger. Still, the IPCC Synthesis Report (2007) does provide a useful means to frame the problem(s) associated with global warming. As discussed in chapter four, the IPCC’s 2007 Synthesis Report documents empirical evidence for a number of climate changes and impacts caused by a human-induced warming of earth’s atmosphere. These findings are very broadly summarized in a diagram at the beginning of the Synthesis Report. See Figure 5.1 for a version of this diagram. I used the subcategories listed under “climate change” and “impacts and vulnerabilities” noted in Figure 4.1 as analytical categories to sort the content of the curriculum in this study and

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1 One question about global warming sometimes debated among factions of the U.S. public is whether global warming exists at all. Those who identify ideologically as very conservative, many members of the Tea Party, for instance, believe the evidence supporting observations of rising average global temperatures is either too weak to conclude anything or non-existent. My analysis of textbooks and supplemental materials revealed the question of whether global warming existed at all was moot. All textbooks and supplemental materials analyzed in this study conceded that the average global temperature was indeed rising.
understand how it was (or was not) positioning global warming as a problem, who or what it might be a problem for, and when and where the problem might manifest itself.

**Figure 5.1.** IPCC conceptualization of the relationship between climate drivers, climate change, and the impacts of climate change. Adapted from the UN Intergovernmental Panel on Climate Change publication *Climate Change 2007: Synthesis Report*, p. 26.

Most of the adherent curricula attended to each of the four areas of climate change (rising temperature, rising sea levels, increase in extreme weather events, change in precipitation patterns) as well as the five broad areas the IPCC mentions as being impacted by global warming (ecosystems, water resources, food resources, human health, and settlements and society).

Furthermore these curricula often note that some of the changes and impacts are already apparent or will be in the near future, coded for in this study as happening by the year 2100. Table 5.2 compares the changes to climate and the impacts of global warming mentioned in the adherent, hesitant, and dissenting textbooks and supplemental materials.
Table 5.2. Major Changes to Climate and the Potential Impacts of These Changes as Noted Within Supplemental Curricula and Textbooks

<table>
<thead>
<tr>
<th>Conceptual Category and Title</th>
<th>Changes to climate</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>ecosystems</th>
<th>ecosystems</th>
<th>society</th>
<th>human health</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>temp</td>
<td>precip</td>
<td>sea level</td>
<td>extreme events</td>
<td>food security</td>
<td>water security</td>
<td>physical features</td>
<td>flora/fauna</td>
<td>society</td>
</tr>
<tr>
<td>Adherent Curriculum</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>An Inconvenient Truth in the Classroom (^c)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Climate Change: A Wisconsin Activity Guide (^a), (^b), (^c)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Climate Change: Connections and Solutions (^a), (^b), (^c)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Global Warning 101 (^a), (^b), (^c)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Living in the Environment, 16th Ed. (^b)</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td></td>
</tr>
<tr>
<td>Deliberating in a Democracy: Global Climate Change (^a)</td>
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<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Global Environmental Problems (^a)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Human Geography: Landscapes of Human Activity, 11th Ed. (^a)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>McDougal Littell Modern World History: Patterns of Interaction (^a)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
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</tbody>
</table>
Table 5.2 (continued). *Major Changes to Climate and the Potential Impacts of These Changes as Noted Within Supplemental Curricula and Textbooks*

<table>
<thead>
<tr>
<th>Conceptual Category and Title</th>
<th>Changes to climate</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>temp</td>
<td>precip</td>
</tr>
<tr>
<td>Hesitant curriculum</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Glencoe Earth Science</em> $^b$</td>
<td>$^x$</td>
<td>$^x$</td>
</tr>
<tr>
<td><em>Holt McDougal Earth Science</em> $^b$</td>
<td>$^x$</td>
<td>$^x$</td>
</tr>
<tr>
<td><em>Prentice Hall Earth Science</em> $^b$</td>
<td>$^x$</td>
<td>$^x$</td>
</tr>
<tr>
<td><em>Prentice Hall Biology</em> $^b$</td>
<td>$^x$</td>
<td>$^x$</td>
</tr>
<tr>
<td><em>Glencoe World Geography</em> $^a$</td>
<td>$^x$</td>
<td>$^x$</td>
</tr>
<tr>
<td><em>Prentice Hall World Geography</em> $^a$</td>
<td>$^x$</td>
<td>$^x$</td>
</tr>
<tr>
<td>Dissenting curriculum</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Understanding Climate Change</em></td>
<td>$^x$</td>
<td>$^x$</td>
</tr>
<tr>
<td><em>Unstoppable Solar Cycles</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.*

$^a$ References social studies education standards  
$^b$ References science education standards  
$^c$ References Environmental Education Guidelines for Excellence
Rising average temperatures, shifts in regional patterns of precipitation, rising sea levels, and an increasing number of extreme weather events (e.g. heat waves, stronger storms) represent one group of problems associated with global warming--what some collectively refer to as climate change. Messages about how climates will change permeate the adherent curricula. For example, one of the first readings that students encounter in Facing the Future’s Climate Change: Connections and Solutions curriculum (referred to henceforth as Connections and Solutions) notes, “Eleven years between 1995 and 2006 are among the twelve hottest years recorded since 1850, when global surface temperatures were first recorded by instruments” (2007, p. 97) and, “Wind and precipitation patterns have changed in many regions during the past century, resulting in increased rainfall in some places and droughts in others” (2007, p. 98). In a lesson designed to get students thinking about how some impacts of climate change will be felt worldwide while others will be more regional in nature students read, “Sea levels will continue to rise as a result of global warming. Part of this rise is due to thermal expansion of the oceans [...] and part is due to melting glaciers and icecaps,” (p. 59).

Other adherent materials convey similar messages suggesting changes to climate systems spurred on by global warming are serious and imminent. For instance, in a reading in the Will Steger Foundation’s Global Warming 101 curriculum students read, “As more energy in the form of heat accumulates in the oceans, hurricanes can get more and more intense” (2009, p. 43). The Choices Program curriculum, Global Environmental Problems: Implications for U.S. Policy, notes, “Higher temperatures and the erratic rainfall patterns that are forecast could lead to devastating droughts.” (2009, p. 29). The introductory reading from An Inconvenient Truth in the Classroom produced by the National Wildlife Federation proclaims, “Nineteen of the 20
hottest years on record have occurred since 1980” (2008, p. 15), and the opening reading of Wisconsin DNR’s curriculum titled *Climate Change: A Wisconsin Activity Guide* points out “With the combination of glacier melt and thermal expansion increasing oceanic volumes, scientists predict a substantial sea level rise in the 21st century” (2009, p. 6)

Rising average temperatures and the rising sea level are given particular attention within many of the adherent curricula, perhaps because these are the factors of climate change for which the IPCC provides specific predictions. See Table 5.3 for a comparison of the temperature and sea level predictions in the adherent curricula. Materials from both Facing the Future and the Will Steger Foundation estimate that temperatures will be 2.5-10.4°F higher by 2100, while the Choices curriculum and the National Wildlife Federation curriculum estimate rises of 4-11°F and 2-11.5°F by 2100, respectively. Interestingly, with the exception of the textbook *Human Geography: Landscapes of Interaction*, all of the temperature predictions offered in adherent curricula tend to be on the high end of those predicted by the IPCC. While the 2007 Synthesis Report (IPCC, p. 45) does indeed predict a likely temperature increase between 1.3-11.5°F above the 1980-1989 average, the range of temperatures using the “best estimate” of temperature under each of six emissions scenarios analyzed in the report is a bit more modest at 3.2-7.2°F higher by the year 2100.
Table 5.3. Predictions of Temperature Rise and Sea Level Rise in the Adherent Curricula

<table>
<thead>
<tr>
<th>Source</th>
<th>Predictions of changes in climate</th>
<th>Source</th>
<th>Predictions of changes in climate</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPCC Synthesis Report (2007)*</td>
<td>Temperature rise</td>
<td>Sea level rise</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.2-7.2°F</td>
<td>7.1-23.2 in</td>
<td></td>
</tr>
<tr>
<td>An Inconvenient Truth in the Classroom</td>
<td>4 -11°F</td>
<td>10-23 in.</td>
<td></td>
</tr>
<tr>
<td>Climate Change: A Wisconsin Activity Guide</td>
<td>no prediction</td>
<td>no prediction</td>
<td></td>
</tr>
<tr>
<td>Climate Change: Connection and Solutions</td>
<td>2.5-10.4°F</td>
<td>4 in. to several yards</td>
<td></td>
</tr>
<tr>
<td>Deliberating in a Democracy: Global Climate Change</td>
<td>no prediction</td>
<td>no prediction</td>
<td></td>
</tr>
<tr>
<td>Global Environmental Problems</td>
<td>2 - 11°F</td>
<td>20 inches</td>
<td></td>
</tr>
<tr>
<td>Global Warming 101</td>
<td>2.5-10.4°F</td>
<td>4 in. to several yards</td>
<td></td>
</tr>
<tr>
<td>Living in the Environment, 16th Ed.</td>
<td>3.6-8.1°F between 2005-2100</td>
<td>7.2 in. -23 in., but new models predict 39.3-78.7 in.) between 2050-2100</td>
<td></td>
</tr>
<tr>
<td>Human Geography: Landscapes of Human Activity, 11th Ed.</td>
<td>3.2-7.2°F</td>
<td>11-17 in. with additional 3.9-7.9 in. if recent polar melting of polar ice continues</td>
<td></td>
</tr>
<tr>
<td>McDougal Littell Modern World History:</td>
<td>no prediction</td>
<td>no prediction</td>
<td></td>
</tr>
<tr>
<td>Patterns of Interaction</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Note. Unless otherwise noted the predictions are for the span of time ending in 2100. The temperature increases represent the rise in temperature above the 1980-1989 global average temperature.

These numbers represent the range of the “best estimate” predictions of global average temperature considering the six emission scenarios included in the IPCC’s 2007 Synthesis Report. The likely rise in temperature using the range of all emission scenarios is 2-11.5°F.

Similar to the temperature predictions offered within the adherent materials, these materials also tend to present estimations for rising sea levels at the high end of the predicted range. By 2100, the IPCC predicts the sea level to rise 7.1-23.2 in. over the 1980-1989 average.²

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² This prediction is based only on the thermal expansion of the seas due to increased average global temperatures. Melting of land-based ice would significantly add to the total sea level rise.
Materials from Facing the Future and the Will Steger Foundation are particularly alarming in that they state that sea level will rise anywhere from four inches to several yards (thus implying 72 or more inches). While the 2007 Synthesis Report acknowledges that a 275 inch rise in sea level is possible via the melting of ice sheets, such a rise would take centuries to actually transpire (IPCC, 2007).

Aside from changes to the climate system, the IPCC recognizes five broad areas such changes will impact: ecosystems, water security, food security, human health, and settlements and society. Adherent curricula often expose students to these impacts with specific lessons. For example, the third of six lessons in *Global Warming 101* is titled “Communities of Living Things” and has as one of its learner objectives “Students will predict how continued warming may affect communities of living things with which they are familiar” (p. 21). In this lesson, students learn about the detrimental effects rising temperatures have on animals and human inhabitants of the Arctic including an increase in competition among animals for habitat and food resources and the disruption of society, such as the impediments to travel and destruction of infrastructure, all due primarily to the ongoing melting of ice and permafrost. One lesson in *Connections and Solutions* has the following objectives for student learning:

- Consider the common manifestations of climate change
- Predict how a rise in average global temperature might impact countries in particular regions
- Explore how humans will be impacted by changes in their own environment and by changes in foreign environments (2007, p. 53)

In this lesson students learn, among other things, that global warming will contribute to human health concerns including an increase in heat-related deaths and an increase in the range of

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These high predictions are based on a scenario whereby massive melting of land-based ice, such as the ice sheets on Greenland and Antarctica, adds water to the oceans.
disease carrying insects, the decrease in amount and quality of potable water supplies, and a decrease in crop yields.

Importantly, I did not find that each of the adherent examples contained the same, or even equal amounts of information, on the various problems related to global warming. As might be expected, different organizations approach the problems associated with global warming from different perspectives and with different outcomes in mind. For instance, Will Steger is a polar explorer who has spent a lifetime adventuring and documenting the earth’s polar climes. Not surprisingly *Global Warming 101*, the global warming curriculum produced by his self-named foundation, contains several learner objectives that focus students’ attention on issues of global warming in the Arctic. Similarly, the mission of the Constitutional Rights Foundation Chicago (CRFC) is “to develop critical thinking skills, civic participation, and commitment to the rule of law among young people.” One way they attempt to live up to this mission is by teaching youth to deliberate over public policy. Accordingly, CRFC’s *Deliberating in a Democracy: Global Climate Change* materials only briefly mention changes to the climate (and neglect to mention a rise in sea level at all) and instead focus on the pros and cons of a cap-and-trade system to mitigate future greenhouse gas emissions. Regardless, the CRFC’s material still situates global warming as a serious problem. Consider the following passage from the background essay provided to students:

The IPCC forecasts that growing concentrations of greenhouse gases in the atmosphere will dramatically increase the Earth’s temperature, resulting in more droughts, declines in crop yields, and even famine in poorer countries. Insects will thrive and insect-borne diseases like malaria will expand. Increasingly violent storms, gathering additional energy from a warmer ocean, will threaten life. (p. 2)
So far this analysis has attended only to the adherent supplemental materials; however, three textbooks, including two AP level textbooks and one “mainstream” textbook, also fit into the adherent category. I separate them from the supplemental materials here because they displayed some unique characteristics I want to highlight.

The only mainstream textbook to fit the adherent category, Modern World History: Patterns of Interaction published by McDougal Littell, is neither an Earth Science nor a World Geography textbook. This was a surprise because Earth Science and World Geography represent the courses within each core area of science and social studies, respectively, that serve as de facto intellectual homes for global warming content. There is much to be desired about how Patterns of Interaction presents climate change to students. The authors use just 20 sentences (which is relegated to the epilogue of the text) and convey little specific information about the predicted impacts of global warming other than if the “gradual warming of the earth’s atmosphere” continues, “deserts will expand and crops will fail. The polar ice caps will melt and oceans will rise” (p. 679). Despite the lack of significant content, however, Patterns of Interaction positions global warming as one of the world’s “two major areas of concern” regarding the environment and notes that “Failure to solve environmental problems will threaten the health of the planet” (p. 679).

Two Advanced Placement (AP) level textbooks, Human Geography: Landscapes of Human Activities, 11th Edition (AP Human Geography) and Living in the Environment, 16th Edition (A.P. Environmental Science), stand apart from the rest of the adherent curricula in the dire language they use to position global warming as a particularly pressing problem. For
instance, *Living in the Environment* describes to its readers a 2003 report from the U.S. National Academy of Sciences using particularly alarmist language:

...[the 2003 report] laid out a nightmarish *worst-case scenario* in which human activities, alone or in combination with natural factors, trigger new and abrupt climate and ecological changes. At that point, the global climate system would reach an irreversible *tipping point* after which it would be too late to reverse catastrophic changes for tens of thousands of years. (p. 506, emphasis in original)

Shortly after this passage a quotation from the U.K.’s chief science adviser reads, “In my view, climate change is the most severe problem we are facing today--more serious even than the threat of terrorism” (p. 506). Taking the notion of climate change as a threat one step further, the textbook reports that a military security think tank posits a continued rise in greenhouse gases will have catastrophic consequences “on the level of nuclear war” (p. 506). The text makes the need to immediately mitigate global warming clear: “Many scientists argue that our most urgent priority is to do all we can to avoid any and all irreversible climate or ecological tipping points. Once we reach such a point, there is no going back. It is like going over a cliff” (p. 510, emphasis in original).

*Landscapes of Human Activities*, the AP Human Geography textbook, also takes an alarming tone in conceptualizing the problem of global warming, though it is not as given to hyperbole as *Living in the Environment*. For example, students read “if temperatures rise by the ‘best estimate’ made in 2007 by the [IPCC] of [3.2 to 7.2°F] over the 21st century, the effects on world climates would be profound” (p. 425). After seven content-rich paragraphs describing the impacts of global warming, the authors summarize by stating:

Nevertheless, on the world scene, any significant continuing deviation from the present norm would at the very least disrupt existing patterns of economy, productivity, and population-supporting potential. [...] At the worst, severe and pervasive changes could result in a total restructuring of the landscapes of culture and the balances of human-
environmental relationships presently established. Nothing, from population distributions to the relative strength of countries, would ever be quite the same again. (p. 426)

Thus far my analysis has investigated what adherent curricula bring to light in terms of the impacts of climate change, and I argue that the various impacts they touch upon--changes such as a rising sea level, rising temperatures, changes to precipitation patterns, and increasing extreme weather events and the impacts to ecosystems, food security, water security, human health and human society--are largely consistent with conclusions put forth in the IPCC’s 2007 Synthesis Report. Next, I explore who global warming will be a problem for, according to these materials. Recall from the summary of the IPCC’s 2007 Synthesis Report in chapter four that no area on the globe will be spared from significant changes to physical and biological systems. Moreover, poor communities will be particularly vulnerable to the impacts of global warming.

Adherent curricula, more so than either hesitant or dissenting curricula, draw attention to the impacts of global warming as a worldwide problem, consistent with the conclusions of the IPCC. Many adherent materials discuss how global warming is affecting (or is predicted to affect) a geographically diverse range of places. For instance, An Inconvenient Truth (AIT), the documentary serving as the centerpiece for the National Wildlife Federation’s global warming materials, refers to no fewer than 11 countries as it illustrates the impacts of global warming. Furthermore, the film draws on many specific regions, cities, and physical features including Mt. Kilimanjaro, the Himalayas, the Southwest United States, Calcutta, and Antarctica to argue the effects of global warming are widespread. A lesson in Global Warming 101 has students consider the impacts of global warming on various Arctic communities while another lesson asks students to investigate the climate and geography of a particular region on earth (e.g. Iowa, The
Republic of Chad, and the Maldives) and make predictions of what might happen to the region as warming continues.

Some of the adherent curricula make a special note that the impacts of global warming will be disproportionately felt around the world in developing countries, with the poor in general bearing the brunt of the consequences. The authors of *Human Geography: Landscapes of Human Activity* write, “Many world regions facing the greatest risk or certainty of adverse environmental change are among the world’s poorest; damage and misery will not be evenly shared” (p. 425) and the Wisconsin DNR’s *A Wisconsin Activity Guide* (2009) notes, “Many parts of Africa already suffer from water and food shortages and severe economic and social challenges. Climate change is likely to greatly exacerbate these conditions. Worldwide, people with fewer financial resources are likely to be less able to cope as the climate changes” (p. 7).

Facing the Future’s *Connections and Solutions* curriculum takes it a step further. These materials have an entire lesson devoted to Climate Justice. Students complete a reading centered on the premise that “The world’s poorest people are likely to be the ones most affected by climate change” (p. 110), and then take part in a quasi-simulation that ultimately asks them to compare the consumption choices that are available to those with little access to wealth to those with high access to wealth and the environmental and social impacts of these choices.

**Is human activity causing global warming?**

It is clear from the evidence discussed above that the adherent curricular materials consider global warming to be a significant problem. Equally clear, according to these materials, is that humans are driving the recent upward trend in the global average temperature. Adherent materials leave no room for doubt about this--it is a closed (Hess, 2009) question: after engaging
with these textbooks and supplemental materials students are to come away believing that human activity is to blame for recent global warming. For example, the background essay included in the Constitutional Rights Foundation-Chicago’s *Global Climate Change* lesson explains:

> Of course, the Earth can become warmer naturally, but scientists estimate that most emissions that are warming the atmosphere come from burning fossil fuels like coal, oil, and gasoline. [...] The IPCC’s 2007 report noted that most of the increase in global average temperatures in the past 50 years is “very likely due” to human activities. (2009, lines 27-29 and 36-37)

Also in the introductory reading, Facing the Future’s *Climate Change: Connections and Solutions* sets up the rest of the two week unit when it offers this conceptualization of the cause of global warming:

> The exact amount of climate change that can be attributed to human actions is not clear. However, it is clear that increasing greenhouse gas emissions result in warmer global temperatures and that human activities emit greenhouse gases. While climate change may not be due solely to human activities, it is very likely that the changes observed during the past 50 years are not due to natural causes alone. (p. 98)

Materials from the Wisconsin Department of Natural Resources curriculum titled *Climate Change: A Wisconsin Activity Guide* convey a comparable message: “During the past 100 years, human behaviors have been affecting our world’s climate. As human activity increases greenhouse gases, and the greenhouse effect subsequently warms the planet, Earth’s climate and climate patterns are changing” (p. 82).

Adherent textbooks offer statements supporting the conclusions of the IPCC, too. For instance, the opening sentence in *Human Geography’s* pages about global warming read, “That humans have significantly altered the chemical composition of the atmosphere since the advent of the industrial Revolution around the year 1750 is beyond dispute” (p. 423). *Living in the Environment* echoes this sentiment and adds a bit more detail:
Since the beginning of the Industrial Revolution about 275 years ago, human actions have led to significant increases in the concentration of earth-warming, and thus climate-changing, CO$_2$, CH$_4$, and N$_2$O in the lower atmosphere. These increases came mainly from agriculture, deforestation, and burning of fossil fuels. (p. 499)

Indeed, a “Key concept” for students to take away, and highlighted at the beginning of the chapter about climate change and ozone depletion, reads, “The overwhelming scientific consensus is that the earth’s atmosphere is warming rapidly, mostly because of human activities, and that this will lead to significant climate change during this century” (p. 497).

Interestingly, the content in Patterns of Interaction, the only non-AP-level textbook categorized as adherent, is not nearly as strongly worded, or factually accurate, as either of the AP level textbooks. The textbook states:

Scientists use the term greenhouse effect to describe problems caused by industrial pollution. Much of this pollution comes in the form of gases, such as carbon dioxide. These gases—sometimes called greenhouse gases—are the exhaust from factories and automobiles. The gases create a kind of ceiling, like the roof of a greenhouse, that traps heat near the earth’s surface. This buildup of heat near the earth’s surface causes a gradual warming of the earth’s atmosphere. (p. 679)

While this account of global warming and the greenhouse effect is inaccurate on a number of counts, the message is clear that human activity, in this case exhaust from factories and automobiles, is causing the atmosphere to warm.

Perhaps the most concise phrase that highlights the stance Adherent curricula takes toward the cause of global warming comes from the introduction essay in the AIT in the Classroom materials. In the summary of this nine-page essay the authors posit, “The important thing to remember is that humans have caused this problem, so humans should be able to fix it” (p. 21).
Is there scientific consensus about global warming?

According to the adherent textbooks and supplemental materials global warming is a wide-spread problem cause by human activity, but do experts in the field of climate science agree with these conclusions? The adherent curricula say yes. To be fair, not all of the adherent curricula make a strong argument that scientific consensus exists. The social studies textbook *Modern World History: Patterns of Interaction* is a case in point. The authors do not refer to any specific scientists, or even the IPCC, when they note, “Scientists are also worried about global warming. [...] Scientists use the term *greenhouse effect* to describe problems caused by industrial pollution” (p. 679). Clearly this is not a clarion call advancing the notion of scientific consensus; still, that there is no mention of disagreement within the scientific community implicitly signals some degree of consensus.

Much of the adherent curricula, however, take a stronger stance regarding whether the issue of scientific consensus exists. For instance, the bulk of global warming content communicated to students in the National Wildlife Federation’s *AIT in the Classroom* curriculum comes from watching the 2006 documentary *An Inconvenient Truth*, featuring the IPCC advocate Al Gore. At one point in this film, Gore asks:

Isn't there a disagreement among scientists about whether the problem is real or not? Actually, not really. There was a massive study of every scientific article in a peer reviewed journal written on global warming in the last ten years. They took a big sample of 10 percent, 928 articles. And you know the number of those that disagreed with the scientific consensus that we're causing global warming and that is a serious problem out of the 928: Zero. The misconception that there is disagreement about the science has been deliberately created by a relatively small number of people.

This message is reinforced in the background reading for the materials:

For a long time, people did not agree about whether global warming was really happening and, if it was, whether people were to blame or not. Now that has
changed. There is now irrefutable evidence that the Earth’s climate is changing and global temperatures are rising. Consensus has emerged among the majority of scientists and experts. (p. 17)

As this quotation demonstrates, the authors of An Inconvenient Truth in the Classroom not only argue that there is scientific consensus about anthropogenic climate change, but take the additional step of refuting any attempt to frame this as an open question.

AP Environmental Science textbook Living With the Environment takes a similar tack. In an early chapter in the text a special section specifically addresses the scientific consensus regarding global warming. After presenting some of the major conclusions drawn by the IPCC’s 2007 Annual Assessment Report the authors observe, “This scientific consensus among most of the world’s climate experts is currently considered the most reliable science we have on this subject” (p. 33). They continue:

As always, there are individual scientists who disagree with the scientific consensus view. Typically, they question the reliability of certain data, say we don’t have enough data to come to reliable conclusions, or question some of the hypotheses or models involved. However, in the case of global warming, they are in a distinct and declining minority. (p. 33)

Later in the text, students are confronted with the subheading, “Scientific Consensus: The Atmosphere Is Warming Mostly Because of Human Activities” (p. 500) and the authors reiterate, “There is an overwhelming consensus among the world’s climate scientists that global warming is occurring at a rapid rate, [and] that human activities are a major factor in this temperature increase since 1950” (p. 503).

To review, adherent curricula take a particular stance concerning how they answer the three framing questions I put forth at the beginning of this chapter. First, with Modern World History: Patterns of Interaction being the lone exception, adherent curricula offer a relatively
sizable amount of content regarding the potential effects of global warming. This content positions global warming as a serious and widespread problem, though the skewed predictions for sea level and temperature rise and the extreme language deployed in some adherent curricula paints perhaps an unnecessarily dour picture. Second, it treats the cause of global warming as uncontroversial: human activity. Finally, the adherent curriculum promotes the notion that climate scientists have formed consensus concerning the theory of human-induced global warming. Next, I turn my attention to the dissenting curricula, a curricula that conceptualize global warming in strikingly different ways than does the adherent curricula.

**The Dissenting Curriculum**

Dissenting curricula align most closely with the “Doubtful” category of the *Six Americas* studies; these curricula present the conclusions about global warming forwarded by the IPCC as highly suspect. Dissenting curricula acknowledge that climate change is occurring (usually by offering a reassuring statement like “climates are *always* changing”); however, global warming is not presented as a notable concern to societies or ecosystems. Also in contrast to the adherent curricula, dissenting curricula appear to present the cause of global warming as an open question: one with multiple and competing answers explaining the rise in temperatures. However, a more in-depth look reveals that these curricula take the stance that global warming is decidedly *not* caused by human activity. Finally, dissenting curricula cast serious doubt that scientific consensus exists concerning global warming. In this study, I classified only two sets of supplemental materials as dissenting.
Is global warming a problem?

Unlike the adherent curricula, dissenting curricula give scant attention to the changes in climate or the impacts on society and ecosystems often reported by the scientific community. The very limited information about problems and impacts of global warming, and the way the information is presented in the lessons, suggests that these outcomes are largely speculative or unimportant. For example, the DVD and accompanying teacher lesson plan titled *Unstoppable Solar Cycles* makes no mention of how global warming contributes to changing climates other than rising temperatures. Even this, though, is presented as unproblematic. “The Little Ice Age ended at about 1850. So over the past 150 or so years we have been in a cycle where the earth has generally been warming,” claims Dr. David Legates⁴, one of two climate experts featured in the video. “And this current climate cycle is what most people call ‘global warming’,“ concludes the narrator, thus conveying the totality of the information about rising temperatures mentioned in this curriculum. See Table 5.2 for a list of the changes to climate and the impacts of global warming mentioned in the dissenting curricula and Table 5.4 for the predictions these curricula give for rising temperatures and sea levels.

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⁴ Dr. Legates, an associate professor of Geography at the University of Delaware, has played a prominent role in the global warming skeptic movement, including signing both the Oregon Petition which asserts that there is no convincing scientific evidence of anthropogenic warming and the Evangelical Declaration on Global Warming declaring, among other things, that, “Recent global warming is one of many natural cycles of warming and cooling in geologic history.”
Table 5.4. Predictions of Temperature Rise and Sea Level Rise in the Hesitant and Dissenting Curricula

<table>
<thead>
<tr>
<th>Source</th>
<th>Predictions of changes in climate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temperature rise</td>
</tr>
<tr>
<td>IPCC Synthesis Report (2007)*</td>
<td>3.2-7.2°F</td>
</tr>
</tbody>
</table>

**Hesitant Curricula**

- **Glencoe Earth Science**
  - Temperature rise: 1.8-6.3°F
  - Sea level rise: 3mm per year

- **Holt McDougal Earth Science**
  - Temperature rise: 3.6 - 7.2°F
  - No prediction

- **Prentice Hall Earth Science**
  - Temperature rise: more than 9°F
  - No prediction

- **Prentice Hall Biology**
  - Temperature rise: 1.8-3.6°C by 2050
  - No prediction

- **Glencoe World Geography**
  - Temperature rise: 3.2-7.2°F
  - No prediction

- **Prentice Hall World Geography**
  - No prediction
  - Sea level rise: 20 in.

**Dissenting curricula**

- **Understanding Climate Change**
  - Temperature rise: 1.3-11.5°F
  - No prediction

- **Unstoppable Solar Cycles**
  - No prediction
  - No prediction

*Note. Unless otherwise noted the predictions are for the span of time ending in 2100. The temperature increases represent the rise in temperature above the 1980-1989 global average temperature.

*These numbers represent the range of the “best estimate” predictions of global average temperature considering the six emission scenarios considered in the IPCC’s 2007 Synthesis Report. The likely rise in temperature using the range of all emission scenarios is 2-11.5°F.

Understanding Climate Change also paints global warming and its associated effects as unproblematic. To be fair, this material mentions the average rise in temperature and offers a prediction of future warming—approximately 5.4°F— that is in line with that of the IPCC.

Additionally, one lesson in Understanding Climate Change considers the possibility that extreme weather events, in particular hurricanes, are increasing in number and intensity, while another mentions a rise in sea level and alludes to a potential for food security issues in the future;
however, none of these are positioned as urgent problems. For example, that sea levels are predicted to rise and that warming global temperatures will likely make food security an issue are mentioned only once—in bullet point form on the last page of the 109 page curriculum.

The point of the lesson highlighted above is not even to inform students about the potential impacts of global warming (i.e. an increase in extreme weather events). Rather, the purpose of the lesson is to “help students to better understand how researchers present their findings, and [illustrates] how truncated data sets, missing information about raw numerical data, and data sets that have not been normalized can result in misleading conclusions” (p. 74). After analyzing a graph of the number of category three, four, and five hurricanes in the Atlantic Ocean per year from 1944-1977, students are asked to write a response to the question, “Does this data [sic] support the hypothesis that climate change caused by human activities has affected the intensity and frequency of hurricanes?” The teacher’s edition of the handout provides the “right” answer: “No. This data [sic] does not provide enough evidence to demonstrate a correlative or causative relationship between hurricanes and climate change” (p. 89).

Interestingly, the dissenting curricula, like the adherent curricula, position global warming as a problem for economically impoverished groups. However, how global warming is a problem for the poor is conceptualized very differently. For instance, the narrator of *Unstoppable Solar Cycles* (2008) explains, “From what I’ve heard the cost to reduce CO₂ will be enormous and, as the scientists said, this may not be the cause. We could create disaster for poor countries and hardship for all of us and not change the pattern of warming and cooling.” *Understanding Climate Change* (2009) conveys a comparable sentiment. According to this set of materials, not only would those in developed nations pay more if energy costs went up due to
attempts to reduce carbon dioxide emissions, but those in developing countries would be harmed as nations spend money on mitigation efforts rather than current development efforts like providing potable water, malaria prevention, and agriculture advancements.

Is human activity causing global warming?

Global warming is not considered a pressing problem in dissenting materials. The changes to climate and impacts to societies and ecosystems are largely ignored or trivialized despite the content found within the IPCC’s 2007 Synthesis Report. Similarly, dissenting materials arrive at their own conclusion about the cause of global warming, and this conclusion stands in contradiction to the most current scientific understanding supporting the theory of human-induced global warming.

At first glance, the cause of global warming as conceptualized by dissenting curricula appears to be an open question: scientists are uncertain about what is causing global warming. For example, in Understanding Climate Change students read, “Whether carbon dioxide emissions resulting from human actions have contributed to climate change is a matter of intense debate” (p. 22). Within the same reading the authors note, “Current research is focused on the role of CO₂ and other greenhouse gases in climate change; however, scientists are also exploring other factors and, in doing so, are helping us to refine our understanding of the climate system.” Similarly, in the DVD Unstoppable Solar Cycles, the young teen narrator proclaims, “Today an important question is, ‘What’s really causing global warming?’ We’re told it’s CO₂ but I was surprised to learn it could be something else. We certainly need to find out the truth. Some of my friends think the debate is over. Now I’m not sure.”
Upon further analysis, however, the open status of the question appears disingenuous given the significant amount of space these materials give to refuting the scientific evidence supporting human-induced global warming. Instead, dissenting curricula conceptualize a “right answer” to this question: human activity does not cause global warming. On multiple occasions dissenting materials give students reason to doubt that human activity causes global warming. Consider the following, taken from a lesson plan rationale in Understanding Climate Change: “This lesson emphasizes that, even with advanced technology, there is still much that is uncertain about climate change. This lesson shows that there are natural forces that inevitably cause glacial periods as well as warming periods, irrespective of human activities” (p. 54). Within this lesson students learn about the sun as “the most significant influence on earth’s climate. Thus, when we study climate change, it is important to consider the various factors that affect the amount of solar radiation that reaches the earth” (p. 56). In another lesson, designed to caution students against the assumption that correlation equals causation, students are presented with a commonly used graph illustrating the estimated carbon dioxide and temperature levels in Antarctica over the past 650,000 years. The graphs appear to match closely; when the carbon dioxide level goes up, the temperature also appears to rise. The student reading accompanying this graph warns students of two important points:

First, it shows that climate changes over time. It has done so for hundreds of thousands of years and will continue to do so, regardless of human behavior.

Second, it shows that temperatures rose, on average, 800 years before carbon dioxide levels rose. Temperatures peaked and began to fall before carbon dioxide levels fell. Thus, temperatures do not appear to have risen because of changes in atmospheric levels of CO₂. The relationship between these two variables demonstrates that correlation does not imply causation.
Unstoppable Solar Cycles (2008) follows a related pattern of treating the cause of global warming as open on the surface, yet providing only content that refutes the IPCC’s conclusion that human activity is largely to blame. For example, Dr. Willie Soon\(^5\), the other scientist featured alongside Dr. Legates in the DVD, argues:

> It’s very, very difficult, in my opinion, to try to insist and suggest that carbon dioxide, even as of today when we emit this carbon dioxide, is going to drive the climate system. This is a complete false picture and there is no such scientific basis to support that.

The producers of the 13-minute DVD marshall evidence to strengthen their claim that natural oscillations in the energy Earth receives from the sun are causing the recent global warming. For instance, they point toward historical data that indicates the level of carbon dioxide in the atmosphere goes up after temperatures go up. Dr. Legates and Dr. Soon offer the only explanation for this evidence: that the sun and changes in solar output are responsible for changes in Earth’s temperature. Again, the narrator, summarizes:

> Narrator: Variations in radiation from the sun would logically contribute to variations in temperature and climate on earth. Dr. Soon says this is important when we’re trying to understand climate patterns. One thing is certain--the sun’s natural cycles are a primary driver of natural climate cycles here on earth.

That the authors of Unstoppable Solar Cycles consider the cause of global warming a closed question is further emphasized in the list of 20 discussion questions they provide at the end of the lesson. Teachers are directed to use the questions as discussion prompts in class or to

\(^5\) Dr. Soon is widely known as a leading advocate in the climate change skeptic movement. Funding for much of Dr. Soon’s work has been traced to a number of big oil organizations including ExxonMobile and the American Petroleum Institute. Though he has no formal training in climate science, Dr. Soon has published work and given Congressional testimony concerning the cause of recent global warming, taking the position that human activity is not the primary driver of global warming. See greenpeace.org for a detailed account of Dr. Soon’s funding sources and position on global warming.
assign them as homework. Instead of fostering an open exchange of ideas, these questions serve
to reinforce the messages of the DVD. Consider the first five questions:

1. What different theories might explain the climate changes that wiped out the Vikings in Greenland and caused the Thames River in England to freeze over? Could humans have caused those changes?
2. The best available records of temperature and atmospheric CO2 show that over the past 650,000 years temperature has always increased before CO2 increased. What does that indicate about the cause of previous climate changes?
3. According to the scientists interviewed, how important is atmospheric CO2 in driving climate change? What do they believe is the primary cause of earth’s climate fluctuations?
4. Should we only learn about what some scientists and political leaders believe? Should other views be taken into account? Why/why not?
5. Can you think of significant ideas that were once widely held to be true but were later found to be false? Give examples.

Though it is not explicitly stated, the message here seems clear: Human activity did not cause the recent global warming.

Is there scientific consensus about global warming?

Despite empirical evidence to the contrary (cf. Anderegg, et al., 2010), one of the most notable features of the dissenting materials is they communicate the scientific consensus about global warming as tenuous or non-existent. Moreover, the two sets of dissenting materials I analyzed go a step further and adopt a conspiratorial tone regarding the documented consensus supporting the theory of anthropogenic global warming.

Beginning with the first lesson of the Fraser Institute’s Understanding Climate Change and continuing in several of the subsequent lessons, learners are told that many scientists disagree with the major findings of the IPCC. “Although still incomplete,” the introduction to lesson one reads, “our scientific knowledge of climatology has increased tremendously in just the past few decades. However, hypotheses about climate change abound, and despite the popular
media conception of consensus, the issues are far from settled” (p. 3). The background essay meant for teachers to read before implementing a lesson titled “Understanding Changes in Climate Conditions” informs teachers, “…many scientists who once thought human activities caused climate change are no longer certain that that is the case” (p. 49). The next paragraph drives the point home:

Even scientists who have worked with the United Nations Intergovernmental Panel on Climate Change (IPCC) are raising doubts about a climate crisis. In a January 2007 TV interview, scientist Richard Linden of the Massachusetts Institute of Technology said that fears of human-made climate change are “silly.” (p. 49)

According to the lesson plan, the purpose of this lesson is to “[emphasize] that, even with advanced technology, there is still much that is uncertain about climate change” (p. 54). The lesson begins with students looking at a series of headlines from *Time* magazine and *The New York Times* that demonstrate the various ways experts predicted climates would change from the 1920s onward. The teacher prompt for this visual reads:

In the early 1900s, some people were concerned that the world was entering an ice age. By the 1930s and 1940s, the media reported that the world was warming but by the 1970s, the focus was again on cooling. There have been cooling and warming trends throughout history. Over time, technology will improve, new data will become available, and better models will be designed to help us understand climate. (p. 54)

Students who watch the DVD *Unstoppable Solar Cycles* are confronted with a similar message portraying scientists as uncertain about the major findings of the IPCC. Upon hearing Dr. Legates and Dr. Soon hypothesize about solar cycles as responsible for global warming, the narrator posits:

Do we really understand what’s happening? We are urged to accept just one theory--that human-generated CO2 is the principal [sic] cause of global warming. Yet these and other scientists point to other possible causes. The journal of *Physics and Society*, which is a publication of The American Physical Society with a membership of over 50,000 physicists, now welcomes debate of the question. (video transcript, p. 5)
Both sets of dissenting materials indicate a lack of scientific consensus concerning the cause of global warming. They take a more conspiratorial tone when they imply the major findings of the IPCC are not to be trusted. For example, in *Unstoppable Solar Cycles*, Dr. Soon proclaims, “Those views [of anthropogenic global warming] are indeed promoted by political bodies which is the Intergovernmental Panel for Climate Change. And there appears to be a corrupted process, in my opinion, of the bodies.” Later in the video, while talking about the work produced by the IPCC, Dr. Legates, another climate scientist, continues:

There’s a science document which is really written by scientists for scientists. There’s also a summary for policy makers. It’s put together by policymakers and in many cases they go back to the scientist and say, ‘Can you change the science document to match our summary? We want to beef this up.. we want to make it look worse.’ That’s not the way science is done. (video transcript, p. 5)

Equally doubtful of the motives of mainstream climate scientists, *Understanding Climate Change* offers a lesson titled “Data Mining.” The purpose of this lesson is “to help students better understand how data are presented and how data are used to test a hypothesis. Students will learn that data can be misused, whether by a selective use of data subsets or by graphing and charting tricks” (p. 69). No doubt that these are important ideas for students to learn about; however, one has to question the authors’ motivations when they decide to use a series of graphs widely used to display evidence supporting the theory of anthropogenic climate change to make the point that “it is possible to mislead an audience using various graphing techniques, even if the same data are used” (p. 90). Implied in both sets of dissenting supplemental materials is that climate scientists, or at least those contributing to findings endorsed by the IPCC, use nefarious methods to curry public support for their theories.
In summary, dissenting curricula offer students a conceptualization of global warming running counter to what experts in the field of climate science have come to believe. Indeed, these materials imply climate science experts may be more con-artist than expert. Dissenting materials position global warming as a natural phenomenon, not something caused by human activity, and certainly not a high-priority problem. Compared to the adherent curricula, the dissenting curricula provides far less specific content regarding the potential effects of global warming on human society and ecosystems. Furthermore, despite empirical evidence suggesting otherwise, dissenting materials do not acknowledge the overwhelming scientific consensus about human-induced global warming.

**The Hesitant Curriculum**

Supplemental materials in this study fall on the opposite ends of the spectrum of Maibach et al.’s (2009) *Six Americas* research: the adherent curricula speak to the “alarmed” and “concerned” segments of the population while the dissenting curricula channel the “doubtful” and “dismissive” voices. However, six of the nine textbooks in my analysis fit somewhere in between these polarized positions. These are what I call the hesitant curricula and they align most closely to how the “cautious” segment of the *Six Americas* conceptualizes global warming. Hesitant curricula usually treat global warming as a problem, albeit a problem requiring little urgency to address. The cause of global warming, according to these curricula, is considered an open question: human activity might be to blame, though this is debatable. Furthermore, hesitant curricula, like the dissenting curricula, reinforce the false notion that climate science experts disagree a great deal about global warming.
One of the more striking features of the hesitant textbooks is the wide range in amount of space given to cover global warming, particularly within the Earth Science and World Geography texts (the two “intellectual homes” for global warming within each of the broader fields of science and social studies). For instance, *Glencoe World Geography* contains 57 sentences spread throughout six different sections of the text, while *Prentice Hall World Geography* hosts just 19 sentences spaced over four different sections. Turning to Environmental Science texts, *Glencoe Earth Science* gives 154 sentences over to global warming content, but *Prentice Hall Earth Science* contains just 54 sentences about global warming.¹⁶ Regardless of the amount of global warming content a hesitant text may contain, in this section I demonstrate that none of the them end up relaying much information about the phenomenon at all.

**Is global warming a problem?**

Hesitant materials provide only limited coverage of the physical changes to climate systems brought about as the atmosphere warms (i.e. rising temperature, rising sea levels, increase in extreme weather events, and changes in precipitation patterns) and the five broad areas impacted by global warming (ecosystems, water resources, food resources, human health, and settlements and society). Moreover, hesitant curricula have a tendency to geographically distance the problems of global warming from their intended audience of U.S. students. The overall effect is that these materials position global warming as much less dangerous (at least to American youth) than the adherent curricula convey. Refer to Table 5.2 for the changes to climate and the impacts of global warming mentioned in the examples of hesitant curricula.

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¹⁶ Compare these sentence counts to those of the AP level texts: 119 sentences in *Human Geography: Landscapes of Human Activities (11th Ed.)*, and 696 sentences in *Living in the Environment (16th Ed.)*
Changes most often referenced in the textbooks are a rise in temperatures and a rise in sea level. Nearly all of the hesitant materials provide a prediction for how much the average global temperature will rise, though only *Prentice Hall World Geography* provides a prediction for the amount the sea level will rise. Notably, the temperature predictions offered in the hesitant curricula align more closely with the IPCC’s best estimates than the predictions given in the adherent curriculum. Table 5.4 shows the temperature and sea level predictions in the hesitant curricula.

Often, hesitant curricula understate the changes to climate. For example, *Glencoe World Geography* informs students “[... ] scientists who study [global warming] warn that the increase in temperature will cause glaciers and ice caps to melt, raising the level of the world’s oceans” (p. 110). Only one other sentence, 223 pages later, returns to the not insignificant problem of rising sea levels: “A warmer climate will melt polar ice caps and mountain glaciers, causing ocean levels to rise and submerge coastal areas” (p. 333). *Holt McDougal Earth Science* (2010) proffers, “If a significant amount of ice melts, sea levels around the world could rise,” and follows that by stating, “As sea level rises, shorelines could shift inland many miles.” The lack of detail about who and what might be affected by the rise in sea level, how much sea levels are predicted to rise, and the rate sea levels might rise is common among the hesitant textbooks.

The treatment hesitant textbooks give to the change in precipitation patterns is similarly vague. Consider the only information in *Holt McDougal Earth Science* concerning changes in precipitation patterns:

An increase in global temperature can lead to an increase in evaporation. Increased evaporation could cause some areas to become drier than they are now. Some plants and animals would not be able to live in these drier conditions. An increase in evaporation in other areas could cause crops to suffer damage. (p. 679)
*Prentice Hall Biology* (2008) is just as imprecise about changes to precipitation patterns when it informs students that “Some [climate change] models suggest that parts of North America may experience more droughts during the summer growing season” (p. 159).

For hesitant materials, the inclusion of the IPCC’s five broad areas impacted by changes to the climate is far less robust than that of the adherent curricula. For example, food security issues, like the decline of worldwide crop yields due to desertification, receive attention in just one social studies text and one science text. That global warming will impact the amount and quality of freshwater resources gets a total of one sentence of coverage among all hesitant textbooks: “[...] and freshwater and agricultural land resources would be diminished (*Holt McDougal Earth Science*, p. 619). Moreover, hesitant textbooks altogether ignore the impact that global warming is having on human health, such as the spread of disease vectors and the increasing heat-related deaths.

Hesitant materials lack substantial information about what is happening due to global warming; they also reveal few details indicating who global warming will impact. Perhaps most interesting is the lack of attention hesitant textbooks give to how the U.S. will be affected by global warming. For instance, when textbooks are not using generic descriptions of places affected by global climate change, like “coastal” or “low-lying”, they position the impacts as occurring far away from the continental U.S. in places like Oceania and the South Pacific. The places hesitant textbooks most often specifically refer to are in distant locations in Arctic climes like regions of Alaska and Siberia. Two textbooks, *Glencoe Earth Science* and *Holt McDougal Earth Science* host enrichment pages specifically dedicated to global warming in the Arctic. The *Glencoe* text pays particular attention to how the impacts of global warming are changing Inuit
culture, while the \textit{Holt McDougal} text covers the much publicized plight of polar bears as they adjust to warmer temperatures. Importantly, four of the six hesitant textbooks make no reference to specific locations within the continental U.S. The upshot is that the hesitant curricula’s lack of detail about global warming and focus on locations far removed from most U.S. students’ actual lives detracts from any sense of global warming as a problem for residents of the U.S.

\textbf{Is human activity causing global warming?}

One way of understanding how textbooks are conceptualizing the cause of global warming is to look at how they define the term. Looking at all textbooks analyzed in this study, including those classified as adherent, six of the nine texts included an entry for the term “global warming” within the glossary. Only one of the five hesitant textbooks providing a definition of global warming is a social studies textbook; the remaining four are science texts. This alone hints at the relative (un)importance of the topic in general within the social studies. Two of the texts provide no hint at the cause of global warming in their definition: global warming is simply defined as an increase in the average temperature of the Earth. Three of the textbooks, one social studies and two science texts, include a phrase that attributes the cause of global warming to either pollution or an increase in the level of carbon dioxide. \textit{Glencoe Earth Science} (2008) goes so far as to mention that the increase of carbon dioxide comes from human activities. Two of these texts, though, are tentative in their attribution--a rise in the level of carbon dioxide \textit{might} be responsible for the rise in temperatures. See Table 5.5 for the definitions of global warming.
### Table 5.5. Textbook Glossary Definitions for the Term Global Warming

<table>
<thead>
<tr>
<th>Conceptual Category and Title</th>
<th>Definition of “global warming” in glossary</th>
<th>cause(s) of global warming in definition</th>
<th>cause tentative or certain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hesitant textbooks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Glencoe Earth Science</em></td>
<td>rise in global temperatures, which might be due to increases in atmospheric CO2 from deforestation and burning of fossil fuels</td>
<td>increases in atmospheric CO2 from deforestation and burning of fossil fuels</td>
<td>tentative (might be due...)</td>
</tr>
<tr>
<td><em>Holt McDougal Earth Science</em></td>
<td>a gradual increase in average global temperature</td>
<td>X</td>
<td>n/a</td>
</tr>
<tr>
<td><em>Prentice Hall Earth Science</em></td>
<td>the increase in average temperatures of Earth and the atmosphere due in part to increased carbon dioxide levels.</td>
<td>increased carbon dioxide levels</td>
<td>certain (due in part...)</td>
</tr>
<tr>
<td><em>Prentice Hall Biology</em></td>
<td>increase in the average temperatures on Earth</td>
<td>X</td>
<td>n/a</td>
</tr>
<tr>
<td><em>Glencoe World Geography</em></td>
<td>gradual warming of the Earth and its atmosphere that may be caused in part by pollution and an increase in the greenhouse effect</td>
<td>pollution and increase in greenhouse effect</td>
<td>tentative (may be caused in part...)</td>
</tr>
<tr>
<td><em>Prentice Hall World Geography</em></td>
<td>None</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Adherent textbooks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Living in the Environment, 16th Ed.</em></td>
<td>Warming of the earth’s lower atmosphere (troposphere) because of increases in the concentrations of one or more greenhouse gases. It can result in climate change that can last for decades to thousands of years.</td>
<td>increases in the concentrations of one or more greenhouse gases</td>
<td>certain (because of...)</td>
</tr>
<tr>
<td><em>Human Geography: Landscapes of Human Activity, 11th Ed.</em></td>
<td>None</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><em>McDougal Littell Modern World History: Patterns of Interaction</em></td>
<td>None</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Aside from the definitions put forth by some hesitant textbooks, the content included within hesitant curricula positions the question of whether human activity causes global warming as open. Both human activities and a number of natural events are considered potential causes of global warming. For example, *Holt-McDougal Earth Science* reads “Global temperatures have increased approximately 1°C over the last 100 years. Researchers are trying to determine if this increase is a natural variation or the result of human activities, such as deforestation and pollution” (p. 619). Moreover, the subsection in this textbook discussing the potential role of human activity in global warming is couched within a larger section titled “Potential Causes of Climate Change,” sandwiched between subsections on the other potential causes including orbital activity and volcanic activity.

*Glencoe Earth Science* conveys a comparable message. A special “Earth Science and Technology” supplemental page about modeling global warming begins by asking, “...what causes global warming?” (p. 751) and concludes “natural changes and greenhouse gas increases together” are responsible for the observed rise in temperature. While this is an accurate conclusion, other passages in the book indicate this issue is far from settled. For instance, the authors write, “Some scientists hypothesize that natural cycles adequately explain the increased temperatures. Mounting evidence suggests that the rate of global temperature changes over the past 150 years is largely due to human activity” (p. 394), and “Other scientists, however, assert that humans have not kept weather records long enough to tell to what extent the present rate of global warming is an artificial or a natural phenomenon” (p. 744)

*Glencoe World Geography* (2012) is an interesting example of hesitant curriculum because it imparts a bipolar message about the cause of global warming. Like the textbooks
discussed above, when global warming is first introduced in this text the authors state that it is
*believed* to be caused in part by human activity. The authors hedge two paragraphs later,
however, when they write, “Scientists do not all agree on the nature of global warming and its
effects. Some claim that a natural cycle, not human activity, is causing rising temperatures.
Others claim that the evidence for global warming is inconclusive and that it is too early to
forecast future effects” (p. 53). What is so interesting about this textbook is that later mentions
of global warming take a decidedly adherent stance. For instance, in a section about
environmental concerns in Europe the text presents global warming to be distinctly human-
induced problem when they write, “The burning of fossil fuels has raised the amounts of carbon
dioxide in the atmosphere, increasing global temperatures. [...] a trend called global
warming” (p. 333). When discussing human-environment interactions in North America the
authors state:

> Most experts agree that human activity has most likely accelerated warming
trends. The clearing of forests and the burning of fossil fuels result in the
greenhouse effect. In fact, the level of carbon dioxide in the atmosphere is higher
now than it has been for thousands of years. (p. 176)

However, in the book’s final mention of global warming the authors return to their
original position that the cause is uncertain: “Scientists in the region, especially in
Antarctica, are studying global warming and are hoping to discover causes, predict
consequences, and provide solutions” (p. 846).

Some hesitant materials actively encourage students to consider factors other than
human activity as the primary driver of global warming. Though *Prentice Hall Earth
Science takes a fairly strong stance about the human-induced cause of global warming. An inquiry activity at the beginning of the chapter containing much of the content on climate change situates the cause of global warming as an open question. Under the title, “Global Warming: What Is Causing It?” a paragraph explains:

Global warming is one of the most hotly debated environmental issues. The world is getting warmer. Do we need to worry about it? How much warming is due to human activities? In this activity, you will gather evidence and decide for yourself. (p. 587)

Students are directed to use the internet to gather three articles that present the view that global warming is due to human activities and three articles that claim natural causes are to blame and then formulate their own opinion on the matter.

My analysis suggests hesitant curricula position the cause of global warming as an open question. Despite the empirical evidence supporting the theory of anthropogenic global warming, students learning about global warming via these textbooks are allowed to arrive at their own conclusions concerning its causes. What of the notion of scientific consensus regarding the matter?

Is there scientific consensus about global warming?

Depending on the textbook, scientists are in disagreement regarding the cause of global warming and, in some cases, whether global warming is happening at all. Glencoe Earth Science, for example, communicates, “Based on available temperature data, many scientists agree that global warming is occurring. They disagree, however, about what is causing this warming” (p. 394). Others communicate that both the cause and the actual phenomenon of

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7 For example, the authors write, “The amount of carbon dioxide in the atmosphere has increased since industrialization began in the nineteenth century. This increase has altered the carbon cycle and contributed to the unnatural warming of the lower atmosphere, known as global warming,” (p. 110).
global warming are contested within the scientific community. For instance, according to the authors of *Glencoe World Geography*:

> Scientists do not all agree on the nature of global warming and its effects. Some claim that a natural cycle, not human activity, is causing rising temperatures. Others claim that the evidence for global warming is inconclusive and that it is too early to forecast future effects. (p. 53)

In another passage about global warming in the same textbook, students are confronted with a comparable message that reads, “Some scientists believe that rising levels of carbon dioxide in the atmosphere are contributing to a general increase in the Earth’s temperature, a trend called global warming. Although not all people agree that global warming is occurring, scientists who study it warn...” (p. 110).

An interesting observation concerning all of the hesitant textbooks—and underscoring the general lack of detailed content within them—is their failure to recognize specific scientists or scientific bodies prominent in the global warming discourse. These texts make generous use of terms like “Many scientists,” and “Some scientists”; however, only the AP level textbooks--both categorized as adherent--make any mention of the IPCC.

In review, the hesitant curricula is similar to the dissenting curricula in two ways. First, the hesitant curriculum offer little in the way of content concerning the effects of global warming and the predicted impacts on human societies and ecosystems. Second, the hesitant curricula portray wide disagreement among climate scientists concerning the cause—and in some cases the existence—of global warming. The hesitant curricula stand apart from the adherent and dissenting curricula in that they treat the cause of global warming as a genuinely open question. According to these curricula, some evidence suggests human activity plays a role, but other evidence indicates natural cycles are the blame.
Chapter Summary

In this chapter I used three questions central in the debate about global warming currently raging among the U.S. public to frame my analysis of the curricula: 1) is global warming a problem? 2) is global warming caused by human activity, and 3) is there scientific consensus about global warming? From this analysis I developed three categories of global warming curricula, the adherent, the hesitant, and the dissenting, and illustrated their distinguishing characteristics. The adherent curricula align most closely with the views of the scientific consensus and offer the most content, relatively speaking, about the predicted effects and problems associated with global warming. The content in some adherent curricula use language framing global warming in catastrophic terms and present predictions skewed towards the high end of scientists’ predictions. The dissenting curricula acknowledge that global warming is happening though it is not considered to be a problem nor is it presented as something human activity has exacerbated. Any consensus that exists indicating otherwise is the product of the IPCC’s nefarious consensus building process or active manipulation of data by scientists to gain public support. Finally, the hesitant curricula consider global warming a problem, though it is not one of immediate concern. Furthermore, what is causing the problem is not well understood: this is an open question, one which scientific consensus has not yet formed around.

In the next chapter I turn my attention towards how the adherent, hesitant, and dissenting curricula answer a fourth question prevalent in debates about global warming: What should we do about it?
Chapter Six: How Should We Respond to Global Warming?

Recall that the various *Six Americas* segments theorized by Maibach, et al. (2009) correlate with different worldviews. Those doubtful and dismissive of global warming are more likely to be conservative, hold individualist values, and have strong traditional or evangelical religious values while those who are alarmed and concerned about global warming are more often liberal and hold egalitarian and environmental values. In line with what thinking in the cultural theory of risk perception (Schwarz and Thompson, 1990) predicts, it should come as no surprise that those occupying the ends of the *Six Americas* spectrum think quite differently concerning what society should do about global warming. For example, 56 percent of Democrats agree that global warming should be a very high or high national priority but only 19 percent of Republicans prioritize global warming as such (Leiserowitz, et al., 2011b). To be sure, some policies, like establishing a cap and trade system for carbon dioxide emissions and raising the gasoline tax, are unpopular among all segments of the U.S. population, while others, like individual tax rebates for buying solar panels and support for research into renewable energy, enjoy wide popularity across segments. Still, the alarmed and concerned segments of the population are far more likely to privilege policies that protect the environment over those that promote economic growth and the doubtful and dismissive segments hold the opposite view (Maibach, et al.).

In the previous chapter I offered a framework for thinking about how curricular materials conceptualize the topic of global warming. The categories of my framework correlate with the opinions held by various segments in Maibach, et al.’s (2009) *Six Americas* research. Adherent curricula, like the alarmed segment of the population, position global warming as something that
experts agree on: that it is an immediate and widespread threat caused by human-activity.

Hesitant curricula give voice to the cautious segment of society by treating global warming as something to potentially be concerned about and considering the question of what causes global warming to be open and widely debated among the scientific community. Dissenting curricula are in tune with those doubtful or dismissive of global warming and consider global warming to be a natural phenomenon that should be of little immediate concern. In this chapter, I consider how adherent, hesitant, and dissenting global warming curricula tackle the question “What should we do about global warming?” What strategies to address global warming, if any, do textbooks, supplemental materials, and teachers mention and who (or what) is responsible for leading the charge to address global warming?

With these questions in mind, I make two claims. First, global warming curricula privilege mitigation strategies to deal with global warming at the expense of having students consider a broader range of strategies including adaptation and geo-engineering. Second, notable differences exist among the curricula concerning which sector of society should take the lead in responding to global warming and its associated threats. On one hand, adherent and hesitant curricula emphasize the role of the government and individuals to take action. On the other hand, according to the dissenting curricula the government has no place in addressing global warming. Furthermore, an analysis of the social studies and non-social studies curricula reveals equally disparate ideas of which sector should lead global warming mitigation efforts. Social studies materials highlight governmental action whereas non-social studies materials put individual action and conservation efforts in the fore.
Strategies for Responding to Global Warming

Experts in the area of climate change recognize three broad sets of strategies, aside from doing nothing at all, to deal with global warming and its effects. One set of strategies, collectively referred to as mitigation strategies, centers on reducing the amount of carbon dioxide in the atmosphere. Pursuing this strategy would check the rising global average temperature and diminish or halt some of resulting changes to climate, ecosystems, and societies, or so the thinking goes. Some examples of mitigation efforts include creating international agreements limiting countries’ greenhouse gas emissions, establishing markets for businesses to buy and sell carbon dioxide emission allowances, developing technologies that reduce or eliminate the need to burn fossil fuels for energy, and energy conservation efforts.

Adaptation strategies comprise a second group of responses to global warming. These responses are deployed in order to prepare societies for living with what scientists anticipate to be a rapidly changing climate. For instance, settlements on the coast might build walls to keep out the rising seas, the private sector might begin constructing buildings and infrastructure able to withstand increasingly intense storms or developing genetically modified crops able to withstand severe drought conditions, and individuals might relocate from areas that have a high risk of flooding.

Finally, a third set of strategies falls under the label “geo-engineering.” Geo-engineering refers to any planetary-scale climate control project designed “to manipulate the physical functioning of the Earth’s system in such a way as to achieve a stated climatic goal or to limit a feared climatic disturbance” (Hulme, 2009, p. 25). Seeding the oceans with iron to encourage the growth of carbon dioxide consuming algae, placing a system of mirrors in low-Earth orbit to
decrease the amount of the sun’s energy that reaches the planet, and deploying machines that filter carbon dioxide directly from the atmosphere are examples of geo-engineering.

Addressing global warming and its effects may take a combination of all of these strategies. In other words, mitigation, adaptation, and geo-engineering strategies should not be considered mutually exclusive endeavors.¹ The textbooks and supplemental curricula tell a different story.

**Mitigation strategies.**

Broadly speaking, the global warming curricula privilege mitigation strategies while ignoring adaptation and geo-engineering strategies. In fact, 13 of the 17 total curricula analyzed (including textbooks and supplemental materials) note at least one mitigation strategy, yet just three of 17 mention adaptation strategies and none bring up geo-engineering as a viable strategy. On top of this, the number of specific strategies noted within the adherent, hesitant, and dissenting curricula varies tremendously. For example, the adherent materials and textbooks mention on average 4.2 categories of strategies each, the hesitant curricula mention 1.8 categories of strategies each, and dissenting materials mention two strategies each.² Table 6.1 shows the specific strategies noted in each of the adherent, hesitant, and dissenting textbooks and supplemental curricula.

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¹ Some climate experts are leery of geo-engineering strategies on the grounds that untested strategies that alter the Earth’s systems on a planetary scale are inherently dangerous not to mention they fail to address the root of the problem (human-induced greenhouse gas emissions). However, other experts--often holding strongly individualist and hierarchical worldviews--recognize geo-engineering as a legitimate course of action.

² The average number of strategies mentioned within the dissenting curricula, two, is slightly misleading. First, I only found and analyzed two sets of dissenting materials, only one of which, *Understanding Climate Change*, noted any strategies at all. Of the four strategies brought up in *Understanding Climate Change*, the authors position three of them as tactics that should not be pursued. I discuss this phenomenon at greater length later in this chapter.
Table 6.1. Overview of Strategies to Address Global Warming Presented in Adherent, Hesitant, and Dissenting Curriculum

<table>
<thead>
<tr>
<th>Conceptual Category and Title</th>
<th>Mitigation strategies</th>
<th>Adaptation strategies</th>
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<tbody>
<tr>
<td></td>
<td>Kyoto Protocol</td>
<td>cap-and-trade</td>
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<tr>
<td>Adherent Curricula</td>
<td></td>
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<tr>
<td>Climate Change: Connections and Solutions</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Living in the Environment, 16th Ed.</td>
<td>x</td>
<td>x</td>
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<tr>
<td>An Inconvenient Truth in the Classroom</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Global Environmental Problems</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Climate Change: A Wisconsin Activity Guide</td>
<td></td>
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<tr>
<td>Human Geography: Landscapes of Human Activity, 11th Ed.</td>
<td>x</td>
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<tr>
<td>Global Warming 101</td>
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<tr>
<td>Deliberating in a Democracy: Global Climate Change</td>
<td>x</td>
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<tr>
<td>McDougal Littell Modern World History: Patterns of Interaction</td>
<td>x</td>
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### Table 6.1 (continued). Overview of Strategies to Address Global Warming Presented in Adherent, Hesitant, and Dissenting Curriculum

<table>
<thead>
<tr>
<th>Conceptual Category and Title</th>
<th>Mitigation strategies</th>
<th>Adaptation strategies</th>
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<tbody>
<tr>
<td></td>
<td>Kyoto Protocol</td>
<td>cap-and-trade</td>
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<tr>
<td><strong>Hesitant curricula</strong></td>
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<tr>
<td><em>Glencoe Earth Science</em></td>
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<tr>
<td><em>Holt McDougal Earth Science</em></td>
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<tr>
<td><em>Prentice Hall Earth Science</em></td>
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<tr>
<td><em>Glencoe World Geography</em></td>
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<tr>
<td><em>Prentice Hall World Geography</em></td>
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<tr>
<td><em>Prentice Hall Biology</em></td>
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<tr>
<td><strong>Dissenting curricula</strong></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td><em>Understanding Climate Change</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Unstoppable Solar Cycles</em></td>
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Using green technology is one of two mitigation strategies mentioned most often within the global warming curricula. According to my coding strategy, using green technologies (brought up in nine of the 16 curricula) includes developing alternative and renewable energy sources and employing carbon capture and storage (CCS) technology in power plants and other large-scale emitters of greenhouse gases. For example, in the background reading that serves as an introduction to the Wisconsin Department of Natural Resource’s (DNR) Wisconsin Climate Change Activity Guide lessons students read:

Using alternative energy sources that emit no or few greenhouse gases will allow people to shift to a new way of living that better protects the global climate. In addition to solar, wind, and hydroelectric alternative energy sources, biomass, and biofuel are receiving increased attention. (p. 8)

Other materials, like An Inconvenient Truth in the Classroom (AITC) note CCS--the process of capturing carbon emissions from power plants and storing them deep underground--is an emerging technology “with promise.” Students reading the AP Environmental Science textbook Living in the Environment also learn about CCS; however, the authors of this text put forth a very different conclusion about this strategy. Rather than positioning CCS as an encouraging new development the authors of Living in the Environment conclude that it is rife with problems and imply that coal companies advocate for CCS in order to remain a relevant industry. “To coal companies,” they write, “CCS is the wave of the future that will help keep them in business. To scientists...CCS is an extremely risky output solution to a serious problem that can be dealt with by using a variety of cheaper, quicker, and safer input approaches” (p. 517).

The strategy of energy conservation also receives mention in nine of the 16 global warming curricula. Coding for conservation strategies included a wide range of examples from promoting the general idea of energy conservation to much more concrete activities. For instance, the
authors of Prentice Hall *Biology* simply state, “People can make wise choices in the use and conservation of resources” (p. 160). A number of other materials including The Will Steger Foundation’s *Global Warming 101*, on the other hand, give a number of specific strategies to conserve energy such as “turn down your water heater thermostat,” “whenever possible, walk, bike, carpool, or use mass transit,” and “buy energy-efficient compact fluorescent bulbs for your most used lights” (p. 19).

Perhaps the most politically-charged mitigation strategy is the Kyoto Protocol. Due to the widespread ramifications of global warming international cooperation is thought to be paramount for effectively mitigating greenhouse gas emissions. The 1997 Kyoto Protocol, an international agreement binding developed countries to meet certain goals in reducing their greenhouse gas emissions by 2012, is thus far the pinnacle of international cooperation concerning the problem of global warming. One hundred and ninety countries have ratified the protocol, the notable exceptions being the United States and Canada.\(^3\)

The American public does not suffer from a lack of awareness about the Kyoto Protocol. The media has covered the Protocol from many angles (a quick search through the New York Times online archives came up with over 120 articles written about the Protocol since 1999 appearing in that paper alone) and liberal and conservative voices on the national scene routinely champion or chastise it. American voters are at least familiar enough with the idea of an international treaty to have an opinion on the matter. In fact, 65 percent of US registered voters support the US signing an international treaty requiring the nation to substantially cut carbon dioxide emissions (Leiserowitz, et al., 2011b).

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\(^3\) Canada had originally ratified the Kyoto Protocol; however, in late 2011 it withdrew from the treaty.
Given the attention that the Kyoto Protocol attracts, whether positive or negative, it is not unreasonable to expect that it should receive some coverage within all global warming curricula. I found that this is not the case. Remarkably, just seven of the 16 textbooks and supplemental materials bring up the Kyoto Protocol. Moreover, coverage of the Kyoto Protocol appears to be almost exclusively in the domain of the adherent curricula. The Kyoto Protocol is mentioned in seven different sources I analyzed: six of the seven sources fall in the adherent category. Recall from chapter five that I classified all of the non-AP level textbooks, with one exception, as examples of hesitant curriculum. What this means is that students learning about global warming only through mainstream social studies or science textbooks likely read nothing about the Kyoto Protocol, despite its prominent position in the discussions about how to address global warming.

**Adaptation and geo-engineering strategies.**

While mitigation strategies, like using green technology, conserving energy, and the Kyoto Protocol, receive the lion’s share of content coverage, adaptation strategies receive little attention within global warming curricula. Just three curricula touch on adaptation strategies, two of which include such little content about adaptation as to minimize the efficacy of this approach. For instance, the only mention of adaptation strategies in *Climate Change: Connections and Solutions* occurs in one paragraph in a student reading about the larger theme of climate justice. Here, students read about adjusting cropping patterns and moving communities in low-lying areas as two adaptation strategies. In comparison, this set of materials includes two separate student readings and several lesson plans about energy conservation as a way to mitigate global warming.
Adaptation strategies also receive brief attention in the dissenting *Understanding Climate Change*, though the authors do not refer to them as such. In the last lesson of the entire unit students are asked to “think about what could be done with the billions of dollars that are being spent on combating climate change” (p. 104). Later in the lesson they hear about “alternative actions” the authors position as cost-effective measures to deal with a changing climate including enhancing funding to combat malaria (the mosquito-borne affliction is anticipated to spread as the climate warms), increasing agricultural productivity to make-up for any loss due to climate change, and protecting land from a rise in sea-level. The lesson plan, and global warming unit, abruptly stops at this point. Students are not asked to critique these alternative actions or question why they might be needed in the first place. An honest critique would no doubt recognize the potential of mitigation strategies to at least partially reduce the spread of malaria, the drop in agricultural productivity, and the rise in sea level.

Compared to all other global warming curricula I analyzed, the AP Environmental Science textbook *Living in the Environment* provides students with the only significant amount of content regarding adaptation strategies. The authors explicitly note two approaches to dealing with global warming including reducing greenhouse gas emissions (mitigation) and “to recognize that some warming is unavoidable and to devise strategies to reduce its harmful effects” (p. 514). Adaptation strategies get addressed under the subheading “We Can Prepare for the Harmful Effects of Climate Change.” Suggestions include moving communities away from low-lying coastal areas, stockpiling key foods, expanding wildlife reserves toward the poles, developing plans to deal with environmental refugees, building cooling centers in urban areas to help residents cope with increasingly intense heat waves, and building sea walls to protect coasts from
rising seas.

Mitigation, and to a lesser extent adaptation, are presented as viable strategies to deal with the threats of global warming. What is not positioned as a viable strategy in any of the textbooks or supplemental materials is geo-engineering. In fact, only the AP Environmental Science textbook *Living in the Environment* makes any mention of geo-engineering solutions, though the authors make it clear that geo-engineering is not a particular wise option to pursue. The text discusses several large-scale geo-engineering schemes including injecting massive amounts of sunlight-reflecting chemicals into the stratosphere, anchoring a network of massive vertical pipes in the oceans in order to pump nutrient-rich water to the surface to fertilize carbon dioxide-consuming algae blooms, and wrapping glaciers with insulating blankets to inhibit their melting. However, the authors ultimately argue “the major problem with these techno fixes is that if they ever fail while we continue adding CO$_2$ to the atmosphere, the rebound effects could be calamitous” (p. 518).

Where does this leave us? So far I have discussed the broad trends found within the global warming curriculum concerning how society could address the problem and its associated threats. Generally speaking, global warming content introduces students to a range of mitigation strategies. Depending on the particular curriculum, students hear about how energy conservation, green technology, government regulations, financial incentives, international treaties, economic policy, or actions taken by individuals can reduce carbon emissions. On the other hand, students are neither grappling with content about how societies are preparing or should prepare for the inevitable and relatively rapid climate changes, nor are they asked to seriously consider the promises and perils of large-scale geo-engineering schemes. Overall then,
the global warming curriculum writ large presents students with only a narrow perspective for which to think about how to address global warming.

**Who Should Take the Lead in Addressing Global Warming?**

In the section above, I argued mitigation strategies are by-and-large the only types of strategies students encounter when they learn about how to address global warming. I also established that students may encounter a range of mitigation strategies within the curriculum. For example, they might read that developing alternative fuel sources or using other green technologies can help reduce carbon emissions. Or students might learn that establishing a carbon tax creates an incentive to find other energy sources or that conserving energy is the most effective way to lessen the amount of carbon emitted. In their discussion of explaining *how* we might address global warming, textbooks and supplemental curricula also convey messages about *who* should be in the forefront of addressing global warming.

In exploring this aspect of the curriculum, I consider how each source positions the government, business and industry, and individuals as key agents in dealing with global warming. Recognizing any of these as influential in shaping how we address global warming carries with it its own assumptions and appeals to the different worldviews put forth by Schwarz and Thompson’s (1990) cultural theory. For instance, accepting the government as the primary agent to address global warming assumes that government has the tools (in the form of regulations and other policies) to bring about emissions reductions and the legitimacy to govern over other spheres of society. Hulme (2009) calls this *green governmentality* and notes that with its top-down approach and insistence on order and rules, green governmentality fits particularly well with a heirarchist worldview. The Kyoto Protocol is an example of a government-led action
to address global warming.

The second group that can spur action to deal with global warming is private business and industry. Validating business and industry as the rightful faction to lead the way in dealing with climate change assumes that a free market will ultimately guide society to better manage the environment and that the motivating force to spur action is increasing the bottom-line. The private sector can take the lead in addressing global warming in several ways. For example, they could volunteer to participate in a cap-and-trade system. Cap-and-trade refers to a situation whereby industries are allotted credits giving them the right to produce a specific amount of carbon emissions over a given period of time; therefore the total amount of carbon emissions is limited (or capped) based on the number of credits allotted. Entities can then trade carbon credits for a price determined by the carbon market. Alternatively, the private sector can increase their energy efficiency--and their bottom line--by conserving energy within the production process, constructing energy efficient buildings, or in their day-to-day operating procedures. Hulme refers to this as market environmentalism and notes how neoliberal methods agree with the individualist worldview.

The third group that can catalyze action to address global warming are the individuals and groups comprising civil society. Believing that civil society, particularly individuals and small groups, should lead efforts to address global warming assumes that high levels of democratic participation are efficacious in bringing about change. Creating a global warming awareness campaign, turning down the thermostat in the winter, or planting trees, are examples of actions that individuals take to address global warming. This is similar to what Hulme calls civic environmentalism, and its bottom-up, grassroots approach is especially appealing to those with
an egalitarian worldview.

Actions to address the threats associated with global warming pursued by the government and by individuals enjoy various degrees of support within global warming curriculum; however, the role of business and industry in addressing global warming is largely ignored. A significant contrast exists between the factions the adherent and hesitant curricula promote as the best positioned to respond to global warming and the group favored by the dissenting curriculum. Specifically, the adherent and hesitant curricula generally advance the government and individuals as key drivers leading mitigation efforts while the dissenting curricula offers little in the way of addressing global warming other than the message that the government should not be involved.

Adherent and hesitant global warming curricula endorse the government and/or individuals as the rightful leaders to address global warming. Two curricula draw clear attention to this bias. The AP Environmental Science textbook *Living in the Environment* implores students to consider the importance of individuals in society to affect change:

> The question is, will enough individuals exert sufficient bottom up political pressure and consumer pressure (through their purchases) to reach a political tipping point? At that point, such pressure could force elected officials and business leaders to implement well-known solutions on an urgent basis to avoid reaching various irreversible climate change tipping points.” (p. 514, emphasis in original)

While the authors set up grass-roots, “bottom up political pressure” as a vital agent in calling for a response to global warming, the subheadings they use to organize the content within the chapter indicate individuals are not the only agents of change. Subheadings titled, “Governments Can Help Reduce the Threat of Climate Change” (p. 518), and “Some Governments are Leading the Way” (p. 520), suggests that government action, in addition to
individual action, is important in the effort to address global warming. The National Wildlife Federation’s AITC is even more succinct in directing students’ attention to the importance of governments and individuals in addressing global warming:

The important thing to remember is that humans have caused this problem, so humans should be able to fix it...But remember there is no single solution: it is going to be a combination of people and governments working together to implement a range of strategies to tackle this problem. (p.21)

Even in the adherent and hesitant curricula that are not as explicit Living in the Environment and AITC about who should be leading efforts to mitigate carbon dioxide emissions, the very nature of the particular mitigation strategies included in the content reveals the important role of government and civil society to drive efforts to address the problem. For example, the types of strategies listed in Table 6.1 including the “Kyoto Protocol,” “laws and regulations,” and “individual action (not conservation)” necessarily indicate the import of either the government or individuals in addressing global warming.

To be fair the adherent and hesitant curricula do not entirely ignore the private sector as an agent in addressing global warming. For example, Holt McDougal Earth Science mentions “car manufacturers have been developing cars that are more fuel efficient” (p. 620) and the authors of Living in the Environment write about how major global companies are voluntarily taking measures to reduce their carbon footprints. They conclude “companies see an enormous profit opportunity in developing or using energy-efficient and cleaner-energy technologies, such as fuel-efficient cars, wind turbines, and solar cells. They understand that there is gold in going green” (p. 521). Similarly, in a reading students complete to prepare them for a lesson about sustainable energy solutions the authors of Climate Change: Connections and Solutions include a subsection with the heading “Strategies for Business and Industry.” Here, students read about a
handful of strategies the private sector can or does use, one of those being energy conservation. “Wal-Mart,” the authors note, “is one such business trying to reduce its environmental impacts by reducing product packaging and increasing the energy efficiency of its stores and trucks” (p. 117).

These examples of how the private sector is actively pursuing strategies to address global warming are rare. More common within the global warming curricula are examples which position the private sector not as a leader in addressing global warming but as an entity acted upon by the government and individuals in the name of dealing with climate change. For instance, *Climate Change: Connections and Solutions* advises “being informed and demanding more efficient, climate-friendly products when you go shopping, consumers like you will influence manufacturers to care more about their effects on the climate” (p. 108). Interestingly, in the same section that the authors of *Connections and Solutions* praise Wal-Mart, they also write, “…businesses may be required (usually by a government mandate) to use specific technologies to reduce emissions…” (p. 117). Textbooks also get in on the act. Glencoe’s *World Geography* states “In response to global warming and greenhouse gases...Governments offer subsidies and put pressure on utility companies to limit emissions and include renewable energy sources in their future plans” (p. 176).

Cap-and-trade, another strategy listed on Table 6.1, ostensibly puts business and industry in a leading role to addresses global warming; however, a nuanced look at they way cap-and-trade is contextualized within the curriculum points to the private sector taking a more reactive role. As discussed earlier in this chapter, business and industry could demonstrate an ethos of corporate responsibility by embracing--and helping to shape-- a cap-and-trade strategy. Rather,
supplemental materials and textbooks analyzed in this study suggest that cap-and-trade is a strategy used by governments to take action on global warming. For instance, the AP Environmental Science text *Living in the Environment* positions the strategy under the subheading “Governments Can Help Reduce the Threat of Climate Change” (p. 519). *Deliberating in a Democracy: Global Climate Change* similarly contextualizes cap-and-trade as a government solution. The thrust of this set of supplemental materials is to have students deliberate over the question “Should our democracy adopt a cap-and-trade system to limit greenhouse gas emissions?” The focus on what policy should be followed indicates that cap-and-trade is a strategy initiated by the government, not by the private sector.

The foregrounding of individuals as the driving force behind efforts to address global warming is most apparent when examining how curricula contextualize conservation efforts. Adherent and hesitant curricula clearly position conservation efforts, coded for as any action taken to directly reduce the amount of energy consumed, as the responsibility of individuals. *Climate Change: Connections and Solutions* drives this point home. This supplemental curriculum repeatedly informs students of actions *individuals* can take to conserve energy. In fact, three of the five student readings included in this set of materials indicate the conservation efforts led by individuals is critical. One reading rhetorically asks, “Is it too late to become part of the solution?” It continues, “No--we already have the knowledge and technology to start making positive changes. For example, a change in lifestyle (consuming fewer resources, *conserving energy*, reducing travel, etc.) can help mitigate climate change” (p. 98, emphasis added). A second reading defines the concept *carbon footprint*--a measure of one’s impact on Earth’s climate in terms of carbon emissions-- and then discusses specific actions individuals can
take to conserve energy. A third reading, titled “Save Your Energy,” implores students “Of all approaches to reducing greenhouse gas emissions, energy conservation is the easiest and least expensive” (p. 107, emphasis in original) and proceeds to discuss ways they could conserve energy. Connections and Solutions further promotes individual conservation in a forty-five minute lesson whereby the objective is for students to “explore ways to reduce their carbon footprint” (p. 35).

Facing the Future’s materials are by no means unique in their focus on individuals as leading the charge for energy conservation, nor are they unique in asking students to think about, or actively seek out, ways to conserve energy. Climate Change: A Wisconsin Activity Guide, notes “Reducing fossil fuel combustion by conserving energy is a way that people of any age can help” (p. 8). Later in the curriculum, a lesson titled “How Green Are You?” lists as one of its learning objectives “Students will make choices to reduce the amount of resources they consume over time” (p. 36). In the second lesson in the Will Steger Foundation’s Global Warming 101, teachers are to point out “the majority of human-caused carbon emissions today comes from the burning of fossil fuels” (p. 12). The way forward? Reducing their emissions. Students are given a handout titled “20 Simple Steps to Reduce Global Warming” which reminds them “Whenever you save energy--or use it more efficiently--you reduce the demand for gasoline, oil, and natural gas. Less burning of these fossil fuels means lower emissions of carbon dioxide, the major contributor to global warming” (p. 19). The handout imparts a variety of actions, including conservation measures, meant for individuals to adopt.

Thus far, I have discussed how the adherent and hesitant global warming curricula position the government and individuals as leaders in efforts to address global warming, but what of the
dissenting materials? In this regard, all of the global warming curricula, no matter whether adherent, hesitant, or dissenting, have one thing in common: all of them largely ignore the role of the private sector in addressing global warming. Where the dissenting and adherent/hesitant curricula most deeply diverge, though, is in their conceptualization of how government should address global warming.

As noted above and in Table 7.1, the two sets of dissenting materials are virtually silent on providing pro-active strategies to respond to global warming. Instead, these supplemental materials implicitly and explicitly advocate taking no action at all. *Unstoppable Solar Cycles* is a telling example. The DVD on which this particular global warming curriculum is based focuses the vast majority of its content on seeding doubt about the veracity of the theory of anthropogenic global warming. In her closing comments, Beth, the young teen narrator, editorializes, “I’m not a scientist. I’m a student like you but everyone knows that what science says is true changes with each new research project and with every new piece of evidence.” She continues:

> From what I’ve heard the cost to reduce CO.2 will be enormous and, as the scientists said, this may not be the cause. We could create disaster for poor countries and hardship for all of us and not change the pattern of warming and cooling.

> We need to encourage scientists to consider every possibility. We need to get this right. Don’t you agree?

Underscoring that the best way forward is to do nothing are twenty-one “discussion” questions designed to either “spark class discussion” (izzit.org, p. 1) or be assigned as homework. Some of the questions for students to answer include:

- If we would have to give up all of our modern conveniences and start living like people in Europe and America did 200 years ago--or like people in many developing countries do today--just to possibly slightly slow the rate of warming in the distant
future, would it still be worth the effort? How and by whom should this be decided?

- How should we weigh the costs of action versus inaction, real harm now due to economic decline versus potential harm later from warming?

- Who is best able to determine what we should do about global warming? Scientists? Politicians? Who should make decisions about how we live?

- Assuming we could prevent global warming, is this the only goal that matters? Are there other goals--individual freedom and economic prosperity, for example--that should be factored into any decision about how to respond to global warming?

(p. 6-7, emphasis in original)

The Fraser Institute materials, *Understanding Climate Change*, also suggest that inaction is the preferred strategy; however, here the authors use a slightly different tack. Whereas *Unstoppable Solar Cycles* calls for inaction because of lack of scientific certainty, *Understanding Climate Change* calls for inaction because of financial concerns. According to the authors students should come away from the the final two lessons understanding that “It is often believed that governments can solve our environmental and social problems. It is important to understand, however, that even government resources are limited” (p. 95).

A background essay for *Understanding Climate Change* uses findings from the Copenhagen Consensus Project, a roundtable conference held in Denmark in 2004, to underscore the point that mitigation is a financially unsound policy. Part of the Consensus Project included a summary developed by eight accomplished economists concerning the best way to use $50 billion of resources to advance global welfare. In *Understanding Climate Change* students read that “addressing climate change was found to be a ‘bad opportunity’ [by participants at the Conference], and was placed at the bottom of the list [of cost-effective actions to take to increase global welfare]” (p. 95). According to these lesson plans, the teacher is to show her class a transparency titled “Policy choices” outlining the global priorities from the Copenhagen
Consensus Project in descending order of desirability (global warming is at the bottom). “Note where climate challenges were ranked” the authors direct the teacher to mention. Next, drawing from two short descriptions the authors provide, the teacher is to explain the policies of cap-and-trade and carbon taxation and then she is to “Discuss with students the costs of emissions regulations. Stricter emissions regulations would increase the price of most products” (p. 103). Finally, students are sent to work in small groups with their task being to “design a policy that will address your constituents’ concerns about climate change.” The constituents that students must consider include taxpayers (“none of whom want their tax dollars to be wasted”), oil companies (“concerned about their public image and higher energy costs”), alternative energy suppliers (“that want subsidies to lower the higher costs of their products”), environmental groups (“that advocate dramatic reductions in CO$_2$, irrespective of the costs”), and low-income households (“that cannot afford higher energy prices”). It is not hard to imagine that between the information front-loaded by the teacher and the descriptions of what constituents want, the “right” type of policy for students to develop has nothing to do with mitigating carbon emissions.

Whereas the adherent and hesitant materials emphasize the necessity of the government or individuals in taking action to address global warming, implicit in the dissenting curriculum is the notion that if any action need be taken at all, the government is not the proper entity to lead the way. This is wholly consistent with the vision and mission of both the Fraser Institute, the organization responsible for Understanding Climate Change and izzit.org, which produced Unstoppable Solar Cycles. The vision of the Fraser Institute is “a free and prosperous world where individuals benefit from greater choice, competitive markets, and personal responsibility.” To help make this vision a reality, the Fraser Institute espouses a mission “to measure, study, and
communicate the impact of competitive markets and government interventions on the welfare of
individuals” (www.fraserinstitute.org). Likewise, izzit.org is the educational branch of the not-
for-profit Free To Choose Network, whose purpose, “To use accessible and entertaining media to
build popular support for personal, economic and political freedom” (www.ideachannel.com),
champions Milton Friedman’s neoliberal economic philosophy.

*Six Americas* research (cf Maibach, et. al., 2009) reminds us that one’s conceptualization of
global warming is correlated with what one believes to be the proper course of action to address
global warming. Therefore, those who believe global warming is a serious and pressing threat
typically indicate stronger support for government policies that reduce carbon dioxide
emissions. On the other hand, those who consider global warming to be a low priority issue (or
in some cases a non-issue) often believe that governments, corporations, and individuals need
not take any action to reduce greenhouse gas emissions. Given the differences in opinions
between the alarmed and dismissive segments of the U.S. population regarding the appropriate
course of action, differences revealed within the adherent, hesitant, and dissenting curricula are
not surprising. What was surprising are the distinct differences between the social studies and
non-social studies curricula concerning how societies might address the threats associated with
global warming. It is to these differences that I now turn.

**Differences Between Social Studies and Non-Social Studies Curricula**

I classified a source as “social studies focused” if its content clearly addresses one of the
disciplines that fall under the umbrella of social studies as defined by the Wisconsin Department

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4 Importantly, none of the six Americas indicate strong support for a cap-and-trade system or increasing the gasoline
tax (Maibach, et. al., 2009).
of Instruction (DPI). In this case, the social studies include the disciplines of history, geography, political science, economics, anthropology, archaeology, law, psychology, and sociology (Wisconsin DPI, nd). I classified all other supplemental materials and textbooks as “non-social studies focused.”

Tables 6.2 and 6.3 display the global warming curricula categorized as social studies and non-social studies, respectively. My analysis indicates that social studies-focused curricula primarily note the importance of government implemented strategies of dealing with global warming, and to a lesser degree, the role of the individual actors, whereas non-social studies materials position individual actions as paramount to addressing the threat.

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5 Originally I had planned to classify global warming curriculum according to the core content areas they addressed. This classification made sense for the textbooks as the titles clearly indicate which core subject they belong to; however, this classification system was not as cut-and-dried with the supplemental materials. Two sets of supplemental materials, *Global Environmental Problems: Implications for U.S. Policy* produced by Brown University’s Choices Program, an initiative of the Watson Institute for International Studies, and *Deliberating in a Democracy: Global Climate Change* produced by the Constitutional Rights Foundation Chicago (CRFC), sit squarely in the realm of the social studies based on the content and the missions espoused by the organizations that produce them. The other supplemental materials, though, are not as easily classified. Nearly all other sets of supplemental materials explicitly reference two or more sets of standards, most often including the national science education standards, the national social studies education standards, and the environmental education guidelines for excellence. To complicate the matter even more, both sets of supplemental materials I consider to be examples of dissenting global warming curricula did not allude to any professionally recognized set of standards. See the notes for Table 6.3 for the specific standards the non-social studies materials address.
Table 6.2. Strategies to Address Global Warming Contained in the Social Studies Curriculum

<table>
<thead>
<tr>
<th>Social studies materials and texts</th>
<th>Mitigation strategies</th>
<th>Adaptation strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kyoto Protocol cap-and-trade laws and regulations financial incentives green technology energy conservation individual action (not conservation)</td>
<td></td>
</tr>
<tr>
<td>Choices: Global Environmental Problems</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Deliberating in a Democracy: Global Climate Change</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Human Geography: Landscapes of Human Activity, 11th Ed.</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>McDougal Littell Modern World History: Patterns of Interaction</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Glencoe World Geography</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Prentice Hall World Geography</td>
<td>x</td>
<td></td>
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</table>
The social studies textbooks and supplemental materials focus on ways that government plays a role in handling society’s response to global warming. Of the six social studies global warming curricula, four bring up the Kyoto Protocol—a strategy that necessitates a leading role for the government—and four sources, including all three non AP-level textbooks, mention laws and regulations as tools to mitigate greenhouse gas emissions. Furthermore, the AP Human Geography textbook is the only social studies source that mentions the strategy of energy conservation and even this is situated as a government led effort: “Germany, Denmark, and the United Kingdom are just some of the many countries that have shown that energy efficiency and a switch to renewable energy sources can... [reduce] greenhouse gas emissions” (p. 426).

Social studies textbooks generally contain little content regarding global warming, but the limited information they do have about possible strategies to deal with global warming positions a governmental response at the fore. For instance, in Glencoe World Geography students read about how the European Union “continue[s] to develop ways to protect the environment” (p. 334), that “some countries are developing alternative fuels. For example, Sweden introduced the first biogas-powered passenger train” (p. 334, emphasis added), and “Governments offer subsidies and put pressure on utility companies to limit emissions and include renewable energy sources in their future plans” (p. 176, emphasis added). The perspective the social studies textbooks take on the role of government in addressing global warming is perhaps best summed up in McDougal Littell Modern World History: Patterns of Interaction, whereby the authors point out that “Government action and stronger regulations may provide solutions to the world’s environmental problems in the 21st century” (p. 682).

The two sets of social studies specific supplemental material, Choices: Global
Environmental Problems and Deliberating in a Democracy: Global Climate Change are exclusively about discussing a range of potential U.S. policies regarding global warming. As previously discussed, the Deliberating in a Democracy lesson asks students to deliberate over the question “Should our democracy adopt a cap-and-trade system to limit greenhouse gas emissions?” In the Choices materials, the focus on students’ deliberations are a bit broader, but still in the same vein. The capstone of the five day curriculum includes a role-play activity in which small groups of students are to develop a compelling argument supporting one of four policy options the U.S. should pursue concerning environmental problems.

What makes the Choices curriculum unique from any other curriculum I analyzed, social studies or non-social studies, is that it explicitly asks students to consider the values undergirding the various policy options. As they make preparations to present their particular policy to the “presidential advisory panel,” students work through a handout that explains:

Values play a key role when defining the broad parameters of public policy... People in the United States are constantly being forced to choose among competing values in the ongoing debate about foreign policy. Each of the four options revolves around a distinct set of values. Your job is to identify and explain the most important values underlying your option. (p. 35)

The intended result is that in their exploration of the different policy routes and the ensuing presentations, each group should come to an understanding of the competing values associated with having different sectors of society take the lead on mitigating global warming. One policy option students encounter includes putting the economy ahead of environmental concerns. Here, students consider how those with ideologies not sympathetic to the idea of a government led response might instead believe that the rightful sector to address the threats associated with global warming is the private sector via the free-market. Still, it is important to clarify that this
set of supplemental materials focuses on how the government should react to global warming, not on how business and industry should react.

Compared to the focus of the social studies curricula, the focus of the non-social studies materials is considerably different. For instance, only three of eleven non-social studies curricula mention the Kyoto Protocol and only four of eleven have content about how governments can use laws and regulations to address global warming. The difference between social studies and non-social studies materials is most striking when comparing the science textbooks to the social studies texts and supplemental materials. None of the science textbooks offer content about the Kyoto Protocol, and only one science textbook mentions laws and regulations or advances in green technology as potential strategies to mitigate carbon emissions. Refer to Table 6.3 for a list of strategies found within the non-social studies curriculum.

Whereas individual actions to address global warming are ignored in the social studies texts and materials in favor of highlighting the government’s role, individual efforts play a prominent role within the non-social studies curricula. Disregarding the two sets of dissenting materials (which I classified as non-social studies materials), eight of the remaining nine non-social studies curricula discuss non-conservation individual actions other than conservation efforts. Examples of non-conservation individual actions include educating others about global warming, writing letters to policy makers, or taking consumer action. Eight out of nine of these sources also specifically discuss energy conservation, and this, too, is most often framed as something for individuals to take action on. In other words, the role of the government and the private sector to address global warming is marginalized, if not ignored altogether.
Table 6.3. Strategies to Address Global Warming Contained in the Non-Social Studies Curriculum

<table>
<thead>
<tr>
<th>Non-social studies materials and texts</th>
<th>Kyoto Protocol</th>
<th>cap-and-trade</th>
<th>laws and regulations</th>
<th>financial incentives</th>
<th>green technology</th>
<th>energy conservation</th>
<th>individual action (not conservation)</th>
<th>Adaptation strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate Change: Connections and Solutions (abc)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Living in the Environment, 16th Ed. (b)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>An Inconvenient Truth in the Classroom (c)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>X</td>
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<tr>
<td>Climate Change: A Wisconsin Activity Guide (abc)</td>
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<tr>
<td>Global Warming 101 (abcd)</td>
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<td>X</td>
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<td></td>
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<tr>
<td>Glencoe Earth Science (b)</td>
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<td></td>
<td>X</td>
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<td>X</td>
<td></td>
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<tr>
<td>Holt McDougal Earth Science (b)</td>
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<td>X</td>
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<td>X</td>
<td></td>
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<tr>
<td>Prentice Hall Earth Science (b)</td>
<td></td>
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<td>X</td>
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<td></td>
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<tr>
<td>Prentice Hall Biology (b)</td>
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<td>X</td>
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<td></td>
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<tr>
<td>Understanding Climate Change</td>
<td>X</td>
<td></td>
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<td></td>
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<tr>
<td>Unstoppable Solar Cycles</td>
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Note: \(^a\) References social studies education standards  \(^b\) References science education standards  \(^c\) References Environmental Education Guidelines for Excellence  \(^d\) References Mathematics, English-Language Arts, and/or Art-Design standards
The non-social studies textbooks and supplemental materials abound with content about energy conservation and this is nearly always discussed as something for individuals to do as opposed to the government or the private sector. For example, *Glencoe Earth Science* states

Individuals reduce the amount of carbon dioxide emitted to the atmosphere by conserving energy, which reduces fossil fuel consumption. Some easy ways to conserve energy include turning off electrical appliances and lights when not in use, turning down thermostats in the winter, recycling, and reducing the use of combustion engines, such as those in cars and lawn mowers. (p. 395)

Similarly, in a section subtitled “Individual Efforts,” *Holt McDougal Earth Science* informs readers:

Each individual person can also help to reduce pollution that is caused by the burning of fossil fuels, such as running automobiles and using electricity…humans can have a significant effect on pollution rates by turning lights off when they are not in use, turning down the heat in the winter and by reducing air conditioner use in the summer. (p. 620).

*A Wisconsin Activity Guide, Global Warming 101, Connections and Solutions*, and *AITC* each convey a comparable message. Interestingly, the last three all do so using a lesson whereby students calculate their carbon footprint. In addition, all three list nearly identical learner objectives for the carbon footprint lesson put most succinctly in the *Global Warming 101* materials: “Students will calculate their carbon footprint,” and “Students will identify ways they can reduce their carbon footprint” (p. 11).

A notable trend that non-social studies materials follow when discussing individual conservation efforts is to convey them as an “easy” solution. The excerpt from *Glencoe Earth Science* in the previous paragraph is a case in point as it lists “Some easy ways to conserve energy” (p. 395). A handout used in the *Global Warming 101* listing ways to reduce one’s carbon

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6 *An Inconvenient Truth in the Classroom* defines *carbon footprint* as “an expression that describes how much carbon dioxide a person emits/releases over his/her lifetime” (p. 42).
footprint is titled “20 Simple Steps to Reduce Global Warming,” and in the three sentences

*Prentice Hall Biology* devotes to addressing environmental problems it rhetorically asks students “Is there any way that people can help maintain the health of the biosphere *without drastically changing their lifestyles*? The answer is yes. People can make wise choices in the use and conservation of resources” (p. 160, emphasis added). Finally, Facing the Future’s *Climate Change: Connections and Solutions* reminds students that “Shrinking your carbon footprint doesn’t need to be painful. When you shrink your carbon footprint, you’re not just giving things up. You’re getting a lot, too” (p. 103).

Individual conservation efforts aside, non-social studies curricula also offer a litany of other ways individuals can take action to address threats associated with global warming. Individual actions other than conservation noted in the non-social studies curricula typically fall into one of four categories: changing personal habits, educating others, consumer action, and to a much lesser extent, political action. Some non-social studies materials discuss changing one’s personal habits—particularly what they eat and how they drive. For instance, noting that “Even how we eat can make a difference” (p. 98) *Climate Change: Connections and Solutions* recommends eating foods grown closer to home to reduce carbon dioxide emissions from the long-distance transportation of food. *Holt McDougal Earth Science*, on the other hand, touches upon the import of “Driving at a consistent speed” (p. 620) for the sake of efficiency.

Consumer action represents another category of actions individuals can take to address global warming. *Climate Change Connections and Solutions*, for example, positions consumer action as a means to alter how the private sector responds to global warming when it states “By being informed and demanding more efficient, climate-friendly products when you go shopping,
consumers like you will influence manufacturers to care more about their effects on the climate” (p. 108). Other curricular materials, like *Global Warming 101*, provide more specific advice for consumers such as “when you buy a car, choose one that gets good gas mileage” (p. 19), “Buy minimally packaged goods, choose reusable products over disposable ones…” (p. 20), “As you replace home appliances, select the most energy-efficient models” (p. 20), and “buy products from, or invest in, companies that are trying to reduce their impact on climate” (*Living in the Environment*, p. 522).

Educating others is an individual action that receives significant attention within the non-social studies curricula. Sometimes this is manifested in the form of creating a school- or community-wide global warming awareness campaign. For example, at the heart of the *AITC* materials is a series of “action projects” that are “designed to impact the recipients (residents, wildlife, community members, etc.) and the students involved” (*AITC*, p. 10). Two of the global warming awareness action projects recommended by the authors include having students develop and host a school-wide global warming awareness fair and throwing a “movie-watching party” to show the global warming documentary *An Inconvenient Truth*. With the exception of showing Al Gore’s politically polarizing *An Inconvenient Truth*, these awareness campaigns are relatively benign politically in that they do not ask students to take an overt political stance. The authors of *Climate Change: Connections and Solutions*, however, are less subtle about why students should educate others when they proclaim “One way you can shape the future is by educating others about climate change and encouraging them to vote for policies and politicians who will work to reduce climate change” (p. 117).

Educating others in order to influence their vote hints at the final type of individual action
some non-social studies curricula bring up: taking political action. In these curricula the scope of political action is extremely narrow, limited to monitoring the voting records of and communicating with public officials. The authors of *Global Warming 101* aptly illustrate this sentiment when they implore students to “Be informed about environmental issues. Keep track of candidates’ voting records and write or call to express concerns” (p. 20). Similarly, authors of *A Wisconsin Activity Guide* remind readers “Everyone, including young adults, can bring about change by being active and engaged citizens. They can encourage law makers to support policies that alleviate or lessen the impacts of climate change…” (p. 8). *Prentice Hall Earth Science*, *Connections and Solutions*, and *AITC* also enlist students to write letters to policymakers regarding global warming as one way of taking action to address global warming.

To summarize, global warming curricula relay a variety of messages concerning who in society should lead the effort to address global warming. The adherent and hesitant curricula privilege the government and civil society, while dissenting materials indicate the government should *not* take on the burden of mitigating global warming. Also notable are the differences between social studies and non-social studies textbooks and supplemental materials. Social studies curricula focus primarily on the role of government in “solving” global warming. Non-social studies materials highlight the need for individuals to take a range of actions from practicing conservation to educating others to consumer action.

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7 It is noteworthy to mention that *Prentice Hall Earth Science* contains no content within its main section of global warming content about potential ways to address the problem. A task on an enrichment page in the front of the chapter on climate asks students to use the internet to gather evidence in order to develop their own opinion about what causes global warming and whether we need to worry about it. Students are directed to “Write a letter in which you attempt to persuade your state senator to agree with your position” (p. 587).
Chapter Summary

In this chapter I put forth evidence to support two claims: 1) global warming curricula expose students to a limited range concerning how our society addresses the problem and, 2) different categories of global warming curricula highlight different messages about who should lead efforts to deal with global warming. Data I collected suggest that, taken as a whole, global warming curricula narrow the discussion about what society should do regarding global warming by focusing attention almost exclusively on mitigation strategies—strategies designed to limit the amount of carbon dioxide entering the atmosphere—while ignoring other potential methods of dealing with the problem including adaptation strategies and geo-engineering. My findings also suggest adherent and hesitant curricula privilege the leadership of government and individuals in civil society (as opposed to the private sector) when considering who should take the lead in addressing global warming. Dissenting materials, on the other hand, insinuate government should not take a leading role. Finally, I demonstrated a significant difference between social studies and non-social studies curricula in that social studies materials promote “solutions” necessitating leadership from the government and non-social studies materials promote energy conservation and individual actions as methods to address global warming.
Chapter Seven: Making Sense of Teachers’ Stances in the Classroom

During my years of teaching high school social studies I spent countless hours developing curriculum. Sometimes this meant creating curriculum “from scratch,” other times this meant modifying curriculum that a colleague developed, and still other times this meant finding and tweaking supplemental materials so that they supported the learning objectives I had for my students. I am not suggesting that what I did as a teacher is unique--every teacher that I have come to respect actively shapes his or her curriculum to best meet the needs of students. I bring this up because looking at how textbooks and supplemental curricula conceptualize global warming, the focus of the previous two chapters, provides only a limited glimpse into how schools deal with the publicly controversial issue of global warming. In order to broaden my understanding of how schools are dealing with the publicly controversial topic of global warming, I sought to include the viewpoints of high school educators who teach about global warming--and presumably create and/or modify existing materials on the topic--in one or more of their classes. Therefore, during the fall semester of 2011 I interviewed a purposeful sample of fourteen high school social studies and science teachers who teach in a variety of schools throughout Wisconsin. In this chapter I explore how these teachers report teaching the topic of global warming in their classrooms.

Of particular interest to me is understanding what, if anything, about global warming teachers present as an open question. Said differently, I wanted to know which version of global warming high school teachers convey in their classrooms: the adherent, the hesitant, or the dissenting version. Recall from chapter five the three types of global warming curricula. Adherent curricula position global warming as a serious and widespread problem caused by
human activity. The cause is a closed question (Hess, 2009) with one correct answer for students to learn. Moreover, climate science experts have reached consensus on this matter. Dissenting curricula, in contrast, position global warming as a trivial concern of which there is wide disagreement among scientists about its cause. Dissenting curricula ultimately imply what causes global warming is also a closed question with the correct answer being natural cycles. Finally, hesitant curricula treat global warming as a potential problem at some point in the future and portray scientists as unsure about many aspects of global warming including the cause. According to hesitant curricula what causes global warming is an open question (Hess, 2009), one that has multiple and competing correct answers we want students to consider. In this case, global warming might be caused by human activity, natural cycles, or some combination of the two.

On top of understanding which version of global warming teachers present, I wanted to understand why the teachers presented that particular instantiation of global warming to their students. In other words, how are these teachers making sense of the stance they take on global warming in their classrooms? All of the fourteen teacher-participants I interviewed take stances in their classrooms akin to either the hesitant and adherent curricula--none took a dissenting stance within their classrooms. Perhaps the most interesting pattern I noticed is that what a teacher personally has come to believe about global warming is not necessarily consistent with how he says he presents the topic to his students. Moreover, while my findings suggest that how a teacher personally conceptualizes global warming influences the stance he or she takes in the classroom, teachers report a host of other factors which also shape their global warming curriculum.
Before going on, though, I want to draw your attention to a noteworthy pattern I noticed when looking broadly at the teacher-participants in this study. As illustrated in Table 7.1, teacher-participants represent a range of self-reported political ideologies. During a follow-up interview with each teacher, I asked how they would identify themselves on a five-point political spectrum including the points very conservative, somewhat conservative, middle of the road, somewhat liberal, and very liberal. Two teachers who indicated they identified as middle of the road also noted that they tend to “lean liberal.” As discussed in chapter three, I used purposeful sampling to select teacher-participants. I did not use political ideology as a factor for selection; however, one of the factors I did use to purposefully sample was a teacher’s self-reported conceptualization of global warming. (See Appendix C for the Six Americas (Maibach, et al., 2009) descriptions teacher-participants chose from). I intentionally sought teacher-participants who represented a range of Six Americas perspectives. It turns out that a teacher’s self-reported ideology, with a few exceptions, aligns fairly closely to what cultural theory would predict their self-reported stance on global warming to be. That is to say those who identify as very liberal also tend to identify as alarmed, and those who identify as somewhat conservative tend to identify as doubtful of global warming.  

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1 Despite repeated attempts, I did not reach Mr. Taylor or Ms. Foster for follow-up interviews.

2 While he did self-report being “doubtful” about global warming, I never directly heard how Mr. Taylor identified in terms of political ideology. Comments he made during our time together strongly suggest he does not consider himself a liberal. If this is indeed the case, it would support my observation that teacher-participants’ stance on global warming aligns closely to their self-reported political ideology.
### Table 7.1. Teacher-Participants Arranged by Content Area

<table>
<thead>
<tr>
<th>Teachers</th>
<th>title of course</th>
<th>self-reported political ideology</th>
<th>self-reported Six Americas category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms. Evans</td>
<td>Environmental Studies</td>
<td>very liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Mr. Martin</td>
<td>Environmental Issues &amp; Action</td>
<td>very liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Mr. Richardson</td>
<td>Geography</td>
<td>middle of the road/lean liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Mr. Griffin</td>
<td>World geography &amp; history</td>
<td>somewhat liberal</td>
<td>Concerned</td>
</tr>
<tr>
<td>Mr. Lewis</td>
<td>A.P. Human Geography</td>
<td>middle of the road</td>
<td>Concerned</td>
</tr>
<tr>
<td>Ms. Diaz</td>
<td>Contemporary World Problems</td>
<td>middle of the road/lean liberal</td>
<td>Cautious/Alarmed</td>
</tr>
<tr>
<td>Mr. Allen</td>
<td>Citizenship</td>
<td>somewhat conservative</td>
<td>Doubtful</td>
</tr>
<tr>
<td>Mr. Carlson</td>
<td>Weather and Climate</td>
<td>somewhat liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Ms. Hamilton</td>
<td>Environmental Science</td>
<td>very liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Mr. Powell</td>
<td>Earth Science</td>
<td>somewhat liberal</td>
<td>Alarmed *</td>
</tr>
<tr>
<td>Ms. Foster</td>
<td>Environmental Science</td>
<td>X b</td>
<td>Alarmed/Concerned</td>
</tr>
<tr>
<td>Mr. Williams</td>
<td>Earth and Space Science</td>
<td>somewhat liberal</td>
<td>Alarmed/Concerned</td>
</tr>
<tr>
<td>Mr. Bell</td>
<td>Environmental Science</td>
<td>somewhat conservative</td>
<td>Concerned</td>
</tr>
<tr>
<td>Mr. Taylor</td>
<td>Earth Science</td>
<td>X b</td>
<td>Doubtful</td>
</tr>
</tbody>
</table>

**Note**  
*According to Maibach, et al., 2009, the *Six Americas* segments, from most concerned about global warming to least concerned, are alarmed, concerned, cautious, doubtful, and dismissive.  
*bTeacher-participant did not provide these data.  
*Mr. Powell self-identified as alarmed; however, in describing his conceptualization he emphasized repeatedly that the description for the alarmed category would be more accurate if it read human activity is *partly* instead of human activity is *largely* to blame for global warming, he did not think scientists were in agreement about global warming. Moreover, in our interview he indicated that climate change is not something he particularly worries about. All of this indicates that perhaps his personal conceptualization of global warming is a better fit with the “concerned” or “cautious” segments.
One’s self-reported *Six Americas* stance (Maibach, et al., 2009) is somewhat predictive of the version of global warming he or she presents to students. Consider Table 7.2 which shows the teacher-participants arranged by the version of global warming curriculum they convey in their classrooms, as informed by the interview data and a document analysis of global warming lessons they shared with me. Those who self-report as alarmed about global warming appear more likely to teach an adherent stance (especially if they also identify as very liberal).

However, to assume what a teacher personally believes about global warming corresponds exactly to the version of global warming she presents in class is naive. Take, for example, Mr. Richardson, who by self-identifying as alarmed about global warming indicates he feels global warming is a serious problem, is certain that human activity is largely to blame, and understands that experts in climate science are in agreement—all tenets of an adherent curriculum. Still, interview data and a document analysis of part of Mr. Richardson’s global warming lessons suggests he conveys to his students a conceptualization of global warming more in line with the hesitant curriculum. Likewise, Mr. Taylor and Mr. Allen, both of whom are doubtful that global warming is a problem caused by human activity, also present a hesitant version of global warming to their students. Importantly, none of the teacher-participants promote taking a dissenting stance in their classrooms.
### Table 7.2. Teachers Arranged by Classroom Teaching Stance

<table>
<thead>
<tr>
<th>Teachers</th>
<th>content area</th>
<th>self-reported political ideology</th>
<th>self-reported Six Americas category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adherent stance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. Carlson</td>
<td>Science</td>
<td>somewhat liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Ms. Evans</td>
<td>Social Studies</td>
<td>very liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Ms. Hamilton</td>
<td>Science</td>
<td>very liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Mr. Martin</td>
<td>Social Studies</td>
<td>very liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Mr. Lewis</td>
<td>Social Studies</td>
<td>middle of the road</td>
<td>Concerned</td>
</tr>
<tr>
<td>Mr. Griffin</td>
<td>Social Studies</td>
<td>somewhat liberal</td>
<td>Concerned</td>
</tr>
<tr>
<td>Hesitant stance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. Richardson</td>
<td>Social Studies</td>
<td>middle of the road/lean liberal</td>
<td>Alarmed</td>
</tr>
<tr>
<td>Mr. Powell</td>
<td>Science</td>
<td>somewhat liberal</td>
<td>Alarmed*</td>
</tr>
<tr>
<td>Ms. Foster</td>
<td>Science</td>
<td>X</td>
<td>Alarmed/Concerned</td>
</tr>
<tr>
<td>Mr. Williams</td>
<td>Science</td>
<td>somewhat liberal</td>
<td>Alarmed/Concerned</td>
</tr>
<tr>
<td>Mr. Bell</td>
<td>Science</td>
<td>somewhat conservative</td>
<td>Concerned</td>
</tr>
<tr>
<td>Ms. Diaz</td>
<td>Social Studies</td>
<td>middle of the road/lean liberal</td>
<td>Cautious/Alarmed</td>
</tr>
<tr>
<td>Mr. Allen</td>
<td>Social Studies</td>
<td>somewhat conservative</td>
<td>Doubtful</td>
</tr>
<tr>
<td>Mr. Taylor</td>
<td>Science</td>
<td>X</td>
<td>Doubtful</td>
</tr>
</tbody>
</table>

*Note* a teacher-participant did not provide this data.

*Mr. Powell self-identified as alarmed; however, in describing his conceptualization he emphasized repeatedly that the description for the alarmed category would be more accurate if it read human activity is *partly* instead of human activity is *largely* to blame for global warming, he did not think scientists were in agreement about global warming. Moreover, in our interview he indicated that climate change is not something he particularly worries about. All of this indicates that perhaps his personal conceptualization of global warming is a better fit with the “concerned” or “cautious” segments.
What is going on here? In the remainder of the chapter I demonstrate how the teacher-participants I interviewed make sense of the stance towards global warming they take in their classrooms through various combinations of four factors: 1) their personal beliefs about human-induced global warming and the science supporting it, 2) the larger goals they have for their students, 3) their beliefs about teaching and, 4) the school community’s support or opposition to their stance (whether real or perceived).

Making Sense of an Adherent Stance in the Classroom

The six teacher-participants who choose to present their students with an adherent version of global warming curricula make sense of their teaching stance in several ways. First, they draw on their particularly strong faith in climate science and scientific consensus as a means of supporting their position. Second, they voice a strong rationale for teaching their students about global warming. Moreover, they feel their stance is aligned with the broader goals and beliefs they hold about schooling writ large. Finally, some of these teachers explain that they feel emboldened to take an adherent stance because they do not perceive a credible challenge from others in the school community regarding their stance on the matter.

One way teachers make sense of, and bolster, their adherent stance is by drawing on their faith in the evidence supporting the theory of anthropogenic global warming. For instance, Ms. Hamilton, an Environmental Science teacher is “certain that scientific consensus supports [the theory of anthropogenic global warming].” “It’s not a belief,” she continues, “It’s a scientific fact. It exists and what you choose to do about it can be what you believe or don’t believe, but you can’t not believe in it.” In discussing whether her personal beliefs about global warming are consistent with how she conveys the topic in class, she leaves little doubt when she explains,
“...there’s no, ‘well different people think different things in terms of that it’s happening.’ [...] there’s no debate about that. You can’t question me…”

Other teachers echo Ms. Hamilton’s support of the scientific evidence. For instance, Weather and Climate teacher Mr. Carlson reports expressing to his students his faith in climate scientists’ conclusions. He explains, “I let them know that I believe what the data tells me. [...] I put forth [to students], ‘Yes, I believe in global warming. I believe that aspects of it are coming from humans and I believe that comes from the data that I’ve looked at.’” Ms. Evans provides another example, this time from the perspective of a social studies teacher. In her elective Environmental Studies class she present her students with “the most accurate current information about people’s knowledge and the extent to which we have experienced warming and the projections of future warming and the possible impacts that’s going to have, and has already had.” She argues that “so much good evidence[...]points to human cause of global warming....I just don’t think there are other conclusions to be drawn.” Mr. Martin, who taught a social studies course at an environmentally focused charter school, arrives at a comparable verdict. He admonishes students who say global warming isn’t happening to “look at the numbers, look at these facts. [...] I feel like the information that’s being presented is accurate, [...] I’m not promoting a secondary view.”

Teachers promoting an adherent version of global warming have an unshakable faith in the findings of climate scientists and for some the fact that experts have reached consensus adds strength to their convictions. For Ms. Hamilton, knowing that climate experts have reached consensus about global warming is an “extremely important” piece of information for her to know in order to teach about global warming for two reasons. First, it serves as compelling
evidence to convince students to heed the findings of climate scientists. Discussing the stance she takes toward global warming in her instruction, Ms. Hamilton explains:

We just look at the fact, like, look at this big list of people, you know, look at all the people that were part of [the Intergovernmental Panel on Climate Change]. These are people who have, you know, all sorts of different world views, ideas, issues, approaches, and they can all agree. We could sit them down and this could be the only thing they can all agree on. But they can all agree and say we are causing this problem. So, you know, like what could we in this room all agree on? There’s not a lot of things that everyone can come to consensus on. That’s pretty powerful.

Second, the fact that climate science experts agree makes her confident defending the stance she takes in the classroom against others in the school community who might challenge her:

I am very confident that that is, not that it’s unchallengeable, but it’s an un-winnable challenge to say that there’s not consensus on that and that they don’t all believe that it’s human caused. I mean, that makes me very comfortable in taking the strong stance that I have taken.

Scientific consensus also provides Ms. Evans with a sense of confidence. Without the knowledge that scientific consensus about global warming exists, “I wouldn't be able to be so confident that I’m right in saying [the theory of anthropogenic climate change is correct].” Finally, Mr. Lewis approaches the importance of scientific consensus to his stance as a matter of pragmatism. “I’d just have to say it’s common sense. I consider myself to be a fairly well-read person, and that just seems like what the scientific community is saying.”

Teachers who teach an adherent version of global warming curriculum believe in the scientific evidence behind the theory of human-induced global warming and take heart in the scientific consensus supporting this position. They also express a powerful rationale for teaching about global warming. A common refrain among these teachers is that it is an important problem for students to know about. Or, as Mr. Martin puts it, it is a “big letter issue.” Mr. Griffin explains that the main point he wants his students to take away is that “climate change is going to
drastically affect the way humans live on this planet.” Global warming is part of Mr. Lewis’ A.P. Human Geography curriculum; however, his purpose for teaching about it is greater than the fact than its included in the official curriculum. For Mr. Lewis, that students know about global warming is important in it’s own right: “It impacts the kids’ lives, and they need to know about it.”

Of all the teachers, Ms. Hamilton is perhaps the most impassioned about why she teaches about global warming. Similar to former Vice President Al Gores’s position in the documentary An Inconvenient Truth, she positions dealing with global warming as a moral imperative. “…I tell my students almost every day in my Environmental classes that [global warming] is their, like, Civil Rights movement. This is what they’re going to be judged on as a generation.” Ms. Hamilton also directly connects teaching about global warming to notions of citizenship as noted in the following exchange:

**Ms. Hamilton:** “...if you don’t know about [global warming], if you leave High School and don’t know about this, you are at a distinct disadvantage to be a well-educated citizen.”

**C:** Why do you say that?

**Ms. Hamilton:** Well, because I think that there are so many decisions that you have to make in terms of being a consumer, in terms of being a voter, in terms of being a community member that all come back to our response to what we think we’re going to do about this. Are you going to buy a great big car and drive all the time? Or are you going to think about buying a bike? Are you going to vote for somebody who, you know, is going to get rid of public transportation? I think there are so many facets to what’s contributing to it and what we can do to fix it that are so much a part of our everyday life, if you can’t be cognizant of that, you are at a distinct disadvantage—well, maybe you’re not at a distinct disadvantage—but you’re not going to help us solve the problem. You’re going to be part of the problem instead of part of the solution.

As articulated here by Ms. Hamilton teaching students about global warming is both a moral and a civic imperative.
Beyond their strongly voiced rationales for teaching about global warming, the adherent version these teachers present to their students corresponds with their beliefs about what type of knowledge schools should privilege. For example, Mr. Carlson and Ms. Hamilton feel that science courses should convey the best available scientific facts, and that these facts are not open to interpretation. Says Mr. Carlson, “...this is a science course and we’re going to put forth scientific information about [global warming] and when they say you’re not teaching the other side of the controversy, well, in science there really isn’t a controversy on it.” Ms. Hamilton, in explaining what she says to her students, puts it more succinctly: “...you might hear other things at home, but in science class, there’s no debate here.”

Several of these teachers defend their teaching stance by claiming an adherent stance is the “intellectually honest” position to take. This proves to be a particularly powerful reason for Ms. Evans:

I think that the reason that I would want, that I want to teach [anthropogenic global warming] as a closed issue is that I am frustrated by the fact that in our society there is a huge number of people who consider it to be controversial and an open question, and I think that I want to present my students with what I see as the sort of the most accurate current information about people’s knowledge and the extent to which we have experienced warming and the projections of future warming and the possible impacts that’s going to have, and has already had. And so, I think that you know, like one thing that I want my students to learn is how to evaluate evidence. And there is so much good evidence, so much of the good evidence, points to human cause of global warming that if you are teaching students to be a good consumer of information and look at the evidence and draw conclusions, I just don’t think there are other conclusions to be drawn. So, I think that part of it is like, that aspect of asking them to sort of be intellectually honest about looking at the information, but also really, that like I’m frustrated that people generally in our society don’t seem to be very intellectually honest about this and are motivated by other things that I don’t maybe fully understand...

Mr. Griffin, too, favors what he believes to be a more intellectually honest position. His understanding of the public controversy about global warming is that “it’s a controversy that is
created more so than a controversy in reality.” From what he can tell, he sees no ulterior motives for scientists who claim global warming is caused by humans, but he *does* see ulterior political motives for those who question the current scientific understanding. Moreover, Mr. Griffin acknowledges that this sentiment justifies the stance he takes when teaching about global warming.

Other teachers I interviewed are also very cognizant of misinformation campaigns launched by those who disagree with the scientific consensus and seek to help students evaluate the validity of climate science skeptical sources. The notion that “there is so much misinformation out there” motivates Mr. Carlson to talk about it. He reports that within his unit about global warming the class learns “about distortion, cherry picking, exaggeration, how it’s used in the media, how it’s used in politics and why it’s normally not used in science.” While she “didn’t talk a lot about that in the past,” Ms. Evans is hoping to devote more time to teaching her students about misinformation campaigns:

>[...] this year I’m going to spend a larger portion of the time thinking about like who is benefiting from fossil fuel use and who has an interest in kind of keeping up the status quo and not making the kind of changes that would be necessary to try to address global warming

To teach about bias in articles that refute the scientific consensus about global warming, Mr. Martin asks his students to analyze several websites which convey “evidence” running counter to the current scientific understanding. Specifically, they are to learn about the organization that hosts the website, including their sources of funding, and then assess whether the information found on the site is trustworthy.

Teachers who convey an adherent version of global warming curriculum to their students report having a strong belief in the validity of scientific evidence and scientific consensus,
maintain a strong rationale for teaching about global warming, and believe schools should transmit an “intellectually honest” curriculum. A fourth factor teacher-participants use to make sense of why they teach an adherent version of global warming is their level of concern regarding challenges to their stance from students and parents. Most challenges to their stance come from students and these are not considered credible challenges. Others report anticipating challenges from parents and other community members and have previously strategized how they will respond to these challenges. In any case, consistently adherent teachers do not seem compelled to change their stance due to challenges: their faith in the best available scientific knowledge about global warming and their purpose for teaching about global warming is simply too strong to overcome.

While some of the teacher-participants, like Mr. Lewis, Mr. Griffin, and Ms. Evans, report not facing any challenges to their stance from students, parents, or other school community members, others report getting “push back” from some of their students. Teacher-participants delivering an adherent stance to global warming in their classrooms often cast aside student challenges. Mr. Martin explains, “[...] it’s not necessarily credible push back, meaning it’s not based on facts, it’s not based on information. On other issues, yes. [...] But not in global warming.” Mr. Carlson talked about how he responds to those students who offer evidence contrary to what climate scientists have concluded:

**Mr. Carlson:** ...a lot of the people that [students who are skeptical of global warming] cite are people who they hear from the media who, “I was listening to this meteorologist and they were talking about global warming currently caused by sunspots when he was debating Bill Nye the Science Guy.” They’ll cite different politicians and stuff like that. I’ve had a student cite Governor Walker about how sunspots are the cause for global warming...

**C:** How do you respond to that?
Mr. Carlson: ...generally my response [is], they’re people and they have the right to their own opinion, but if you look into the world of science, that’s not reflecting the consensus that we have among climatologists.

C: And how is that taken?

Mr. Carlson: They don’t take it well. They don’t like it. Normally that’s the end of what they put forth. [Skeptical students] generally just sit there with an upset look on their face for most of this unit.

Mr. Carlson and Mr. Martin are dismissive of those students who challenge their adherent stance. Ms. Hamilton takes it a step further, inviting students who disclaim the theory of anthropogenic global warming to bring in “a valid scientific study that proves your point [...], but until you can show me evidence and data that was collected in a reasonable and scientific manner, I’m sorry, you’re just talking.”

None of the teachers who take an adherent stance reported having their stance challenged by parents, although they expect those challenges will occur at some point and have thus envisioned how they will respond. While thinking about how her adherent stance was received during the previous year, Ms. Evans elucidates her plan:

Ms. Evans: I thought maybe there would be some students who would go home and tell their parents, and their parents would call. And I was prepared for that because I felt really confident in my approach, but I was also really surprised that I didn’t get any push back, even from students who I knew were very conservative.

C: How did you prepare for that?

Ms. Evans: I had kind of rehearsed in my mind how I would approach a parent who felt that way and I think the fact that I feel very convinced that [global warming is a serious problem caused by humans], that there is a scientific consensus and that it’s not controversial, so that I could like be confident in talking about it that way.

Interestingly, Ms. Evans was asked about her global warming beliefs in the interview for her current position. “I told them straight up in my interview that I was not going to teach it as a
controversy, that I was going to teach it as this is the scientific consensus. So, they hired me knowing that.” Having the support of the administration further fortified her resolve to stand up to any future challenges:

[...] the fact that I knew that the administration and the school knew where I stood on that and how I would approach it, made me feel good because if a parent were to complain to administration about it, that they would be on my side. So I think that all made it seem less threatening to me.

Mr. Carlson and Ms. Hamilton follow suit. As Mr. Carlson puts it, he is expecting at some point “To get the phone call saying, ‘why are you telling all this stuff to my kids?’” When asked how he was planning to respond to this eventuality, Mr. Carlson replied:

I think in that case it’s probably best just to invite them in and sit down and spend some time talking about what it is--that this is a science course and we’re going to put forth the scientific information about it and when they say you’re not teaching the other side of the controversy, well, in science, there really isn’t a controversy on it. So it’s the same kind of thing I think—same kind of response you’d give when people are talking about evolution in science. That’s where I’ve kind of thought it through to the point, to right now.

Thus far, Ms. Hamilton also has not received challenges from the parents of her students regarding her strong adherent stance, yet she will not waver in her stance in the event that a parent challenges her. That she knows experts in climate science have reached consensus is vital to her ability to withstand any parental challenge: “Because I think if I didn’t know [climate scientists have reached consensus], I wouldn’t be so confident that I’m right in saying...It would make me more nervous that I would get challenged by a parent or a student.”

In summary, teachers who take a stance corresponding to the adherent curriculum within their classrooms make sense of this stance in several ways. First, they are fortified with an unwavering faith in the conclusions put forth by the Intergovernmental Panel on Climate Change (IPCC) and in the scientific consensus. Second, they maintain a strong rationale for teaching
about global warming. Third, taking an adherent stance aligns with their beliefs about what type of knowledge schools should pass on. Finally, the stance these teachers take is rarely challenged by other stakeholders; however, they feel confident defending their stance should challenges arise. In the next section I turn my focus to the eight teacher-participants who do not present an adherent version of the global warming curriculum in their classrooms.

Making Sense of a Hesitant Stance in the Classroom

Like the six teachers discussed above, some teachers who take a hesitant stance do so in part because it is consistent with their personal beliefs about global warming. For instance, Ms. Diaz, Mr. Bell, and Mr. Powell harbor reservations concerning the science supporting the theory of anthropogenic global warming and present this viewpoint to their students. Their beliefs about what it means to teach within their content area supports the hesitant stance they take. However, other teachers, like Mr. Williams, Ms. Foster, and Mr. Allen, hold personal beliefs about global warming that run contrary to the hesitant version they present. Generally speaking, what these teachers think about teaching in their particular discipline, the broader goals they have for their students, and, in some cases, the challenges from community members (whether real or anticipated) work in conjunction with their personal beliefs about global warming to shape how they present the topic to their students. Below, I discuss how those teachers whose personal beliefs about global warming align with their hesitant classroom stance make sense of the position they take with their students. Then, I discuss how those teachers whose personal beliefs do not align with the hesitant version of the curriculum make sense of their teaching stance.
When personal beliefs about global warming align with a hesitant stance.

Mr. Bell, Ms. Diaz, and Mr. Powell, teach a hesitant version of the global curriculum, largely consistent with what they personally have come to believe about global warming. Similar to the teachers discussed in the section above, what these teachers have come to believe about global warming plays an important role in determining the stance they take in the classroom; however, unlike the teachers discussed above, Mr. Bell, Ms. Diaz, and Mr. Powell do not believe that questions about global warming have “tipped” (Hess, 2009) to a closed position. They tentatively support the findings of climate science experts, yet they are more open than adherent teachers to entertain evidence refuting these findings. Furthermore, they may not know or agree that scientists have come to a consensus about the cause of global warming. It is important to all three of these teachers that students make up their own minds about global warming. It is also apparent for Ms. Diaz and Mr. Powell that the beliefs they hold about teaching their particular subject area closely align with, and thereby fortify, the hesitant stance they take in the classroom.

Mr. Bell, Ms. Diaz, and Mr. Powell are cautious in their support for the theory of anthropogenic global warming. Mr. Bell, an Earth Science teacher, believes that global warming will eventually be a problem for everyone, but it is nothing that will affect him during his lifetime. While he thinks it wise to heed the findings of the IPCC, he also recognizes some scientists think otherwise: “There’s people saying it’s happening, people saying it’s not happening. ... the truth’s gonna be in the middle somewhere. Every time a new report comes out, someone’s gonna write a counter report that says just the opposite.” Mr. Powell, also an Earth Science teacher, takes a similar tack. He believes that “it’s impossible to say that there’s no
evidence for global warming...”, yet he is “not going to sit at home and worry about it.”

Moreover, he is not inclined to believe that human activity is largely to blame for global warming. Humans are partly to blame, he concedes, but “I still believe in the natural cycle of things.” Concerning scientific consensus, Mr. Powell differentiates between “scientific evidence” and consensus, arguing that the scientific community is not in agreement:

And I don’t think, it’s not clear that somebody can stand up and say oh, climate change is occurring and it is definitely a result of this. It isn’t, I’m not convinced that somebody could say that that has caused this. How much of it is part of the natural processes that are going on? [...] So how much damage are we doing? I don’t know. So, yeah, I think the scientific consensus, well a better word is scientific evidence or observation, supports [the IPCC] beliefs, rather than consensus. I don’t think that the scientific community do agree amongst themselves...

Mr. Bell and Mr. Powell agree the way they present global warming to their students coincides with how they personally conceptualize it. Mr. Powell, for example, has students use data—whether generated from a lab that they participate in or a series of “then and now” pictures of glaciers that they analyze—to draw conclusions on their own. The result is that “they’ll all say something different, they’ll all have their own opinions...” about what global warming is and what is causing it. Mr. Bell reports that he makes an effort to present both the case for human activity and natural cycles as the cause of global warming and feels fine with students taking away their own idea regarding the cause. Whether students think human activity or natural cycles are to blame does not concern Mr. Bell.

These two teachers make sense of their hesitant teaching stance differently. Mr. Bell simply says his stance is based on “just my own personal belief.” Mr. Powell, on the other hand, uses his understanding of the process of science to help justify his teaching stance. “I want [students] to make their decisions and then come to their own conclusions about it,” Mr. Powell
explains, “So, I as a scientist, which is what I was trained as, that’s what I’m trying to do.” He continues, “What we try to do in Science is to get them to perform investigations, make observations, and draw their own conclusions.”

Ms. Diaz, a Nationally Board Certified Social Studies teacher in a large suburban school, is also consistently hesitant about global warming. I highlight her case separately from Mr. Powell and Mr. Bell because her thinking and teaching about the topic has changed dramatically in the past two years and thus illustrates a clear example of Hess’ notion that global warming is a topic currently “in the tip” (2009).

Three or four years ago, Ms. Diaz conceptualized the existence of global warming as a closed question: “I had thought that this was a closed issue. I had decided that it was closed, global warming exists. The people that don’t think it exists are nutjobs, they’re crazy.” However, the 2009 “Climategate” scandal3 made Ms. Diaz rethink her position on global warming. She admits:

You know, those emails really threw me. I really had to step back and say, whoa. Is this true? Are these stories true? Are these researchers really doctoring their data on this? You know, because there really are a lot of people that don’t agree with it and I have to ask myself, why?

To be sure, Ms. Diaz still considers global warming to be a very real problem and she believes that human activity contributes to global warming. Still, since Climategate she recognizes that a “tiny little bit” of her questions the consensus among climate scientists, because, as she puts it,

3 “Climategate” is the name given by the mainstream media referring to a series of leaked email conversations between top climate scientists purportedly demonstrating that they were misrepresenting their data in order to sway public opinion towards a more alarmed position regarding global warming. No less than eight committees reviewed the alleged unethical behavior and fully exonerated the scientists involved, finding no evidence of scientific misconduct. Furthermore, the scientific consensus that anthropogenic global warming is occurring did not change as a result of “Climategate.”
“how can all those [global warming skeptics] be completely wrong?... There’s so many and they are so resistant. What’s the reason for that?” Her personal belief regarding the cause of global warming has “tipped” from that of a closed question to one that is sympathetic to considering it an open question.

Consequently, Ms. Diaz’s classroom stance on global warming has undergone a corresponding shift. “The first two years that I taught [about global warming], I was like, oh, global warming is a fact and it’s happening and it’s an issue and let’s figure out how we can solve it,” explained Ms. Diaz. She recounts:

But then, I got the, you know, read about the emails, and that really changed my mind about it. It made me step back from the issue a little bit. And the reason why I didn’t teach it last year was because I wanted to see how all that was going to fall out. If the issue hadn’t tipped, then I needed to respond and teach it in a more different way.

Thinking about how she will teach global warming in the future, she states, “Now, when I teach it next semester, I’m probably going to try to find information that refutes that and see, I don’t know, see how that plays out.” She concludes, “I’d probably present it more as more of a controversy.”

While Mr. Bell’s teaching stance seems to be guided largely by his personal belief, and Mr. Powell’s stance is guided largely by his training in and beliefs about science, Ms. Diaz makes sense of her teaching stance by referencing both her personal beliefs about global warming and her feelings about what effective social studies teaching looks like:

I think it’s so important, this is one of my main, main things in my teaching because I want to be able to present controversies everywhere. I think that’s such an important part of teaching government, of teaching social studies.

She considers her role in the classroom to “serve up the issue, to just kind of present it and let them have it and then help them, guide them through their own decision making process on it.”
As a social studies teacher, particularly one who has expertise in political science, she feels that it’s important to recognize that the “global warming denial” viewpoint exists:

...there are so many people that deny global warming for whatever reason, it’s you know a conservative ideological way to win elections, say what you will about it, a lot of people don’t believe that. And I think it’s important to let kids know that. That’s part of my way of teaching both sides.

That her students learn “both sides,” even if one might fly in the face of what experts in climate science say, is important to Ms. Diaz because in her social studies class she focuses attention on the policy aspect of global warming--what she calls the “what are you gonna do about it?” piece.

When you get to the what are you gonna do about it piece, you have to consider the people that don’t believe it and so that, as I said before, kind of effects any kind of policy change that’s going to take place. So that’s a problem, too, the idea that we have to consider what other people think and is that valid, how is that going to effect our policy, I think that’s a problem. And I think people have to understand that as well. So that’s why it’s important to bring that other group in. But you risk making that incorrect idea valid when you bring that in. That’s a risk. Completely understood. And at least as a teacher, I totally understand that.

Offering views other than an adherent conceptualization of global warming is also important to Ms. Diaz because of her commitment to remain neutral in her classroom.

According to Ms. Diaz, “in a situation where you’ve got a lot of people believing one thing that, you know, might be scientifically incorrect, I don’t think you can just say that they’re wrong.” Ms. Diaz justifies this approach in two ways. First, she does not want to risk the connections she forms with her students by sharing her opinion about controversial issues:

So, if they determine that I believe one thing about a controversial issue, right away I think they’ll take a step away from me because they’ll see that maybe I disagree with them and that’s not how I see my role as a teacher. So, I am of the mind, I try to be as neutral as possible.
Aside from using neutrality to maintain her relationship with students, Ms. Diaz believes that by alienating students based on what they personally think about global warming she runs the risk of stifling the evolution of their own views. Ms. Diaz explains:

The people that believe that global warming is not a problem and isn’t caused by humans, [...] there are enough of them that you can’t just discount them. They won’t be discounted. And if you do, you run the risk of making what you say irrelevant to them and therefore they, you know, they won’t accept it. So I think its a way of keeping things open for the sake of discussion so that people then can create--they can formulate their own views.

In review, Mr. Bell, Ms. Diaz, and Mr. Powell take a hesitant stance when teaching their students about global warming, and this stance largely aligns with their personal beliefs about the topic. These teachers also want to help students consider “both sides” of the controversies and then make their own decision about which side they support. In the cases of Mr. Powell and Ms. Diaz, the beliefs they hold about teaching science and social studies, respectively, align with (and thereby fortify) the stance they take in the classroom. Indeed, one’s beliefs about what it means to teach in their given content area and a desire for students to make up their own mind regarding controversial topics are powerful components the teacher-participants in my study use to make sense of how they teach about global warming. So powerful, in fact, that they can--and do--influence teachers to take a hesitant stance in the classroom, even if such a stance runs counter to a teacher’s personal belief about global warming. It is to this phenomenon that I now turn.

**When personal beliefs about global warming do not align with a hesitant stance.**

Two teachers interviewed for this study hold worldviews that lead them to doubt the current scientific consensus about global warming. Mr. Allen, a civics teacher, and Mr. Taylor, and Earth Science teacher, self-identify as “doubtful” (Maibach, et al., 2009) about global
warming. They believe that natural cycles, not human activities, account for the increasing temperatures around the globe. Furthermore, they feel that global warming is not as serious of an issue as some make it out to be. Despite the fact that they personally question the veracity of scientific evidence supporting anthropogenic global warming, the stance these teachers take on the topic while teaching is not entirely colored by their personal beliefs.

Instead, each takes a more hesitant stance when teaching about global warming. Mr. Allen “endeavor[s] to spend a lot of time explaining both sides of the issue.” To do so, he provides students with data from both supporters and skeptics of the theory of anthropogenic global warming. For instance he has his students read pieces from the IPCC report in addition to reading reports from scientists skeptical of the consensus view. In the past he has shown clips from the documentary *An Inconvenient Truth* and used them to foster classroom discussion as a way of “balancing out any impression I might leave towards my own opinion.” Ultimately, what Mr. Allen hopes students are able to do as a result of his lessons about global warming is “make up their own mind.” “If you disagree with me, that’s great,” Mr. Allen explains, referring to his students. He wants students to get to a point “where they can acknowledge each other’s facts and say, ‘yes, I can see how you’ve interpreted it.’” Speaking about what happens in his science classroom, Mr. Taylor says, “I do present at least what global warming is said to be to my students, what could bring it up, if there are fluctuations maybe why it’s occurring, but I’m not trying to say you’ve got to agree with me.”

Both of these teachers make sense of the incongruence between their personal beliefs and their teaching stance by citing how their beliefs about teaching in social studies or science push them to take a hesitant stance. Mr. Allen considers the empirical evidence produced by climate
scientists as open to interpretation explaining that he knows “intelligent people who look at the facts and interpret it in a liberal mindset and [...] others who do it to a conservative mindset.”

This outlook informs what he believes to be effective teaching in civics:

I try very hard to teach my students, decide what you believe first and I always tell them, “check my facts. Don’t take what I say as gospel. And decide what you believe for yourself and then find a candidate that matches your beliefs. Don’t find a candidate you like and then wrap your beliefs around them.” And that’s, you know, it’s, I think that method of teaching politics is very counter-intuitive but it’s the way that it should be done. Or at least in my mind.

The idea of helping students interpret data and form their own conclusions also informs his broader teaching goals:

Remember the Wizard of Oz, where they’re standing in front of the great Wizard of Oz and Toto goes and pulls the curtain aside and they see the guy there pulling the levers and talking? So, a lot of times and not just for global warming, but for a lot of things, I see myself as Toto. I pull aside some of the rhetoric. Give them a chance to see raw facts, and discuss them. And by taking the Toto approach, I find that I actually, for want a better term, create a better thinking person because then they’re making up their own mind.

Mr. Taylor, too, espouses particular beliefs about what it means to teach in his content area, in this case science. These beliefs are clearly in tension with his personal beliefs about global warming. Here, he illustrates this tension and notes how it ultimately leads him to present a hesitant stance:

I guess just because my personal viewpoint is that [global warming is] not really happening, but at the same time, I don’t know, I don’t think, enough about it for me to say absolutely not, you know. And I guess just kind of presenting some things and discussing things from an open side and it’s a science class also, that, you know, things can always change and in science--they always do--so there’s the possibility that they could find more and more things about it that we could say, hey, this is something we need to be really concerned about, but I haven’t really seen that.

Interestingly, Mr. Taylor’s broad goal for instruction is similar to Mr. Allen’s in that he wants students to understand different interpretations of the empirical data regarding global warming:
...with something like global warming, I mean, science may project back beyond recorded time and say well, this is how things may have happened thousands and millions of years ago. I mean we’re always teaching things from the standpoint of God created things, you know, six thousand years ago or a little bit more than that and so what He tells us in scripture and the science that we’re talking about all has to match up with what we’re told there. [...] So, how does what I look at in the world today, someone who has a different viewpoint looks at the same data; well what’s our interpretation and what’s theirs?

The difference between Mr. Allen and Mr. Taylor’s approaches surfaces when looking at their motivation for helping students draw distinctions between different interpretations and the type of interpretation that they bring up in the first place. Whereas Mr. Allen taught about the “facts” being interpreted along politically ideological lines, Mr. Taylor, befitting his deeply seated evangelical religious values and the religious institution he teaches at, talks about helping students interpret the idea of global warming along the lines of religious ideology. Furthermore, the motivation behind helping students understand different interpretations also varies between the teachers. For Mr. Allen, its to “create a better thinking person” able to “make up their own mind.” Mr. Taylor, on the other hand, is trying to prepare students to succeed in secular public universities. “You know, our kids are going off to public universities,” Mr. Taylor explains, “And so how do they convey their viewpoints that they’ve learned, been blessed with in the faith, and all that about science with someone who doesn’t?”

To sum up, the hesitant stance towards global warming that Mr. Taylor and Mr. Allen take is influenced in part by their worldview. Tempering the manifestation of their beliefs in the classroom are their beliefs about what it means to teach in their discipline and the broader learning objectives they have for their students. Mr. Allen believes that teaching about politics means helping students draw their own conclusions by studying facts, and Mr. Taylor feels that he needs to, as a science teacher, at least mention evidence that runs against his own beliefs.
Broader goals they have for their students in general--preparing students for secular universities, for example--further influences them to take a hesitant stance.

Teachers who self-identify as doubtful about global warming are not the only ones who present a hesitant version of global warming misaligned with their personal beliefs. Mr. Williams, Ms. Foster, and Mr. Richardson reported being concerned, if not alarmed, about the ramifications of global warming. These teachers believe global warming is a cause for concern, that human activity is largely to blame, and that climate science experts have reached consensus about this. For instance, Environmental Studies teacher Ms. Foster believes that scientific evidence supports the idea that climate change is happening, and she is certain that human activity is to blame. Mr. Williams, an Earth Science teacher, reports, “I think about it, I know it’s out there, we’re causing it.” Mr. Richardson, who teaches Eastern Cultural Studies (a class he described as akin to World Geography), notes he is concerned about climate change and he, too, believes scientific consensus exists on the matter. While each of these three teachers may personally conceive global warming to be a problem caused by human activity, they do not take this stance when teaching. Instead, they favor taking an hesitant approach.4

When asked if the way she teaches about global warming is consistent with the way she personally thinks about it, Ms. Foster replied, “...it may not be. ... I try to be more neutral and not go over the top on my opinion.” She explains, “I want them to know what science, what the scientific data supports but I don’t try to tell them what they should think.” Likewise, Mr. Williams explains, “...I give [students] the option of looking at both sides.” According to Mr.

4 Ms. Foster and Mr. Williams reported that their teaching stance did not align with their personal stance. Interestingly, Mr. Richardson, reported that his curriculum did align with his personal stance. Analysis of my interview with him in conjunction with the classroom documents that he provided me indicate otherwise.
Williams, he presents the topic of global warming as an issue that is “closed with a crack.” By this he means that he presents the scientific evidence supporting the theory of anthropogenic climate change to his students, but he “[allows] them to have the ability to look at the ... data that or the the, I don’t know if conspiracy theory is the right word but, to look at the other data.”

What accounts for the misalignment of personal stance and teaching stance? It might be that these three teachers simply do not feel the same sense of urgency as those who take an adherent stance in their classrooms. For instance, Ms. Foster is not convinced that global warming affects her or others in Wisconsin at the moment. “Well I think it’s urgent because I think there’s a cumulative effect taking place. Although, is it affecting my personal life directly right now? I couldn’t probably come up with a lot...,” she explains. Mr. Williams is also uncertain about the urgency of the situation:

...in my lifetime I don’t know if I’ll see any extreme changes. I think as time goes on we will see things that are changing but they may happen slow enough to where we can evolve to them. But when I talk about my kids or my grandkids, I think that’s where my concern lays, that I can see it as a timeline that after a generation or two, if things keep going the way it is, then we’ve got some major problems.

Mr. Richardson, too, feels that global warming is a threat, but like Mr. Williams he is uncertain about when the impacts of global warming will affect earth: “So, it concerns me, ... I do think it’s a threat. Not sure at, how far off.” The lack of urgency may leave them more open to teach a hesitant perspective, especially when combined with their beliefs about effective teaching in their content areas and how they perceive and deal with challenges to their stance on global warming.

Some teachers believe the hesitant stance they take in the classroom is the most effective way to help students understand the stronger and weaker arguments on either side. Mr. Richardson and Mr. Williams feel that allowing students to study perspectives that run contrary
to the best available science helps students see holes in climate change skeptics’ arguments, thereby adding weight to the arguments supported by the scientific consensus. Mr. Richardson reports that in his global warming lessons he “[tries] to present different pieces of information and try to present different perspectives that are out there and have students read papers from different perspectives and then let them make their own choice.” While he recognizes that he “can’t control the eventual opinions [students are] going to form on this,” he hopes that by exposing students to both perspectives, “the more logical arguments are going to come out” in the end. Similarly, when asked why he allows his students to investigate, and then present on, scientifically unsupported ideas about global warming, Mr. Williams explains:

I guess part of it is by looking at the other arguments, that a lot of times can actually strengthen the argument for by seeing what they’re saying is the evidence to show that it didn’t happen, by knowing what they’re using for that evidence that can actually give the pro side more strength, and more data, more things to look at to help show why it is truly happening. So, in the long run it can actually help strengthen the argument.

Aside from believing students should make their own choice, Mr. Richardson feels the best pedagogical approach for him to follow is to remain neutral in his stance towards controversial issues. Mr. Richardson explains:

I guess when I teach it, I’m very careful with language because you do have a large range of opinions on it and I don’t, as a teacher, no matter what I’m teaching, I don’t want my opinion to be coming out. I bring up the issues and I try to stay very neutral and present information and let them come to their own conclusions.

Ms. Foster also believes that her teaching should not favor one side over another: “I try to present from a more neutral, from what I understand, you know, in discussions with environmental science teachers and just trying to promote greater environmental understanding

5 Ms. Diaz, the teacher discussed above as embodying the idea of “teaching in the tip” indicated a similar line of reasoning.
amongst people because you know there’s that whole conception of ‘oh, there’s those environmental wackos.’” While she hopes students arrive at the same conclusion as that of the vast majority of climate science experts, she acknowledges that not all students do:

C: Does anyone come down on the side of saying it’s not happening?

Ms. Foster: Oh yeah.

C: And how do they support it?

Ms. Foster: They, um… I don’t know. They, some of them don’t support it. They just say “I just don’t believe it.” More than anything.

C: What do you do in that situation?

Ms. Foster: I have to say, okay. I do. I just have to say, okay, but the data doesn’t support that. Or, the scientific data we have doesn’t support that.

Should one of her students ultimately conclude that global warming is not happening even after experiencing her environmental science class, Ms. Foster remains neutral despite knowing that the student is taking away a belief that runs contrary to what experts in the field think.

Ms. Foster, who has actively participated in statewide environmental education organizations in the past, believes taking a hesitant stance is pedagogically necessary when teaching about any environmental topic. She explains that her background in environmental education and especially coursework in her Master’s program influenced her decision to present the cause of global warming as an open question in her classroom:

Because, you know, we’re trying to, we hope, teach kids to not just be emotional, but look at science, look at data, make your own decision and not, because there’s that whole concept that anyone who is concerned about the environment is you know, one of those wacko environmental people, so people don’t just dismiss you, it’s like oh you’re just one of those tree huggers...
According to her understanding of environmental education writ large, it is important to present data, but not to endorse any particular stance for fear of not being taken seriously.

Mr. Williams and Mr. Richardson also take a hesitant stance because of the real or perceived challenges they face from those in the community who are “doubtful” or “dismissive” of global warming. Unlike Mr. Carlson, Ms. Hamilton, and Ms. Evans, who feel confident defending their adherent stance to parents and others in the school community, Mr. Williams and Mr. Richardson seek to avoid such challenges. Mr. Richardson is very cognizant of the fact that taking a stance akin to the adherent version of the global warming curriculum may invite challenges from parents, so he actively avoids doing so:

I guess we don’t get ever told or talked to about [remaining neutral], but definitely if I take a real strong stance on something and parent phone calls are coming into the district, I’m probably going to have a few words said, so I think most of the teachers here we teach that middle ground and let kids form their own opinions.

Still, Mr. Richardson struggles with the dilemma that goes with teaching “that middle ground.” He recounted a story of a time soon after the release of the documentary An Inconvenient Truth when a parent complained to the district about the film despite the fact that no teachers had used the film in class. “I don’t remember exactly the email that was sent out about that but it was kind of put out there that people are up in arms about this. To me that’s almost more reason why you should show something, if it’s controversial.” Mr. Richardson contemplated showing the film in class this year but ultimately decided not to. He reasoned, “I guess if I do, I always present a counter. So, what is going to be the counter if I show portions of [An Inconvenient Truth]?...[I] don’t want having kids reading something that I can’t support at all.”

Ms. Foster, like Mr. Richardson, has yet to be directly confronted by parents or other adults in the school community regarding teaching about global warming; however, she indicates
that the threat of being challenged influences how she presents the topic. She admits that she
does not spend significant time talking about her “opinion” about global warming--which
happens to coincide with what climate science experts think-- “because I don’t want [students] to
go home and say, ‘Oh, my teacher is trying to brainwash us even though mom and dad say it’s
not happening.’”

Being challenged by a parent is not just a perceived threat for Mr. Williams. Two years
ago, Mr. Williams faced a direct challenge to his global warming curriculum from the parent of a
student.

I had his [child] in class. So his [child] was doing the project and so she presented him
the project at home, saw it and he read it and very quickly came and let me know that the
project was ridiculously skewed toward the fact that humans have something to do with
global climate change and that that’s not right.

The parent, it turns out, happened to be an outspoken conservative member of the school board.
“So his push back was I think out of anything the strongest that I’ve felt anywhere,” recalls Mr.
Williams, “and I did assure him that I’m giving them the option of looking in the other route but
this is the scientific evidence.” Since Mr. Williams had previously changed this particular
assignment to allow students the option of investigating reasons for global warming other than
human activity, he did not feel the need to further modify his assignment as a result of this
challenge. Nevertheless, the incident serves as a potent reminder to Mr. Williams that he can and
will be confronted regarding how he presents publicly controversial topics.

In summary, teachers who personally identify as alarmed or concerned about global
warming yet take a hesitant stance in their classroom make sense of their teaching in a variety of
ways. Some cite their larger goals for instruction like wanting students to make up their own
minds as important to shaping the stance they take while others believe the best pedagogical
practice is for them to teach a hesitant perspective. Moreover, these teachers seem less willing or less supported to stand up to challenges from other stakeholders--especially from the administration--should they decide to take a more adherent stance.

Chapter Summary

The upshot of this chapter is that when teaching their students about global warming, teacher-participants in my study report taking stances towards global warming akin to the adherent curriculum and the hesitant curriculum. They reference multiple factors that help them make sense of the stances they take: their personal beliefs about global warming, their rationale for teaching about global warming, their beliefs about the purpose of teaching, and stakeholder support or opposition. Importantly, less than half of the teacher-participants I interviewed report taking a stance in their classrooms that positions the science supporting the theory of human-induced global warming as a closed issue. In my final chapter I draw upon these findings in addition to the findings presented in chapters five and six to discuss the implications my study has for educators and researchers.
Chapter Eight: Discussion and Conclusion

In the first chapter of this dissertation I discussed the deep divide among the U.S. public concerning their beliefs about global warming. One of the latest polls indicates 38 percent of Americans believe global warming is happening because of human activity, 18 percent believe global warming is due to a natural cycle, and 28 percent think global warming is not happening at all (Pew, 2011). Furthermore, what Americans think about global warming is highly correlated with political ideology. For instance, 43 percent of Republicans say there is solid evidence that the earth is warming, yet 77 percent of Democrats say solid evidence exists (Pew). This study sought to explore how U.S. secondary school curricula and teachers deal with such disparate beliefs about global warming.

In this chapter I highlight the major findings that help answer the research questions I posed in chapter one. Next, I consider the implications these findings have for educators, teacher educators, and researchers in terms of teaching about global warming, the role of ideology in the curriculum, and the preparation of citizens. Finally, I discuss limitations of this study and offer recommendations on how teachers, curriculum developers, and researchers might move forward in light of my work.

Reviewing the Study

My dissertation is a qualitative study exploring how U.S. high schools deal with the publicly controversial topic of global warming. I use the cultural theory of risk perception (Schwarz and Thompson, 1990) as a theoretical lens to analyze best-selling social studies and science textbooks, supplemental curricular materials about global warming, and interviews with secondary social studies and science teachers who teach about global warming. Below I briefly
review how the data presented in chapters five, six, and seven inform my answers to the three main questions posed in chapter one.

**How do U.S. textbooks and supplemental materials conceptualize global warming?**

Viewed as a whole, the range of global warming content within social studies and science textbooks and supplemental materials reflects a spectrum of conceptualizations found among members of the U.S. public. In chapter five I outlined three distinct categories of global warming curriculum (i.e. adherent, dissenting, and hesitant) differentiated by how each conceptualizes the topic. Adherent curricula speak to those members of the U.S. public closer to the global warming “alarmed” segment of the *Six Americas* spectrum (Maibach, et al., 2009) and conform to a conceptualization of global warming endorsed by the Intergovernmental Panel on Climate Change (IPCC). In the case of the six sets of supplemental materials and three textbooks I classified as examples of adherent curricula, global warming is portrayed as a serious and widespread problem on which societies around the world must take action. Adherent curricula consider the cause of global warming a closed question (Hess, 2009), the right answer being human activity--largely the burning of fossil fuels. Furthermore, these curricula impart the fact that there is widespread agreement among climate scientists regarding the nature of global warming.

Conversely, the dissenting curricula cater to the portion of the U.S. population who are “doubtful” or “dismissive” (Maibach, et al., 2009) of global warming. The two sets of supplemental materials I classified as examples of dissenting curricula are distinctly different than that of the adherent curricula in that they take a stance conflicting with the conclusions of the IPCC. In addition, the dissenting curricula position global warming as a low-priority
problem in no need of urgent attention. At first glance it seems the dissenting materials treat the cause of global warming as an open question (Hess, 2009), one with multiple and competing “right” answers; however, upon closer examination the materials consider this a closed question in which they want students to believe a natural cycle, not the burning of fossil fuels, is responsible for the recent warming trend. A primary method by which dissenting materials seed doubt about the cause of global warming is to claim a lack of agreement exists among climate scientists.

Finally, the hesitant curricula offer tepid support for the theory of anthropogenic global warming. Hesitant curricula position the cause of global warming as an open question: either human activity or natural cycles might be causing global warming. Since the cause of global warming is conveyed as an open question, climate scientists are necessarily conveyed as disagreeing about the phenomenon. I considered six textbooks in this study to be examples of the hesitant curricula. They speak to the cautious segment of the U.S. population who, taken as a whole, is less certain what to believe about global warming compared to the alarmed or the dismissive (Maibach, et al., 2009).

What messages do the curricula convey about how societies should respond to global warming?

As I illustrated in chapter six, the curricula by-and-large communicates only a narrow range of strategies for dealing with global warming and its associated threats. Content in adherent and hesitant textbooks and supplemental materials concerning “solutions” to global warming focuses on a range of mitigation strategies (strategies aimed at limiting the amount of greenhouse gases that are emitted into the atmosphere) and ignores adaptation and geo-
engineering strategies. Moreover, the adherent and hesitant curricula champion the government and individual citizens to lead the response to global warming. One important finding parses the government/individual citizen bias further. None of the six social studies textbooks or materials bring up taking individual action as a viable path to responding to global warming, and only one mentions conserving energy as a potential response. Rather, social studies curricula focus primarily on the role of governments in providing leadership on global warming. On the other hand, eight of the nine non-social studies curricular materials classified as adherent or hesitant highlight energy conservation and eight mention the need for individual citizens to take action on global warming. What little content the two examples of dissenting curricula include about addressing global warming submits that government intervention is not the preferred course of action to deal with the problem.

This all makes sense in light of the cultural theory of risk perception. For instance, of the Six Americas documented in Maibach, et al. (2009), the alarmed segment of the population is much more likely than the doubtful segment to strongly support a range of government actions, including regulating carbon dioxide as a pollutant, requiring automakers to increase fuel-efficiency standards, and signing an international treaty requiring the U.S. to make significant cuts in carbon dioxide emissions by the middle of the century. Furthermore, the alarmed are more likely than any other segment to contact elected officials in order to urge them to take action on global warming, engage in consumer activism, and to provide others with information about global warming (Maibach, et al.). Conversely, the doubtful and dismissive segments of the U.S. population, whose perspectives are given voice within dissenting curricula, believe global
warming should be a low priority for the government and report low rates of global warming-related political and consumer activism (Maibach, et al.).

How do U.S. high school social studies and science teachers personally conceptualize global warming and how are they making sense of the stance they take in their classrooms?

Similar to the range of conceptualizations in the curriculum, U.S. high school social studies and science teachers, like the U.S. public in general, hold a range of beliefs about climate change. Nine teacher-participants reported teaching a version of global warming which closely aligns with their personal beliefs. However, five of the teacher-participants I interviewed reported presenting a conceptualization of global warming in their classrooms that differs in fundamental ways from what they personally believe. Chapter seven explores this pattern. The upshot is that a teacher’s personal beliefs about global warming plays a large role in determining the stance she takes in her classroom, but it is not the only factor shaping how she presents global warming to her students. What she believes “good” teaching looks like, the broader goals she has for teaching about global warming, and how willing and/or prepared she is to confront challenges to her classroom stance also play a role.

Nine teacher-participants report taking a stance on global warming that is consistent with their personal beliefs. Ms. Evans, Mr. Carlson, and Ms. Hamilton, for example, are unwavering in their conviction that the recent global warming trend is caused by human activity and that climate scientists have reached consensus on the matter. Strengthened by their desire to impart “intellectually honest” content, their strong rationale for teaching students about global warming, and their confidence in their ability to fend off challenges to their curricular stance on global
warming, the stance these teachers take in their classrooms closely aligns with their personal conceptualization. Similarly, Ms. Díaz’s personal belief about global warming lines up with the stance she takes in the classroom; however, unlike Ms. Hamilton and Ms. Evans she personally holds a more tentative conceptualization. Ms. Díaz, who harbors some doubt about the veracity of scientific consensus about global warming, wants her students to be aware that disagreement on the matter exists. She further justifies her classroom stance by citing the purpose of her class (deliberating over policy, which necessitates an acknowledgment of multiple perspectives) and her desire to remain neutral on controversial issues as a matter of best practice in social studies education.

Other teacher-participants reported taking stances in their classrooms that did not correspond with their personal beliefs about global warming. Some of these teachers are personally alarmed or concerned (Maibach, et al., 2009) about global warming. For instance, Mr. Williams self-identifies as alarmed or concerned, yet he presents the cause of global warming to his Earth Science class as an issue that is “closed with a crack.” Said differently, he begrudgingly accepts that some students might come away with the idea that global warming is not caused by human activity. Mr. Williams takes this stance at least in part because of challenges to his curriculum from those who disagree with the scientific consensus. Unlike Mr. Williams, Mr. Taylor, who teaches science in a private high school affiliated with an evangelical Christian church, regards himself as “doubtful” about the theory of anthropogenic global warming, yet he, too, presents his students with a hesitant version of global warming. Mr. Taylor tells his students what he personally believes about global warming--that it is caused by a natural cycle--upon request. As a science teacher he also feels compelled to present what climate
scientists believe to be the cause of global warming--greenhouse gas emissions. Furthermore, he believes that in teaching the scientific perspective of global warming he is helping prepare his students, many of whom hold strong religious values, to interact with their soon-to-be peers in secular institutions of higher education. Mr. Taylor’s motivation to prepare his students is not unique among religiously devout teachers (cf. Hess, 2009) and brings to mind questions posed by Schweber (2006) regarding what it means to teach theologically certain students disciplines that are inherently inquiry based and what happens when these students attend public schools.

**Implications**

The findings discussed above pose a troubling conundrum. Some of the global warming curricula treat the cause of global warming--a question that is *not* scientifically controversial--as an open question (Hess, 2009). At the same time, much of curricula positions how we should address global warming--a question that *is* legitimately controversial--as a closed question (Hess), despite there being many reasonable responses to the issue. We present teachers who use either the best-selling textbooks or supplemental curriculum to teach about global warming with two choices: either they choose a curriculum promoting a view of global warming that runs counter to what the best available science tells us is true, or they choose a curriculum that often exaggerates scientists’ claims and limits students’ exposure to multiple and competing perspectives that deserve serious consideration. Both options lack educational soundness and integrity. Below I discuss some of the implications this conundrum has for teaching about controversial topics in social studies and science classrooms, for thinking about ideology in the curriculum, and for the preparation of citizens.
Teaching about controversial topics in social studies and science classrooms

Initially I anticipated that social studies curricula and teachers would be more likely to present the scientific evidence backing the theory of anthropogenic global warming as an open question and science materials and teachers would approach the matter as a scientifically closed question. After all, a major objective of social studies is to help youth consider the multiple perspectives that fuel controversial issues, while one purpose of science education is to impart knowledge learned through the scientific process. Recall from chapter two the National Council of Social Studies’ (NCSS) position that “Controversial issues must be studied in the classroom without the assumption that they are settled in advance or there is only one ‘right’ answer in matters of dispute” (NCSS, 2007) and the National Science Teachers Association (NSTA) promotes the viewpoint that “the professional responsibility of science teachers and curriculum specialists to provide students with quality science education should not be compromised by censorship, pseudoscience, inconsistencies, faulty scholarship, or unconstitutional mandates” (NSTA, 2003). It turns out that there are instances within both content areas whereby global warming is conveyed in a scientifically accurate manner. At the same time, there are instances within both content areas whereby global warming is not conceptualized in a manner consistent with what climate science experts have come to believe.

In an article exploring the pedagogical dilemmas of teaching intelligent design, another topic in which a large portion of the U.S. public disagrees with the scientific consensus, Hess (2006) argues that teaching scientifically settled topics as controversial in science or social studies classrooms is educationally irresponsible. Teaching intelligent design in science classrooms “distorts the purpose of science education” (p. 13), while doing so in social studies
classrooms undermines science education and science educators. Treating the scientific
questions about the cause of global warming as open, as Ms. Diaz and Mr. Powell advocate in
chapter seven, makes sense in that public schools belong to the public. It seems somehow
antidemocratic to cast aside the opinions of a large portion of the public who are concerned about
the validity of climate science. Yet, as I discussed in chapter four, global warming is not a
scientific controversy: an overwhelming body of scientific evidence supports the theory of
anthropogenic global warming. Until a body of empirically sound evidence surfaces suggesting
otherwise, I believe teaching the science of global warming as a controversial topic—whether in
the science or the social studies classroom—is educationally irresponsible. But presenting the
causes of global warming as a controversial topic is exactly what is happening in many high
school social studies and science curricula.

Given previous research on climate change education, this is not altogether unexpected.
Wise’s (2010) survey of high school science teachers in Colorado suggests teachers are aware of
the publicly controversial nature of global warming and this awareness influences, at least in
part, how they present global warming to their students. Two science teachers whom I
interviewed, Mr. Williams, who presents global warming as a topic which is “closed with a
crack” so that he can placate an influential school board member doubtful of the scientific
consensus, and Ms. Foster, who presents the cause of global warming as an open question so as
not to be accused of being “one of those wacko environmental people,” follow the pattern Wise
highlights. I found a similar phenomenon among some of the social studies teachers. Mr.
Richardson, for instance, presents a hesitant version of global warming as a means of avoiding
potential challenges from parents. Moreover, in support of Hess’ (2002) conclusion that
teachers’ personal views strongly influence what they consider to be a controversial topic in their classrooms, my research suggests a teacher’s personal belief regarding global warming is indeed an important factor influencing whether she presents the topic as controversial to her students. Complicating matters, my findings indicate that a teacher’s stance is also influenced by a host of other factors including his beliefs about what best practice looks like, his larger goals for his students, and challenges to his curricular stance. All of this underscores the notion that what gets taught in school is the product of the complex sociocultural context in which schools operate (Binder, 2002; Zimmerman, 2002; Evans, 2010).

Global warming may receive escalated levels of scrutiny in an increasingly polarized U.S. public. Wise (2010) uses data collected during the 2007-2008 school year, just before public polls began showing an increasingly divergent pattern in U.S. public opinion about global warming. At the time, Wise noted that public controversy was “not an important factor affecting the inclusion of instruction about climate change” but warns of the importance of monitoring “whether the effect of public controversy on the inclusion of climate change education remains small over time, as school-related climate controversy appears to be on the rise” (p. 306). My sample of teacher-participants is far too small to make generalizations; however, recall the experience relayed by Ms. Diaz. She decided against the inclusion of global warming as a topic of instruction in her social studies classroom because of the “Climate-gate” controversy. Perhaps Wise’s warnings should not go unheeded.

**Curriculum as a tool to advance ideology**

As I argue in chapters five and seven, the conceptualization of global warming offered in an overwhelming majority of non-AP-level social studies and science textbooks runs counter to
what climate scientists know about the causes of global warming. Instead, these textbooks treat the cause of global warming as an open question with multiple and competing “right” answers. Similarly, eight of the fourteen social studies and science teachers in my study report taking a hesitant stance in their classrooms, even if they personally believe the cause of global warming is not an open question at all. That high school students in science and social studies classrooms may not be learning an accurate conceptualization of global warming is troubling. But is something else going on? Are some global warming curricula used to advance a particular ideological position? I believe the answer is yes.

I want to be very clear here that I am not claiming that the goal of any of the teacher-participants I interviewed is to foster an uncritical acceptance of a particular ideological stance concerning global warming. To be sure, in chapter seven I did offer evidence suggesting that teachers’ personal conceptualizations of global warming are connected to their political ideology and that their personal beliefs indeed influence how they present the topic to their students. Still, without a more robust study including further interviews with the teachers and their students, direct observations of their classrooms, etc. such a claim is tenuous at best, not to mention unethical. Likewise, while the hesitant curricula (i.e. the non-AP level social studies and science textbooks) are often factually inaccurate and lacking specific detail, I do not believe I have the warrants to claim their intent is to advance a particular ideology regarding global warming. That being said, I found evidence that some curricula do serve as tools for promoting particular ideological positions regarding global warming.

To start with the low-hanging fruit, I believe the dissenting curricula are vehicles for promoting tenets espoused by the ideological right. These materials push students to take a
skeptical or dismissive attitude towards an empirically sound body of scientific information. This objective is made clear from the empirically unsupported claims they make about the natural cause of global warming, the conspiratorial tone they take regarding scientific consensus, and the climate science “experts” they choose to profile as authorities on the matter. Taken in context with the mission statements of the Fraser Institute and izzit.org, the organizations responsible for producing these materials, it is hard not to conclude the dissenting curricula are attempting to influence students--in this case to get them to accept a factually inaccurate conceptualization of global warming highly correlated in the U.S. with conservative ideology.

Both sets of dissenting materials imply natural cycles--in particular an increase in the amount of solar energy entering earth’s atmosphere--as the primary cause of global warming. In fact, the title of one set of materials, *Unstoppable Solar Cycles*, could not be more up front about the position it takes regarding the cause of global warming. Beth, the inquisitive narrator featured on the *Unstoppable Solar Cycles* DVD, brings this point home as she concludes, “One thing is certain--the sun’s natural cycles are a primary driver of natural climate cycles here on earth.” Also recall from chapter five some of the lessons highlighted in *Understanding Climate Change*, the other set of dissenting supplemental materials, that convey to students the importance of understanding “various factors that affect the amount of solar radiation that reaches the earth” (p. 56). This line of reasoning, that a change in the amount of solar energy reaching earth (whether due to phenomena like sun spots or the shape of earth’s orbit) is driving recent global warming, is a common trope among those skeptical of global warming. The problem with this argument, however, is that numerous empirical studies have studied the amounts of solar radiation reaching the earth and concluded the minor changes in solar output
since 1750 are not large enough to be responsible for the recent spike in average global temperatures (cf. IPCC, 2007, p. 38).

If curriculum developers truly wanted to help students understand what global warming is, one would hope they would perform the basic research necessary to create lessons conveying the most accurate empirical evidence. One would also hope the authoritative sources they choose to highlight are not political partisans funded in part by ExxonMobile, a company with a vested interest in fossil fuel consumption. However, environmental watchdog organizations like Greenpeace report that both Dr. David Legates and Dr. Willie Soon, the only two scientists featured in *Unstoppable Solar Cycles*, are financially connected to “big oil.”

One would further hope curriculum writers who wish for students to develop an “intellectually honest” conception of global warming would not portray the scientific consensus supporting the human-induced nature of global warming as the product of intentionally manipulated data. Yet *Unstoppable Solar Cycles* and *Understanding Climate Change* do just that. Dr. Legates, for instance, educates the viewing audience about how the IPCC reports are the product of policy-makers, intent on positioning global warming as a serious problem. According to Legates’ claims, policy-makers on the IPCC ask scientists to manipulate their data: “‘Can you change the science document to match our summary? We want to beef this up... we want to make it look worse.’ That’s not the way science is done.” Lessons in *Understanding Climate Change* use graphs commonly used to illustrate the human influence on global warming as examples of data mining, the intended outcome being that “Students will learn that data can be misused, whether by a selective use of data subsets or by graphing and charting tricks” (p. 69).
Some might argue the dissenting materials are simply promoting the laudable goal of “critical thinking.” However, when put into context with the tenets of conservative ideology espoused in the mission statements of the Fraser Institute and izzit.org, the persistent disregard for empirically sound facts, the singular reliance on “expert” authorities funded by large oil companies, and the improbable suggestion that thousands of climate scientists are manipulating their data causes one to question whether these materials truly intend to foster critical thinking skills. Rather, evidence indicates these materials intend to advance a particular agenda. In other words, dissenting materials are putting ideology ahead of empirical facts.

The dissenting curricula are not alone in painting global warming with an ideological brush. Six of the adherent curricula I analyzed in this study advance an ideology highly correlated with liberal beliefs via their extreme portrayal of global warming as a problem, their uncritical use of ideologically positioned sources, or their advocacy for particular responses to global warming favored by those with a liberal bent. Unlike the dissenting and the hesitant materials which downplay the significance of global warming on societies and ecosystems, the skewed predictions and alarmist language found in some of the adherent materials may exaggerate its significance. For instance, of the six adherent curricula that proffer a prediction as to how many degrees the average global temperature will rise by 2100, five report an upper extreme higher than what the IPCC’s 2007 Synthesis Report reports as the “best estimate.” Many of these curricula also exaggerate the predicted rise in sea level. The “best estimate” from the 2007 Synthesis Report is a 7.1-23.2 inch rise by the year 2100. The upper estimate reported in some of the adherent materials ranges from a specific 78.7 inches to a vague “several yards.”
Aside from the extreme predictions, some of the adherent curricula--in particular the AP-level textbooks--use alarmist language to make their point that global warming is a significant problem. Students reading these texts read of apocalypse-like outcomes should the level of atmospheric carbon dioxide reach a certain point: “Once we reach such a point, there is no going back. It is like going over a cliff” (Living in the Environment, p. 510), climate change is “more serious even than the threat of terrorism” with catastrophic consequences “on the level of nuclear war” (Living in the Environment, p. 506), and “severe and pervasive changes could result in a total restructuring of the landscapes of culture and the balances of human-environmental relationships presently established” noting that “Nothing...would ever be quite the same again” (Landscapes of Human Activity, p. 426).

Furthermore, what are we to think about National Wildlife Federation’s use of the documentary An Inconvenient Truth, narrated by former Vice President Al Gore? The documentary is the central text grounding students’ foray into learning about global warming, and while it may indeed convey ascientifically accurate picture of global warming, it is hardly objective. Rather, as Hess (2007) points out, the film is meant to motivate viewers to take immediate action on global warming, a moral struggle Gore suggests is on par with other issues throughout U.S. history like ending slavery, granting women’s suffrage, and desegregating schools. This is not a neutral stance, yet no where in An Inconvenient Truth in the Classroom are students asked to critically assess the perspective of the filmmaker.

Just as problematic as skewed predictions, alarmist language, and unquestioned perspectives are the actions some adherent curricula encourage youth to take to address global warming: actions that can easily be construed as ideologically partisan. Six Americas research
(cf. Maibach, et al., 2009; Leiserowitz, et al., 2011b) informs us of the different policy preferences, personal actions, and intentions endorsed by the various segments of the U.S. public. On one hand those in the dismissive segment of the population “oppose most polices aimed at reducing greenhouse gas emissions” (Maibach, et al., 2009, p. 17) and instead favor building nuclear power plants and increased drilling for oil. Moreover, they feel that “government, corporations and citizens should not be taking action to reduce [global warming]” (p. 17), and “have not engaged in any political activities aimed at reducing global warming and report low rates of consumer activism” (p. 21). On the other hand the alarmed “strongly support almost all policies that would reduce carbon emissions” (p. 17) and “want citizens, industry, and government to do much more to address the threat” (p. 17). Furthermore, the alarmed are much more likely than any other group to have contacted elected officials “to urge them to take action to reduce global warming” (p. 20), to educate others on the topic, and to report an intention “to engage in consumer activism over the coming year” (p. 20).

With this in mind, how does a student (or teacher or parent) who is not in the alarmed segment of the population make sense of the Wisconsin Department of Natural Resources’ Activity Guide? After all, learner objectives in this particular curriculum encourage outcomes that fit closely with actions favored by the alarmed segment of the population, like asking students to “pledge behavior change(s) that will lessen their impact on the environment” and “engage their peers and teachers to make commitments to reduce negative environmental impacts” (p. 82). How are students to interpret the call in Climate Change Connections and Solutions for them to “[demand] more efficient, climate-friendly products when you go shopping” in order to “influence manufacturers to care more about their effects on the
climate” (p. 108)? What is a student engaged with Will Steger’s *Global Warming 101* curriculum to do when, immediately after the teacher introduces the idea that “decisions we make today about what types of buildings and power plants to build will affect our levels of emissions in the future” (p. 48), they are asked to write a letter to policy-makers encouraging them to take action on global warming? All of these strategies, pledging to behave in a more environmentally friendly manner, educating others about the dangers of global warming, and contacting policy-makers to take action on global warming are actions preferred by the alarmed segment of the population.

**Preparing citizens**

Regardless of the ideological spin global warming curricula impart, anyone concerned with the civic mission of schools should be troubled by my findings. Democracy relies on an educated citizenry in order to deliberate over which policies to pursue. Vital to any policy deliberation are 1) a common baseline of “facts” from which all sides draw, and 2) multiple ideas and perspectives about how to address a given problem. If we want students to be able to confront the myriad threats of global warming, then they need accurate information about the problem and an understanding of the range of strategies available to them to address the problem(s). My research illustrates that the global warming curriculum, when taken as a whole, provides neither.

On top of largely failing to convey an accurate scientific account of global warming, the curricula’s single-minded focus on mitigation strategies limits students’ thinking regarding how societies might choose to address the threat(s) of global warming. I am not saying teaching students about mitigation strategies is unimportant: mitigation of greenhouse gas emissions is
important if we are to avoid (or more accurately if we want to help future generations avoid) even greater ecological and societal upheaval. However, positioning mitigation as the strategy to address global warming implies that mitigation can prevent, or at least quickly reverse, the effects of global warming. This is simply not true. The effects of human-induced global warming are manifest now (cf. McKibbon, 2010) and will continue to manifest themselves for tens or hundreds of thousands of years even if all greenhouse gas emissions ceased today (Stager, 2011). Consequently, we do youth a disservice by not also helping them think about how to adapt to and prepare for the anticipated changes brought about by global warming. Among other predicted changes, the shift in agricultural yields and cropping patterns, the movement of climate refugees within and across national boundaries, the small, though steady rise in sea level, the intensifying of weather systems, and the pole-ward shift of plant and animal ranges will no doubt influence how societies function and interact. It would be wise to help youth think through the policy dilemmas such changes will incur.

Ignoring geo-engineering strategies is also problematic. Like many who are concerned about climate change, I, too, am skeptical of large-scale technological interventions to “fix” the climate. However well-intentioned, the use of geo-engineering embodies the same type of hubris that got us to this point in the first place: that the natural world must be brought under control, and indeed can be brought under control by human ingenuity. Still, when deliberating policy in a democratic society all policies which a reasonable person could support must be considered, however unpalatable they may be to opponents of those policies.

Global warming curricula also limit students’ thinking about their role as citizens in addressing global warming. In their important work examining the politics of educating students
for democracy, Westheimer and Kahne (2004) outline three kinds of citizens curricula help shape. The *personally responsible citizen* obeys laws, votes, volunteers in the community, and recycles among other publicly responsible acts. *Participatory citizens* come to understand how governments and civic organizations work, are actively engaged in civic life at all levels of government, and might, for example, organize and participate in efforts to address social problems within the community. Finally, *justice oriented citizens* are attuned to structural issues of injustice within society and seek to organize and participate in social movements, like the Civil Rights Movement, that create systematic change. Recall from chapter six that some supplemental materials, for example *An Inconvenient Truth in the Classroom*, attempt to shape participatory citizens by encouraging students to organize collective action, often in the name of educating others about global warming. However, the bulk of the global warming curriculum I analyzed, and in particular the non-social studies focused materials, conceive a society of personally responsible citizens. Students are given laundry lists of “simple”—and environmentally responsible—actions they can take to mitigate greenhouse gas emissions ranging from driving at a constant speed to changing eating habits to using less energy at home. While some lip service is paid to matters of social justice (cf. Facing the Future’s *Connections and Solutions*), it is tangential to the goal of creating people who act in environmentally responsible ways.

**Limitations**

An important limitation is that my conclusions about how teachers present global warming within their classrooms are based on what they reported during our interviews and an analysis of their curricular materials, but not based on direct classroom observations. It could be
that how a teacher talks about presenting global warming is actually quite different than what
goes on in his classroom. Relatedly, the messages a teacher believes he is conveying about
global warming may be different than what comes across during his instruction. Moreover, a
teacher may not even realize the he is taking a particular stance to begin with. At any rate,
observing the teacher-participants as they teach about global warming would have added a level
of robustness to my work.

Second, no teacher-participants who self-identified as dismissive on the *Six Americas*
spectrum (Maibach, et al., 2009) participated in my study. Dismissives are the most adamant
among the *Six Americas* segments that global warming is not happening. It might be that there
simply are no teachers who hold this viewpoint; however, this seems unlikely. In fact, in the
process of recruiting teacher-participants I received this message from a science teacher whom I
contacted about the study: “I teach very little about Global warming because it doesn't fit [my]
curriculum...by the way it isn't happening anyway.” Instead, it could be that the very nature of
this study precluded those harboring a dismissive personal belief. I could have added nuance to
my analysis had I found a way to include participants with a dismissive perspective.

Finally, while I took measures to eliminate my biases while analyzing the data, a second
limitation to these findings is that I did not interview the authors of the textbooks or the
supplemental materials. Consequently, I was left to interpret the the authors’ conceptualization
of global warming solely from the materials they created--I did not have the advantage of the
authors’ input to clarify their intentions. That being said, it is unlikely teachers and students
using these materials have direct knowledge of the authors’ intentions, either, and are left, as I
was, to draw their own conclusions.
Recommendations: How Might We Move Forward?

One major finding of my study is that some of the supplemental materials and nearly all social studies and science textbooks portray global warming as something different than what experts in climate science have come to believe is true. This is unacceptable if we are serious about preparing youth to deal with the challenges they will encounter. One way to foster a more educationally responsible curriculum is to add specific standards for global warming instruction at the K-12 level in the content areas of social studies and science. The recent development and roll-out of *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (National Academy Press, 2012) is a promising step in this direction. Language within the social studies standards concerning global warming and a position statement from the National Council of Social Studies regarding the teaching of global warming would be welcome additions. In light of the fact that some teachers in both social studies and science are uninformed or uncertain about the empirical evidence supporting human-induced global warming, a second way to foster a more educationally responsible global warming curriculum is to expand and widely advertise the burgeoning web of professional development resources available to help teachers understand the topic.

In chapter two, I made a case for the inclusion of the topic of global warming within both science and social studies content areas. Teachers and administrators would be wise to consider the purposes of both types of classrooms and how teachers of science and social studies could collaborate to teach global warming coherently, responsibly, and in a way that contributes to the formation of democratic citizens. An educationally responsible global warming curriculum requires the science behind it to be taught as settled while leaving open the myriad questions
concerning how to best respond to the problem. I am inclined to believe the primary focus for
global warming curricula should not be on understanding why global warming is happening, but
rather on developing citizens able to understand, analyze, and deliberate the possibilities and
pitfalls of a wide range of responses to the problem.

I use the term “responses” as opposed to “solutions” intentionally. I have come to believe
that conveying to students the message that there is indeed a “solution” to global warming, a
message oft imparted by the global warming curriculum, is problematic for several reasons.
First, framing global warming as a problem which can be solved if we could just stumble upon
the right solution ignores that global warming is a wicked problem (Hulme, 2009). Wicked
problems are defined by “uncertainty; inconsistent and ill-defined needs, preferences and values;
unclear understanding of the means, consequences or cumulative impacts of collective actions;
and fluid participation in which multiple, partisan participants vary in the amount of resources
they invest in resolving problems” (Carley and Christie as cited in Hulme, p. 334). Wicked
problems have no “silver bullet” solution; rather, they have a multitude of responses pursued by
disparate actors. Complicating matters is that we have little idea what “solved” looks like. What
is the optimum climate we are trying to return to? Who decides, and who should decide?

Second, I think that when schools conceptualize global warming as a physical reality to
be solved, they miss an opportunity to help students think more deeply about how we live and
about our wider social goals. In Why We Disagree about Climate Change, Hulme (2009) argues
that climate change is more than a physical phenomenon to be studied and “solved.” Rather,
climate change “has more potency now as a mobilising idea than it does as a physical
phenomenon. Ideas can be used, but they can’t be solved” (p. 328). Hulme advocates
approaching climate change “as an imaginative idea, an idea that we develop and employ to fulfill a variety of tasks for us” (p. 329). He reasons:

...we need to see how we can use the idea of climate change--the matrix of ecological functions, power relationships, cultural discourses and material flows that climate change reveals-- to rethink how we take forward our political, social, economic and personal projects over the decades to come. (p. 362)

In the words of Hulme, “climate change teaches us to attend more closely to what we really want to achieve for ourselves and for humanity” (p. 363). With this in mind, we ought to re-envision how we teach about global warming altogether.

Instead of teaching about global warming only as a physical phenomenon to be solved or as a means to advance a particular ideology (an inherently undemocratic practice), I think it can be done in a way that is both educationally responsible and responsive to the goal of creating democratic citizens. First, a new curriculum would rightly treat the science of global warming as a settled topic so that youth would have a common foundation of facts and knowledge of the scientific process. Just as important, the curriculum would focus on helping students think through the wide array of perspectives among the U.S. public about what global warming means and what constitutes appropriate responses. Here students might learn about the values and assumptions undergirding each perspective, come to understand why different segments of the U.S. population favor different responses, deliberate over the prospects and challenges these responses entail, and think about how we might use the idea of climate change to advance the public good.

Future Research

Findings from my study could be supported, challenged, and extended through a range of future inquiries. First, this study focused only on the messages portrayed in curricular materials
and by teachers about the topic of global warming. It did not take into account the messages that students actually receive and internalize about the topic. Previous work (e.g. Boyes and Stanisstreet, 1998; Andersson and Wallin, 2000) has looked at the scientific facts students learn regarding global warming, but not the conceptualization of global warming students develop or their understanding of potential responses to global warming. Whether students adopt a similar conceptualization as the people and materials they learn from is unknown at this point but would be helpful in future efforts to design global warming curriculum.

Second, comparing the content of mainstream social studies and science textbooks to that of the AP textbooks illuminates a disconcerting pattern. AP textbooks offer a conceptualization of global warming that closely aligned with the scientific consensus, but mainstream textbooks do not. Does a similar pattern exist regarding instruction in AP courses versus instruction in non-AP level courses? Who in schools is given access to learning the most scientifically sound conceptualization of global warming? Exploring these questions would increase our understanding of issues of equity in educational quality.

Equally important would be an investigation into the AP curriculum. AP courses are modeled on comparable college-level courses and as such are seen as rigorous and valuable additions to a school’s curriculum. On the one hand, the AP textbooks are educationally responsible in that they treat the theory of anthropogenic global warming as a scientifically settled issue. On the other hand, the tone of the textbooks can be construed as alarmist and promoting a left-leaning ideological stance. What should we make of this?

Finally, a worthwhile extension of this study might include gathering the perspectives of those who created the supplemental curriculum. In their analysis of curricular materials about
the 9/11 terrorist attack on the World Trade Center, Hess and Stoddard (2007) interviewed authors of the supplemental materials in order to better understand the messages they intended to send about the event. A similar study interviewing authors of climate change materials would add a level of robustness to my study.

**Chapter Summary**

This study has provided some insight into how social studies and science teachers and curricular materials conceptualize the publicly controversial topic of global warming. The major findings illuminate broader implications for how teachers and curricular materials approach controversial issues in the social studies and science, how ideology informs curriculum, and how the curriculum does and does not promote the formation of particular types of citizens. The findings and implications suggest a need for standards in the core areas of social studies and science emphasizing educationally responsible global warming content. Perhaps more importantly, they suggest a need for a thoughtful reconsideration of what students must know about global warming in order to respond in such a way that both respects and strengthens our democracy.
References


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Appendix A: Initial email and questionnaire sent to potential teacher-participants

Hello Ms./Mr. ________,

I am a former high school social studies teacher and current graduate student in Curriculum and Instruction at the University of Wisconsin-Madison. I am running a study exploring how high school teachers teach about the topic of global climate change in their classrooms. [Name of person referring], [position held], provided me with your name as someone who has taught about global climate change in one of your courses.

My study involves analyzing textbooks and supplemental curriculum about climate change and conducting interviews with social studies and science teachers who teach about climate change. Participating teachers can expect to engage in one 60-75 minute interview at a mutually convenient time and location that focuses on how they approach teaching about global climate change. Some participants may be asked to participate in a follow up interview not to exceed 60 minutes. I anticipate all interviews to take place during September and early October of 2011; however, this timeline is flexible depending on participant availability. Please note that this study will not interfere with any of your contractual obligations to your school district. Furthermore, you will not be identifiable in any reports or articles stemming from this data; I will use pseudonyms throughout the entire study and alter any potentially identifying features of participants, including any identifying features of your school and school district.

To be able to take part in this study, you must have taught a formal lesson about climate change to high school level students within the last three academic years and be planning on teaching a formal lesson about climate change during the 2011-2012 school year.

If you are interested in participating or have any questions about the study, please reply to this message by September 15. Along with your reply, it would be of great help if you complete the brief questionnaire below and send it within the reply—it should take no more than 5 minutes to complete. Should you choose to complete this questionnaire, it is important that you understand:

- completing and returning this questionnaire in no way commits you to participate in this study
- you do not have to answer any questions and may skip individual questions that you do not want to answer for any reason
- all information you provide to these questions will be saved on a password protected computer. All information obtained from these questions will be destroyed on or before October 31, 2011, regardless of whether or not you participate in the study.

Very Respectfully,

Casey Meehan
Doctoral student, Curriculum and Instruction
University of Wisconsin-Madison

This email message has been approved by the UW-Madison Institutional Review Board.
If you are interested in participating or learning more about this study, please complete the following questionnaire and return it to Casey Meehan at author@email.edu by September 15. Remember, you do not have to answer any questions and may skip individual questions that you do not want to answer for any reason. Furthermore completing and returning this does not obligate you to participate in this study.

1. Name of high school you currently work at: ____________________________ in the _______________________ school district.

2. What departments are you affiliated with at your school? (Mark an “X” in all that apply)
   ___ Science
   ___ Social studies
   ___ Other (please list): _____________________________

3. A formal lesson about climate change is one that you have intentionally planned to teach. A formal lesson might include predetermined learner objectives that deal with climate change and/or lesson procedures that help teach students content about climate change. In other words, a formal lesson about climate change is not a spontaneous event such as mentioning climate change during class or fielding questions about climate change at the end of a different lesson.

   a) Have you taught at least one formal lesson about climate change within the last three academic years?
      ___ Yes
      ___ No

   b) Are you planning on teaching at least one formal lesson about climate change during the 2011-2012 academic year?
      ___ Yes
      ___ No

4. Please provide some basic information about the course(s) in which you plan to teach about climate change during the 2011-2012 academic year.

<table>
<thead>
<tr>
<th>Title of course</th>
<th>Main content area</th>
<th>Department</th>
<th>grade level</th>
<th>Required course?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex. Global Studies</td>
<td>Geography/History</td>
<td>Social Studies</td>
<td>10</td>
<td>Yes</td>
</tr>
<tr>
<td>Environ. Sci.</td>
<td>Earth Science</td>
<td>Science</td>
<td>11-12</td>
<td>No</td>
</tr>
</tbody>
</table>
5. Which of the following most accurately describes you and your stance on global warming? (Mark an “X” next to the appropriate category)

___ Global warming is a problem that is important to me and that I am very worried about how it is already affecting me and/or others in the U.S. I consider myself well informed about the issues: I am convinced that global warming is happening and that human activity is largely to blame. I believe that there is scientific consensus that supports these beliefs.

___ Global warming concerns me, though it does not present an *immediate* threat to me and/or others in the U.S. I consider myself somewhat informed about the issues: I am fairly sure that global warming is happening, that human activity is largely to blame, and that there is scientific consensus that supports these beliefs.

___ Global warming is something that I tend not worry about—it is not something I feel personally threatened by, though some people in the U.S. might be impacted within 50 years. While I am open to changing my mind, I think global warming is probably happening and that human activity might be the reason. There is a lot of scientific uncertainty about these things.

___ Global warming is not a problem that I worry about since it is unlikely to present a problem for people in the U.S. for at least several generations. If global warming is happening, it is likely caused by natural changes in the environment. There is a lot of disagreement among scientists about whether global warming is happening.

___ Global warming is not an important issue for me personally; furthermore, I do not think it will harm me personally or people in the U.S. I consider myself well informed about the issues: I am quite certain that global warming is not happening, or if it is, it is due to natural changes in the environment. There is a lot of disagreement in the scientific community about global warming.

___ Global warming is something I think and worry little about. I am not sure if it is happening, and if it is, I am not sure why it is happening. I know only a little concerning issues about global warming and could easily change my mind about the matter. I am unsure whether scientists agree or disagree that global warming is happening.

___ Other: ____________________________________________________________

6. How do you prefer that I contact you as the study moves forward?
   Email: (please provide best address here)

   OR

   Phone: (please provide best number here)

Thank you very much for your time. Please submit completed questionnaires to Casey Meehan at author@email.edu by September 15.
Appendix B: Interview protocol

Interview protocol for teachers

A. Context about course and teacher

1. How long have you been teaching? How long have you been teaching [subject area]?

2. In what class(es) do you teach about global climate change?

3. Thinking about the course that you teach about climate change…
   • Describe the course. For example, is it a required or elective course? What are the broader goals of the course?
   • Who typically takes this course?
   • How long have you been teaching about climate change in this course?
   • How many class periods do you devote to teaching about global climate change?
   • Do you use textbooks or supplemental curricular materials when you teach about global climate change? If so, which ones do you use and why?

4. If you had a chance to review the handout I sent you titled “Some Ways of Thinking about Global Warming”, which description, if any, from that list best describes your beliefs about global warming?
   If none of these describe your beliefs, tell me a bit about what you believe regarding global warming.
   How consistent do you think the way you teach about global warming is with your beliefs about global warming?

B. Defining global climate change

1. Why have you decided to teach about climate change, given all of the other things you could be teaching about in your course?

2. Pretend for a moment that I am an average student in your class and you just completed your lessons or unit on climate change. How would I complete this sentence: Climate change is ____________.

   Specifically,
   • Is climate change a problem? Why or why not?
   • What action, if any, should be taken? How urgent is it that action is taken?
   • What are the consequences if no action is taken?
3. Thinking for a moment about your global climate change curriculum as a whole, what, if anything, about global climate change is presented as genuinely open for debate, or controversial?
   - What factors influenced your decision to teach these aspects as controversial?

4. Please walk me through your example global warming lesson.

C. Goals for students

1. What do you want students to know about climate change as a result of your class?

2. What, if anything, do you want students to be able to do regarding climate change as a result of your class?

3. How are students’ knowledge/skills regarding global climate change assessed during your climate change lesson/unit?

4. Is there a particular view about global climate change that you want students to adopt or consider?

D. Role of Teacher

1. What content about global climate change is important for you, as the teacher, to know in order to teach your students about it?

2. When you teach about global climate change, what do you see your role in the classroom being?

3. What do you do in terms of disclosing your position about global climate change to your students? Why?

4. From your perspective as a social studies teacher or science teacher, what makes learning about global warming in your content area unique from learning about it in another area of social studies or science?

E. Conclusion

1. What, if anything, do you want me to understand about how you teach about global climate change that we have not yet covered?
Appendix C: Ways of thinking about global warming (adapted from Maibach, et al., 2009)

Some Ways of Thinking About Global Warming

1. Global warming is something I think and worry little about. I am not sure if it is happening, and if it is, I am not sure why it is happening. I know only a little concerning issues about global warming and could easily change my mind about the matter. I am unsure whether scientists agree or disagree that global warming is happening.

2. Global warming is not an important issue for me personally; furthermore, I do not think it will harm me personally or people in the U.S. I consider myself well informed about the issues: I am quite certain that global warming is not happening, or if it is, it is due to natural changes in the environment. There is a lot of disagreement in the scientific community about global warming.

3. Global warming is not a problem that I worry about since it is unlikely to present a problem for people in the U.S. for at least several generations. If global warming is happening, it is likely caused by natural changes in the environment. There is a lot of disagreement among scientists about whether global warming is happening.

4. Global warming is something that I tend not worry about—it is not something I feel personally threatened by, though some people in the U.S. might be impacted within 50 years. While I am open to changing my mind, I think global warming is probably happening and that human activity might be the reason. There is a lot of scientific uncertainty about these things.

5. Global warming concerns me, though it does not present an immediate threat to me and/or others in the U.S. I consider myself somewhat informed about the issues: I am fairly sure that global warming is happening, that human activity is largely to blame, and that there is scientific consensus that supports these beliefs.

6. Global warming is a problem that is important to me and that I am very worried about how it is already affecting me and/or others in the U.S. I consider myself well informed about the issues: I am convinced that global warming is happening and that human activity is largely to blame. I believe that there is scientific consensus that supports these beliefs.

7. None of the above descriptions aligns with what I think about global warming.