

Academic Freedom, Critical Thinking, and the Culture of American Science Education

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Karmen Melissa Stephenson

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Abstract

Since the publication of Charles Darwin's *On the Origin of Species* (1859) the topic of biological evolution has been controversial. While evolutionary theory is considered a foundational concept of the biological sciences, the role of the theory in public school science education remains controversial in the United States. In April 2012 the Tennessee Teacher Protection and Academic Freedom Act was passed, which provides protection for teachers who teach the "scientific weaknesses" of "controversial" scientific theories that include biological evolution, chemical origins of life, climate change, and human cloning—topics that are, according to mainstream scientific consensus, socially but not scientifically controversial. The law is based on the "Model Academic Freedom Bill" that was crafted, distributed, and promoted by the Discovery Institute. The purpose of this research was to explore the ways in which ideologies and rhetoric regarding American values and identity inform understandings of scientific inquiry and knowledge and influence educational policy and curricula. This project investigated the purposes and impacts of the Tennessee Teacher Protection and Academic Freedom Act through ethnographic analysis of legislative proceedings, interviews of legislators, and interviews of public and private high school science teachers. Interviews explored the perspectives of legislators and teachers regarding impacts of the law as well as attitudes regarding the influence of political, social, and religious ideologies on science education. This research is grounded in theories of social constructionism and Foucault's power/knowledge. Data were analyzed using grounded theory methodology and rhetorical and political discourse and frame analysis. The data in this study indicate that the passage of the Tennessee Teacher Protection and Academic Freedom Act was an ideological victory for anti-science movements and that many of the ideologies that serve to maintain the momentum and salience of anti-science movements are only tangentially related to the scientific theories that these movements reject. Rather, these ideologies embody important American values and therefore serve to broaden the appeal of anti-science to a larger proportion of the population. These values include democracy and the rights of voters to determine policy, freedom of religion, freedom of speech, and common sense and individualism.

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Introduction

How do religious, political, and educational ideologies and rhetoric regarding American identity and values inform understandings of the definitions and roles of scientific inquiry and knowledge? How do these understandings influence science education policy, curriculum, and pedagogy? While evolutionary theory is considered a foundational concept of the biological sciences, the role of the theory in public school science education remains controversial in the United States. Today, about one third of the American public continues to deny the validity of evolutionary theory and finds it to be in conflict with religious or other non-scientifically based explanations of the diversity of life (Berkman and Plutzer 2010; Long 2011; Shannon-Missal 2013). The scientific community contends that evolutionary theory is not scientifically controversial, though this consensus has failed to end the public debate. While laws that require or allow for the inclusion of religiously based content in public school curricula have consistently been declared unconstitutional, efforts to diminish the presence of evolutionary theory or to encourage the inclusion of creationism or other non-scientific alternatives in public schools have continued and have enjoyed consistent public support (Forrest and Gross 2004; K. R. Miller 2008; Moore 2002; Scott 2009). These efforts of the anti-evolution movement have been characterized by ideologies and rhetoric of an “American” identity that values democracy, freedom of religion and speech, common sense, individualism, and the rights of voters to determine policy (Bryan 1925; Caudill 2013; Larson 1997; Numbers 2006).

In April 2012 a law was passed in Tennessee that encourages critique of controversial scientific topics including biological evolution, climate change, chemical origins of life, and human cloning in public school science classes in spite of the scientific consensus that these topics are not scientifically controversial (Tennessee General Assembly 2012a, 2012b). This law, called the “Tennessee Teacher Protection Academic Freedom Act,” is popularly known as the “Monkey Bill” in reference to the “Scopes Monkey Trial” (*The State of Tennessee v. John Thomas Scopes*) of 1925. While supporters of the law have argued that it requires teachers to foster critical thinking skills and protects teachers from undeserved penalties when students raise controversial questions, opponents have argued that this law and others like it are attempts to

include religious ideologies and non-scientific content in public school science classes (Branch 2012; FACT n.d.; Flock 2012; Thompson 2012; Weinberg 2012; Zabarenko 2012).

The purpose of this research is to explore the perceived purposes and impacts of the Tennessee Teacher Protection and Academic Freedom Act through ethnographic analysis of legislative meetings, interviews of state legislators involved in passage of the law, and public and private high school science teachers. This research is grounded in theories of social constructionism (Apple 2014; Beckford 2003; Berger and Luckmann 2011; Elder-Vass 2012; Foucault 1972) and Foucault's power/knowledge (Foucault 1980, 2000; Rabinow 1991; Rouse 2010). Social constructionism provides a framework for investigation of the perceived incompatibilities of scientific and religious explanations of nature embedded in the evolution-creationism conflict (Apple 2014; Berger and Luckmann 2011; Elder-Vass 2012; Ruse 1999). According to Michel Foucault (Foucault 1972, 1977, 1980, 1982; Rabinow 1991; Rabinow and Rose 2003), power is conferred to those who possess knowledge that is valued in a society. Foucault's notions of power and knowledge are particularly useful in the context of the evolution-creationism debate, as socially and politically privileged and therefore "powerful" types of knowledge have changed and been contested since the Enlightenment, and the roles of science and faith in public life continue to be negotiated as a result. Since the Enlightenment scientific knowledge has been highly valued, and as a result scientific knowledge is often regarded as "truth." The impacts of changes in the status of scientific and religious knowledge have been seen in educational policies as well as in educational practice. Analysis of this power/knowledge relationship allows for consideration of the influence of changing cultural notions of scientific "truth" and the use of scientific and moral discourses in maintaining the evolution-creationism controversy (Elder-Vass 2012; Foucault 1980; Pennock 2001; Rabinow 1991; Rouse 2010).

The goal of this project is to supplement and enrich existing quantitative data from surveys, polls, and standardized test scores, as little qualitative data is available that demonstrates the perspectives of legislators or teachers; most studies have focused on the attitudes and beliefs of students and the public (Berkman and Plutzer 2010; Long 2011). Furthermore, the ongoing debate about science education has been the subject of little anthropological inquiry in spite of both its continuing impact on educational policy and curriculum and its relevance to the anthropology of education, religion, and politics. Some scholars (Harding 1991; Howell 2007;

Kapferer 2001) assert that modern academic standpoints result in a framing of fundamentalist Christians (and other anti-evolutionists) as people whose ideologies and behaviors are unreasonable and simple enough to be easily explained (Harding 1991; Howell 2007; Kapferer 2001). Susan Friend Harding (1991, 375) asserts that this modernist standpoint invariably characterizes fundamentalist Christians as “the opponents of modernity, progress, enlightenment, truth, and reason.” This leads to a situation in which this particular group of cultural “others” is considered less worthy of the “antiorientalizing tools of cultural criticism” that are afforded to “cultural ‘others’ constituted by discourses of race/sex/class/ethnicity/colonialism” (Harding 1991, 375). Perhaps this has contributed to anthropological disinterest in the intersections of anti-evolutionism and public education, as the activity of anti-evolutionists or their ideas in the political and educational spheres may automatically be characterized as dismissible. However, the dismissal of anti-evolution and other anti-science standpoints as a relic of backward or uneducated fringe groups oversimplifies the ongoing controversies and fails to acknowledge the reality that the anti-science movement is pervasive and has thrived for a century in modern American culture. The persistence of this debate indicates that there are still important questions regarding this ongoing relationship between anti-evolution and anti-science groups and “modern” Americans, science and scholarship, secular politics and government (Harding 1991, 2000; Howell 2007).

Legislators and teachers are key participants in the passage and enactment of educational policy, and as such these populations are at the center of educational controversies though their involvement may not always be at the forefront of public discourse. With a focus on these groups, the objective of this study is to contribute to an understanding of how culture, national identity, and values mediate understandings of science and how these debates persist and are negotiated in public education (Alters and Alters 2001; Berkman and Plutzer 2010; Long 2011; Scott and Branch 2006).

Chapter 1 outlines the history of anti-evolution legislation and court cases regarding the teaching of evolution in public schools and situates this political activity in the context of evangelical and fundamentalist Christianity as well as in the context of American values and identity. Chapter 2 discusses prior anthropological study of evangelical and fundamentalist Christianity and anti-evolution sentiment in American culture. This chapter also explains the utility of social constructionism and Foucault’s power/knowledge in the study of discourses and

framing in anti-science, politics, and public education. In Chapter 3 the research methodology is outlined, including description of the study populations and data collection methods which include semi-structured interviews as well as transcription of legislative meetings of the Tennessee General Assembly in which the Tennessee Teacher Protection and Academic Freedom Act was debated and passed. This chapter details the process of data analysis using the computer-assisted qualitative analysis software NVivo to employ grounded theory methodology and comparative political and rhetorical discourse and frame analysis. In Chapter 4 the study results are discussed, including legislator and teacher perspectives on the role of government in public education; perspectives on the Tennessee Teacher Protection and Academic Freedom Act; perspectives on science, on teaching controversial topics, and on critical thinking; and perspectives on the strengths and weaknesses in public education in Tennessee. Chapter 5 discusses the perspectives of legislators and teachers in relation to anti-science movements and the differences and similarities in the ways that legislators and teachers frame issues of science, education, and power. Chapter 6 details the project validity and limitations of the study, including limitations relating to methodology and participation and discussion of how saturation was achieved. The Conclusions and Recommendations for Future Research indicate that the ideologies that serve to maintain the success and popularity of anti-science movements are not restricted to evangelical and fundamentalist Christianity, but that issues of science in politics and public education have been framed in ways that appeal to broader American values including democracy and the rights of voters to determine policy, freedom of religion, freedom of speech, and common sense and individualism. Finally, this paper concludes that more and larger scale ethnographic studies could contribute to a clearer understanding of the impact of Academic Freedom legislation and the prevalence of the teaching of anti-science in public schools, and that in order to be effective science education advocates will have to develop a framework that resonates as effectively with American identity and values as that employed by anti-science movements.

Chapter 1:

Historical Context of Anti-Science Politics, Academic Freedom Legislation, and American Values and Science Education

Overview

Since the publication of Charles Darwin's *On the Origin of Species* in 1859 the topic of biological evolution has been controversial. The concept of evolution has been widely accepted in the scientific community, while the mechanisms of change have been debated and ongoing research continues to refine understandings of evolutionary processes. In the public realm, however, Darwin's theory has fueled a debate about religion, social issues, politics, and education that continues today. Contemporary surveys and polls consistently indicate that about one third of the American public believes that humans were created by God in their present form within the past ten thousand years. The reasons that members of the American public tend to reject evolutionary biology are numerous. For fundamentalist Christians, evolutionary science defies a literal interpretation of the Biblical account of human origins and problematizes the notion of humans as specially created and entitled to dominion over the world (Alters and Alters 2001; Bryan 1922, 1925; Numbers 2006; Singham 2009). Although the Catholic and mainline Protestant churches have accepted biological evolution and do not consider science to be at odds with their interpretations of the Bible, it seems that many people in the United States either

disagree with their churches on this issue or they are unaware that their churches have this perspective (Long 2011; Numbers 2006; Scott 2009; Scott and Branch 2006). In addition to these religious concerns, political and social motives are involved in the evolution-creationism debate. In the early- and mid-twentieth century evolutionary science was conflated with the concept of Social Darwinism and seen as linked with eugenics movements, the Holocaust, and other racist ideologies, policies, and actions (Alters and Alters 2001; Bryan 1922, 1925; Caudill 2013; Laats 2010; Numbers 2006). The idea of human descent from an apelike ancestor was and continues to be interpreted by many as a means to justify immoral or “animalistic” behaviors (Bryan 1922, 1925; Laats 2010; Lienesch 2007; Numbers 2006; Toumey 1994). The American values of “common sense” and “fairness” pervade creationist rhetoric, particularly in the debate regarding the inclusion of creationist viewpoints in public education. In spite of the conflict with mainstream science, creationists frequently employ the rhetoric and discourse of science in order to elevate their viewpoints to the status of scientific knowledge (Foucault 1980; Scott 2009; Scott and Branch 2003; Rouse 2010; Ruse 1999). In public education the evolution-creationism debate has centered on the questions of how science is defined and who possesses the knowledge of science, who decides what is best for children, and who should have the power to decide what students learn in school (Berkman and Plutzer 2010; Humes 2008; Larson 1997).

Historical Review of Anti-Evolution and Anti-Science in the United States

Anti-Evolution Laws and the Scopes Monkey Trial

By the 1920s, Charles Darwin's *On the Origin of Species* (1859) had been widely read and was generally accepted by the scientific community and by the public. However, the work of Francis Galton (a second cousin to Charles Darwin) and others who applied concepts of natural selection and "survival of the fittest" to society through concepts of eugenics and Social Darwinism caused some religious groups to find the concept of biological evolution problematic. Furthermore, in the 1920s there were many advancements in evolutionary biology and particularly in the understanding of human evolution due to an increase in fossil discoveries. This in conjunction with increased public high school attendance in the United States due to compulsory education laws and an increase in Christian fundamentalism led to the rise in anti-evolution sentiment and legislation in the 1920s (Larson 1997; Laats 2010).

In 1922 William Jennings Bryan began speaking against the theory of evolution (Bryan 1922). He warned against the "Menace of Darwinism," characterizing the teaching of evolution as promulgating "irreligion" and he argued that it would result in the loss of faith for Christian students (Bryan 1922). He also asserted that Darwin's work amounted to no more than "guesses" that result in "godlessness" and he asserted that the human eye is evidence enough of a creator (Bryan 1925)—this argument that nature implies design dates back to William Paley's *Natural Theology* (1802) and is an idea that remains prevalent in creationist discourse today. In 1924 Bryan gave a speech titled "Is the Bible True?" in Nashville, TN. Copies of the speech were distributed to the Tennessee Legislature, including Representative John Washington Butler. Butler was a farmer and thrasher from Macon County, Tennessee, who ran as a Democrat for the Tennessee State House of Representatives in 1922 (Larson 1997, 2003). In January 1925 he presented a bill that would prohibit the teaching of evolution of man from lower orders of animals and would prohibit school teachers from denying the Biblical account of the origin of

humans (National Center for Science Education n.d.). He stated that he chose to propose the bill because in his time as a teacher he had seen that public schools taught Darwinian evolution, and he had attended a sermon at his Primitive Baptist Church in which the pastor told a story of a young girl who came home from college an atheist after taking a university biology course in which she studied evolution (Larson 2003; Moore 2002; Numbers 2006). Butler drafted the bill and without any discussion in the legislature it was passed with a vote of seventy-one to five. A senate committee voted the bill down, but after a visit from evangelist Billy Sunday to Memphis in which he preached all the evils of evolution, the Senate passed the bill and Governor Austin Peay signed it in May 1925. This was the third anti-evolution law passed in the United States and more states followed suit after the passage of the Butler Act (Larson 1997; Moore 2002; Numbers 2006).

In response to the passage of the Butler Act, the ACLU published classified advertisements offering to defend anyone accused of violating the law. In Dayton, Tennessee George Rappleyea, the local manager of Cumberland Coal and Iron Company, convinced the county schools superintendent Walter White and local attorney Sue K. Hicks that the case would bring the town publicity. These community leaders met in Robinson's Drug Store in Dayton to orchestrate the case, including convincing John T. Scopes, a young local high school teacher, to act as the defendant (Larson 1997; Lienesch 2007; Scopes and Presley 1967; Tompkins 1965). Unlike the portrayal in *Inherit the Wind* (S. Kramer 1960), Scopes was not apprehended in the classroom in front of a poster portraying human ancestors. The case was intentionally planned and organized, and it remains unclear whether Scopes actually even taught evolution in his biology class at the local high school (Larson 1997; Lienesch 2007; Numbers 2006; Scopes and Presley 1967; Tompkins 1965). At the time of the trial, Scopes encouraged his students to testify against him and even coached the students on how to testify in order to guarantee his conviction.

In the test case of the Butler Act, *State of Tennessee v. John Thomas Scopes* (1925), defense attorney Clarence Darrow argued that the Butler Act violated teachers' individual rights and academic freedom. He asserted that Scopes should have the academic freedom to teach science (Larson 1997; Lienesch 2007; Numbers 2006; Scopes and Presley 1967; Tompkins 1965). Furthermore, he argued that there is not necessarily any conflict between the theory of evolution and the Bible. Eight experts on evolution were brought to Dayton to testify but only one was allowed to do so—Maynard Metcalf, zoologist from Johns Hopkins University. The

defense never intended to deny that Scopes violated the Butler Act by teaching evolution, the defense's assertion was that the law was unconstitutional. Therefore, the defense aimed to secure a conviction for Scopes so that the constitutionality of the law could be challenged through the appeals process that would follow (Larson 1997; Lienesch 2007; Numbers 2006; Scopes and Presley 1967).

As an attorney for the prosecution, William Jennings Bryan argued that Scopes did not have the privileges of freedom of speech or academic freedom in this case, for as a teacher Scopes was acting as an employee of the state (Bryan 1925; Larson 1997). Bryan asserted that as a state employee, Scopes was bound by the mandates of the Tennessee Legislature, the elected representatives of the voters, who as taxpayers were credited with paying teachers' salaries (Bryan 1925; Larson 1997). The taxpayers were assumed to be creationists and most of them likely were, so as a teacher Scopes' academic freedom was secondary to taxpayer and voter wishes (Bryan 1925; Larson 2003; Numbers 2006). Bryan's majoritarianism embodied the idea that voters individually have the right to impact policy, and that the "minority" of scientists should not be allowed to become an "oligarchy" that would dictate educational policies and content that taxpaying voters did not want. This concept remains popular today among creationists and among conservatives in general (Caudill 2013; Harding 2000; Lakoff 2002).

Over two hundred reporters from across the United States and some from London, England had traveled to Tennessee to cover the trial. The most famous coverage was by H.L. Mencken of *The Baltimore Sun* who ridiculed Bryan and the town of Dayton, describing it as a backward place full of ignorant "hillbillies" (Mencken 2006). On the seventh day of the trial, William Jennings Bryan was called to testify. Clarence Darrow posed questions meant to illustrate that the stories of the Bible are not scientific in an effort to critique literal Biblical interpretations as well as Bryan's limited knowledge of world religions and science. This most famous day of the case was portrayed by the media as a defeat for Bryan, though the prosecution would ultimately win the case (Larson 1997, 2003; Lienesch 2007; Mencken 2006; Scopes and Presley 1967; Tompkins 1965).

The Scopes Monkey Trial lasted eight days in the summer of 1925. The defense waived the right to closing arguments, so according to Tennessee law the prosecution was not allowed to offer any closing arguments prior to jury deliberation. Scopes was found guilty after only nine minutes of jury deliberation. The appeals process began, and the appeal argued that evolution

was too broadly and poorly defined in the law and that the law violated teachers' constitutional right to free speech. The appeal further argued that the law violated the state Constitution, which prohibited the establishment of a state religion and the Butler Act clearly privileged Christianity and even some particular subsets of Christianity. The appeal also argued that by outlawing the teaching of a particular scientific theory the law violated the Constitutional duty of the General Assembly to "cherish" science (Neal et al. 1925). The appeal was dismissed and the Butler Act was upheld as constitutional, and the Scopes verdict was overturned on the technicality that Judge Raulston had imposed the fine, while Tennessee law required that any fines over fifty dollars must be decided by the jury (Larson 1997; Neal et al. 1925; Numbers 2006). The Butler Act remained law until 1967, when Gary L. Scott was fired from his position as a high school science teacher in Jacksboro in Campbell County, Tennessee, for violating the Butler Act. Scott sued for reinstatement and the dismissal was rescinded, but Scott continued with a class action lawsuit that sought a permanent injunction against the enforcement of the Butler Act. In order to avoid this pending lawsuit, the Tennessee General Assembly repealed the law (Webb 2012).

Reframing the Issue: Flood Geology and Creation Science

The anti-evolution movement of the 1920s became fairly inactive following the Scopes trial, as most science textbooks minimized or removed coverage of evolution following the trial and evolution was essentially ignored in science education (Laats 2010; Lienesch 2007; Numbers 2006). Evolution was removed from public school science textbooks and if mentioned at all it was marginalized, so evolution was rarely taught even in states that had no anti-evolution statutes in place. This changed in the 1950s and early 1960s due to education reform as well as Constitutional cases involving First Amendment issues.

In the 1950s the "Space Race" and the USSR's Sputnik launch in 1957 spurred a national movement to reform and improve science education in public schools. The general American concern with communism and with Russian technological advances led to the concern that American students may be falling behind in science education and may not be prepared to compete, so in 1958 the National Science Foundation formed the Biological Sciences

Curriculum Study (BSCS). In 1963 the first BSCS textbooks, which presented evolution thoroughly, were published and widely adopted (Caudill 2013; Gunn 2004; Moore 2001, 2013). In 1962 compulsory prayer was declared unconstitutional in public schools in the case of *Engel v. Vitale*, and in 1963 compulsory Bible reading was declared unconstitutional in the case of *Abington School District v. Schempp* (Carper and Hunt 2009). This combination of events that were offensive to creationists and to many fundamentalist and evangelical Christians led to a resurgence in the anti-evolution movement. National education reform and the Supreme Court defeat of widespread and long-standing inclusion of Bible reading and Christian prayer in public schools threatened the popular notion of local control of schools as well as the majoritarian value of the rights of voters to influence educational policy, and the anti-evolution movement mobilized in response (Berkman and Plutzer 2010; Bryan 1925).

Following the widespread increase in the coverage of evolutionary theory in public school science classes, Susan Epperson's argument for academic freedom was successful in challenging the Arkansas law that prohibited the teaching of evolution. In the 1968 case of *Epperson v. Arkansas* laws prohibiting the teaching of evolution were declared unconstitutional (Moore 2002; Scott 2009; Scott and Branch 2006). Specifically, these laws were determined to be in violation of the Establishment Clause of the First Amendment, which states that Congress may not make laws that give preference to any particular religion. The *Lemon v. Kurtzman* (1971) case, while not about evolution, established the three-prong "Lemon Test" for determining the constitutionality of laws in terms of the Establishment Clause (Anderson 2000; Moore 2002; Scott 2009; Scott and Branch 2006). The three prongs of the Lemon Test are as follows: the law must have a secular purpose; the law must not result in government advancement of religion; and the law must not result in excessive government entanglement with religion (Anderson 2000; Moore 2002; Scott 2009; Scott and Branch 2006). If the law fails any of the prongs of the Lemon Test, then it is in violation of the Establishment Clause. In this climate the anti-evolution movement found it necessary to modify the overtly religious name and message of their anti-evolution efforts.

Following *Epperson v. Arkansas* and *Lemon v. Kurtzman*, the anti-evolution movement reframed creationism and modified the legislative approach to mandating its inclusion in public school science classes. The anti-evolution movement abandoned the terms "creationism" and "scientific creationism" that had been used since the 1920s and adopted the name of "creation

science” (Caudill 2013; Forrest and Gross 2004; Gunn 2006; Numbers 2006; Scott 2009), The new “creation science” was based on *The Genesis Flood* by John C. Whitcomb and Henry M. Morris, published in 1961. Henry M. Morris was a professor at Virginia Polytechnic Institute and State University and held a Ph.D. in hydraulic engineering. His scientific credentials and career at a mainstream secular university, while in a completely irrelevant scientific field to issues of earth’s origin and history, were thought by many anti-evolutionists to give secular and scientific legitimacy to flood geology, young-earth creationism, and “creation science” (Numbers 2006). Morris also founded the Institute for Creation Research (ICR), which published a “peer-reviewed” journal of research on young earth creationism. However, in spite of borrowing the practice of peer review from mainstream academic scholarship, none of the research of the Institute for Creation Research or similar organizations has been acknowledged or published in mainstream science journals (Moore 2002; Moore, Decker, and Cotner 2010; Scott 2009).

In the 1970s the anti-evolution movement’s next effort to mandate the inclusion of creationism in public school science classes came in the form of laws requiring “balanced treatment” or “equal time” in the teaching of biological evolution and “creation science” (Numbers 2006; Scott 2009). According to these laws if evolution were taught then creation science must also be presented with equal time and emphasis. Tennessee passed the first equal time legislation with the “Genesis Law” in 1973 (Edwards 2014; Moore 2002). This law stated that when evolution was taught equal emphasis must be given to the Genesis account in the Bible and it explicitly prohibited “the teaching of all occult or Satanical beliefs of human origin” (Edwards 2014). In 1975 the case of *Daniel v. Waters* was filed in federal court and the case of *Steele v. Waters* was filed in state court against the Tennessee Textbook Commission and its chairman Hugh Waters. In these cases the National Association of Biology Teachers along with two professors from the University of Tennessee and one public school teacher challenged the Genesis Law, claiming that it had no secular purpose and that it interfered with freedoms of speech, religion, and the press (Moore 2002; Moore, Decker, and Cotner 2010). In both cases the Genesis Law was declared unconstitutional (Moore 2002; Moore, Decker, and Cotner 2010).

“Balanced treatment” and “equal time” laws appealed to the common value of “fairness” and the idea that it is objective and democratic for students to learn “both sides” of debates (Caudill 2013; Scott 2009; Scott and Branch 2006). Like earlier anti-evolution campaigns, the “balanced treatment” and “equal time” mandates relied on the values of individualism and

democracy by requiring that creation science and evolution be treated equally in science education and giving both explanations an equal voice so that students could individually choose which explanation they prefer for the history and diversity of life on earth. Balanced treatment and equal time laws were later declared unconstitutional in violation of the Establishment Clause in *McLean v. Arkansas* in 1982 and by the Supreme Court in the 1987 case of *Edwards v. Aguillard* in Louisiana (Moore 2002; Moore, Decker, and Cotner 2010; Numbers 2006; Scott 2009). In spite of these explicit legal decisions, much of the American public still thinks that creationism or intelligent design should be taught in public school science classes—according to polls, about half of Americans think that creationism should be taught, while slightly less than half (43%) think that intelligent design should be taught (Gallup n.d.; Swift 2017). In these polls only slightly more people, 61%, think that the theory of evolution should be taught in public school science classes (Gallup n.d.; Swift 2017).

McLean v. Arkansas (1982) involved a lawsuit by the ACLU on behalf of twenty-three plaintiffs (individuals and organizations) to challenge the “equal time” statute (1980) that required the teaching of biological evolution and “creation science” equally in public school science classes (Moore 2002; Moore, Decker, and Cotner 2010). Judge William R. Overton’s decision stated that the equal time statute failed all three prongs of the Lemon Test. In addition, Judge Overton outlined important facets of anti-evolutionism, particularly regarding its non-scientific nature. The defendants argued that creation science was scientific and cited the work of Henry M. Morris and other “flood geologists” (Moore 2002; Moore, Decker, and Cotner 2010; Numbers 2006). However, Judge Overton ruled that creation science was non-scientific due to its absence from any peer-reviewed mainstream science publications. It was also declared non-scientific because the process of creation science research does not follow the scientific method and it does not have the same goal as scientific inquiry. In particular, creation science indicates that it is not scientific in that the conclusions of creation science are already known. Furthermore the data, which may be the same data used by scientists such as fossil evidence, is used to suit and support these pre-established conclusions (Moore 2002; Moore, Decker, and Cotner 2010; Scott 2009). Overton also stated that in cases such as this, the appropriate experts for consultation in questions of educational content and curriculum development are educators and experts in the field, who will use the prevailing knowledge of the field to determine

appropriate educational content (Moore 2002; Moore, Decker, and Cotner 2010; Scott 2009; Scott and Branch 2006).

In the case of *Edwards v. Aguillard* (1987) Louisiana's "Balanced Treatment for Creation-Science and Evolution-Science Act" was also found to fail the Lemon Test. The Louisiana law did not mandate the teaching of creationism or evolution, but it stated that in the event that one topic was taught, the other topic must be taught with equal emphasis and time spent. The law stated a secular purpose of protecting "academic freedom" and the court determined that the law did not further this stated secular purpose and that, in fact, it did endorse and advance a particular religious belief by mandating the inclusion of Biblical creationism in opposition to the theory of evolution (Moore 2002; Moore, Decker, and Cotner 2010; Brennan 1987). In this case the state had asserted that perhaps the legislature should have stated a goal of "fairness" (Brennan 1987). In the opinion Judge William J. Brennan stated that the law neither furthered the goal of academic freedom or of fairness or teaching all of the evidence, and that all the law achieved was limiting the freedom of teachers to determine the most appropriate content to include (Moore 2002; Brennan 1987). In spite of this the opinion did offer some hope to the anti-evolution movement as it stated, "We do not imply that a legislature could never require that scientific critiques of prevailing scientific theories be taught...teaching a variety of scientific theories about the origins of humankind to schoolchildren might be validly done with the clear secular intent of enhancing the effectiveness of science instruction" (Brennan 1987). In spite of this case and the invalidation of the law, Louisiana never repealed its balanced treatment act (Moore 2002; Moore, Decker, and Cotner 2010; Numbers 2006; Scott 2009, 2009).

Creationism Without the Bible: The Intelligent Design Movement

Following the failure of balanced treatment and equal time statutes and given the overt declaration in these cases that creation science is not scientific, the anti-evolution movement repackaged its ideas as "intelligent design" in the 1990s. The intelligent design movement was led by lawyer and law professor Phillip Johnson who founded the Discovery Institute in 1991, a think-tank for intelligent design and conservative ideologies based in Seattle, Washington

(Forrest and Gross 2004). The motives, goals, and strategies of the intelligent design movement were outlined in a document called “The Wedge” that was produced following a conference at Biola University called “Mere Creation” in 1996 (Discovery Institute Center for the Renewal of Science and Culture 1998; Forrest and Gross 2004). The document was published in 1998 and it included both five-year and twenty-year goals. Among those goals was the mainstreaming of intelligent design by promoting a definition of science that was not restricted to naturalistic explanations, as Johnson dislikes the methodological naturalism of science and often equates it with philosophical naturalism, which is not necessary for scientific inquiry (Discovery Institute Center for the Renewal of Science and Culture 1998; Forrest and Gross 2004; Scott 2004). Eugenie Scott (2009, 56) explains the distinction, stating that methodological naturalism is “a rule of science that requires that scientific explanations use only material (matter, energy, and their interaction) cause...To go beyond methodological naturalism to claim that the universe consists of only matter and energy—that is, that there is no God or, more generally, no supernatural entities—is philosophical naturalism...One can be a methodological naturalist but not accept naturalism as a philosophy.” The intelligent design movement also aimed to publish its work in peer-reviewed scientific journals in the next twenty years, though that goal was never achieved. In the late 1990s and early 2000s fellows of the Discovery Institute wrote on the “science” of intelligent design. Unlike some of its creationist predecessors, intelligent design allows for an old earth and for many components of evolutionary theory, but it tends to fill any “gaps” with a designer rather than defining questions for further investigation (Forrest and Gross 2004; Scott 2009; Scott and Branch 2003, 2006). The best known arguments for design are Michael Behe’s “irreducible complexity” (Behe 1996; K. R. Miller 2008) and William Dembski’s “specified complexity” and “law of conservation of information” (Dembski 1998, 2007; K. R. Miller 2008; Scott 2009). Behe’s concept of “irreducible complexity” suggests that some biochemical structures are irreducibly complex and could not have arisen through unguided natural processes, and he uses the bacterial flagellum and the blood clotting cascade as his primary examples (Behe 1996; Branch 2013; Mates 2002; Scott 2009). Dembski’s idea of “specified complexity” asserts that when complexity is seen in nature that it cannot be the result of mutation or natural selection, and his “law of conservation of information” implies that complex specified information cannot be generated spontaneously or otherwise independently of a designer (Dembski 1998, 2007; Dembski and McDowell 2008; Felsenstein 2007). These ideas

have been analyzed and debunked by the scientific community, though the books published on these ideas employ the discourses of science and some are even published by reputable university publishers, so the Discovery Institute has succeeded at creating material for public consumption that looks like science to many members of the general public (Caudill 2013; Forrest and Gross 2004; Scott 2009).

National education reform again came to the forefront of United States politics with the 2001 passage of No Child Left Behind (NCLB), a law that mandates more rigorous standardized testing and other measures of student performance in public schools. This reform, like that of the 1960s, led to a revitalization of the anti-evolution movement. An increased focus on standardized testing suggested that subjects such as evolution, that may be considered controversial and may not be covered thoroughly, would begin receiving more attention and coverage in science classes (Scott 2006; Caudill 2013). In response, and in spite of the failure of intelligent design to gain the support of the scientific community or a place in mainstream science textbooks and curricula, the Discovery Institute led the anti-evolution movement in attempting to make a place for their alternatives to evolutionary theory in public schools. In fact, Senator Rick Santorum even proposed an amendment to No Child Left Behind that was intended to promote doubt of evolutionary theory and to open the door to the presentation of alternatives to evolution in public schools. The amendment was ultimately not included in No Child Left Behind but it remained in the Conference Report (107th Congress House of Representatives 2001; Crowther, II 2012). The amendment stated, “The Conferees recognize that a quality science education should prepare students to distinguish the data and testable theories of science from religious or philosophical claims that are made in the name of science. Where topics are taught that may generate controversy (such as biological evolution), the curriculum should help students to understand the full range of scientific views that exist, why such topics may generate controversy, and how scientific discoveries can profoundly affect society” (107th Congress House of Representatives 2001). The Discovery Institute would later use the “Santorum Amendment” to imply that federal law supported their “Teach the Controversy” campaign, which aimed to insert the Discovery Institute-defined problems with evolutionary theory as well as intelligent design ideas such as irreducible complexity, specified complexity, and the law of conservation of information in public school science classes (Crowther, II 2012).

In 2005 two well known cases focused on the creationist insistence that the theory of evolution is worthy of doubt. In the case of *Selman v. Cobb County* (2005) stickers had been placed in science textbooks with the following disclaimer: “This textbook contains material on evolution. Evolution is a theory, not a fact, regarding the origin of living things. This material should be approached with an open mind, studied carefully, and critically considered” (Caudill 2013:87). In the case of *Kitzmiller v. Dover Area School District* (2005) teachers were required to read aloud a disclaimer to their students prior to teaching evolution. The four-paragraph disclaimer included the statement that the theory of evolution “is not a fact. Gaps in the theory exist for which there is no evidence...Intelligent Design is an explanation of the origin of life that differs from Darwin’s view...” (Lebo 2008:62). This focus on diminishing the accepted nature of evolutionary theory created an opportunity for creationists to promote their alternatives to evolution as both scientific and progressive. The disclaimers suggest that scientific theories may not be grounded in evidence and they imply that evolutionary theory is not only insufficient but that creationist alternatives fill the “gaps” in evolutionary theory. Neither case was legally successful, and the actions of both school districts were declared unconstitutional in violation of the Establishment Clause. However, the promotion of doubt about evolution has been effective (Caudill 2013; Epley 2007; Lebo 2008; Scott 2009).

The case of *Kitzmiller v. Dover Area School District* in Dover, Pennsylvania, has been the only real test of Intelligent Design in court. In 2005 when science textbooks were up for adoption in the Dover Area School District, several school board members became concerned that creationism was not included in the textbooks that were being reviewed. The actions of board members and the community prior to the case were quite dramatic. In one school board meeting board member William Buckingham declared that “these textbooks are laced with Darwinism,” expressing his distaste for evolutionary theory. He clarified his motives when he stated, “Two thousand years ago someone died on a cross, shouldn’t someone stand up for him?” (Lebo 2008, 72). The school board members were not the only ones acting out against the teaching of evolution, as a high school janitor removed from a classroom and burned a human evolution mural that a student had made and given to a science teacher. The school board ignored the advice from science teachers regarding good science education and what even counts as science, and they ignored the advice from the school district’s lawyer that the inclusion of creationism could lead to a costly lawsuit for the school system. The school board eventually

adopted a science textbook, though they were not pleased with it so they used donations from a local church to purchase the intelligent design textbook *Of Pandas and People* by Percival Davis and Dean H. Kenyon (1993) and gave them to the school as “reference materials.” The school board also designed the four-paragraph statement that they required teachers to read in class prior to teaching evolution, stating that evolution is “theory, not a fact,” and that “gaps in the theory exist for which there is no evidence.” The statement offered the theory of intelligent design as an alternative and informed the students that the supplementary textbook was available for reference. The teachers refused to read the statement, so the superintendent and assistant superintendent of the school system read the statement to the science classes while the teachers and several students opposed to this school board action waited in the hall.

The ACLU filed a lawsuit on behalf of eleven parents and community members who thought the actions of the school board were unconstitutional. The case came to be named after one parent, Tammy Kitzmiller. Though the Discovery Institute had provided resources for the school board including books, videos, and other educational and advocacy materials and they had influenced the change from the promotion of creationism to the promotion of intelligent design by the school board members, the Discovery Institute declined to be involved in the lawsuit (Humes 2008; Lebo 2008; K. R. Miller 2008). Only one senior fellow of the Discovery Institute, Dr. Michael Behe, testified on behalf of the “science” of intelligent design using his theory of “irreducible complexity.” It was at least somewhat expected that the judge in this case might be friendly to anti-evolutionism, as he is a Republican and was appointed by President George W. Bush (Humes 2008; Lebo 2008; K. R. Miller 2008; Scott 2009). However, after a forty day trial Judge John E. Jones III (Jones III 2005) rendered a decision that not only declared the school board’s action unconstitutional, but it also declared that intelligent design is not scientific. The school board’s policy failed the Lemon Test and the judge declared that the religious intentions of the school board were evident, though uncovering this was a challenge during the case. The defendants did not disclose the truth about their actions in their depositions or in their court testimony, particularly involving their own statements about creationism in board meetings and the process of raising money, purchasing, and donating the copies of *Of Pandas and People* to the school library (Humes 2008; Jones III 2005; Lebo 2008; K. R. Miller 2008; Scott 2009).

In addition to the religious motives of the school board, Judge Jones III also asserted that the religious foundations of intelligent design are apparent (Jones III 2005; Lebo 2008). This part of the case has been a favorite of science education advocates since the trial, as Dr. Barbara Forrest's study of earlier drafts of the textbook *Of Pandas and People* found that in 1987, the year of the Supreme Court case *Edwards v. Aguillard*, the book was changed to say "design proponents" in every place that had previously said "creationists." In fact, there was one typographical error that resulted in many "missing link" jokes because the find-and-replace function had apparently gone awry and left behind what many have termed a "transitional form"—"cdesign proponentsists" (Forrest and Gross 2004; Humes 2008; Lebo 2008; K. R. Miller 2008; Scott 2009; Scott and Branch 2006). Judge Jones III stated that although intelligent design proponents do not name the designer, it can be easily inferred that the Christian God is the designer according to their assertions and that intelligent design is a re-labeling of creationism (Jones III 2005; Lebo 2008). Judge Jones III stated that intelligent design by nature cannot be considered scientific as it invokes supernatural causation—for example, Michael Behe had to redefine science to justify his assertions regarding "irreducible complexity" in his book *Darwin's Black Box* (Behe 1996), and then in court admitted that by his new definition of science that allows for "logical inferences," astrology also counts as science (Humes 2008; Lebo 2008; K. R. Miller 2008; Scott 2009). Similarly to the *McLean v. Arkansas* case, Judge Jones III (2005) gave a significant focus to the absence of intelligent design in mainstream science. Not only were the arguments of design proponents debunked in court by experts for the plaintiffs, but intelligent design was not supported in the larger scientific community and it had not been published in any peer-reviewed scientific journals (and currently, more than a decade later, intelligent design is still absent from mainstream science publications). Though Michael Behe holds a Ph.D. in biochemistry and is a tenured professor at Lehigh University, none of his peer reviewed publications relate to his intelligent design work (Caudill 2013; Humes 2008; Lebo 2008; K. R. Miller 2008; Scott 2009). In his conclusion, Judge Jones III (2005, 138) stated that "The breathtaking inanity of the Board's decision is evident when considered against the factual backdrop which has now been fully revealed through this trial. The students, parents, and teachers of the Dover Area School District deserved better than to be dragged into this maelstrom, with its resulting utter waste of monetary and personal resources."

In response to the Dover case the Discovery Institute asserted that the judge’s decision was misguided and discriminatory and even labeled Judge Jones III an “activist judge” just as the judge had predicted in the court opinion (Jones III 2005; Luskin 2009, 2010, 2015). The Discovery Institute, like other anti-evolution organizations such as Answers in Genesis or the Institute for Creation Research, has maintained the argument that evolution is, in fact, a religion—the religion of “Darwinism,” and it continues to assert that intelligent design is scientific and that it is due to the “youth” of the field and due to discrimination from the “Darwinists” in control of mainstream science publications that intelligent design has yet to be represented in any peer reviewed science publications (Demar 2002; Discovery Institute 2017; H. M. Morris 2001). Although the anti-evolution movement is not ready to abandon intelligent design, they have developed a new approach to introducing their alternatives to evolution in public schools. Since the religious foundations and goals of the Discovery Institute and intelligent design have been exposed, now the anti-evolution movement promotes “Academic Freedom” legislation (Discovery Institute 2007; National Center for Science Education 2013). The anti-evolution movement had already explicitly appropriated the “academic freedom” concept in several cases in the 1990s-2000s, such as the case of Rodney LeVake in *LeVake v. Independent School District 656* in Minnesota in 2000 and others (Moore 2002; Scott 2000). While in the Scopes and Epperson cases it was argued that anti-evolution statutes violate the academic freedom of teachers, now the anti-science movement has appropriated the rhetoric of “academic freedom.” In these academic freedom cases teachers sued their employing districts, claiming that the mandate to teach only evolution and no alternatives to it was in violation of their academic freedom. In response to this proponents of evolution argue that teachers do not have academic freedom to teach “fringe” or otherwise unaccepted theories in science classes (Alters and Alters 2001; Gunn 2004; Scott and Branch 2006). A common analogy that science advocates use is that “Holocaust denial” is not a topic that teachers have the academic freedom to include in public school history courses, as it is not part of the mainstream knowledge or scholarship in the field. Following the Dover case, the Discovery Institute stopped promoting the inclusion of intelligent design in public school science classes and modified their “teach the controversy” approach (Discovery Institute 2017). Rather than promoting the teaching of alternatives to scientific theories that they find controversial, the Discovery Institute began promoting the “academic freedom” of teachers to foster critiques of these particular theories in

public school science classes. In 2007, the Discovery Institute (2007) published a “Model Academic Freedom Bill” online (see Appendix A for the text of the bill).

Academic Freedom Legislation

In April 2012 the Tennessee General Assembly passed House Bill 368/Senate Bill 893 (HB0368/SB0893), the Tennessee Teacher Protection and Academic Freedom Act (See Appendix A for the text of the bill), which promotes criticism of socially controversial scientific theories in public school science classes and protects teachers who “help students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught” (Tennessee General Assembly 2012a, 2012b). The bill was sponsored by Representative Bill Dunn of Knoxville, Tennessee, in the House of Representatives, and it was sponsored by Senator Bo Watson of Hixson, Tennessee, in the Senate. Both sponsors are Republicans. In the House of Representatives, the bill had twenty-three co-prime sponsors, and in the Senate the bill had two. Although the bill was actively and extensively debated and garnered national media attention from the time of its introduction in February 2011 until its passage in April 2012 (Flock 2012; Ghianni 2012; Thompson 2012), the bill was overwhelmingly supported by the legislature. The bill passed with 72 votes for and 23 against in the Tennessee House of Representatives and with 25 votes for and 8 votes against in the Tennessee Senate (Tennessee General Assembly 2012a, 2012b). The Tennessee Teacher Protection and Academic Freedom Act is popularly known as the “Monkey Bill” in reference to the “Scopes Monkey Trial” (*The State of Tennessee v. John Thomas Scopes*) of 1925 (Flock 2012; Ghianni 2012; Thompson 2012). This law does not explicitly require the teaching of creationist alternatives to evolution or limit the teaching of evolutionary theory but instead provides protection for teachers who teach the “scientific weaknesses” of “controversial” scientific theories that include biological evolution, chemical origins of life, global warming (which is now generally referred to as “climate change”), and human cloning (Discovery Institute 2007; Tennessee General Assembly 2012a, 2012b)—topics that are, according to mainstream scientific consensus, socially but not scientifically controversial (Caudill 2013; Maienschein 2007; K. R. Miller 2008; Pigliucci 2002; Scott and Branch 2003; Singham 2009). A similar law was passed by Louisiana in 2008, the Louisiana Science Education Act (see Appendix A for the text of the bill), and comparable bills have been

presented in Alabama, Arizona, Colorado, Florida, Indiana, Iowa, Kentucky, Michigan, Missouri, Montana, New Mexico, Oklahoma, South Carolina, South Dakota, and Texas since 2008 (Branch and Scott 2009; National Center for Science Education 2013). In May 2017 Alabama passed a House Joint Resolution that also follows the Discovery Institute’s Model Academic Freedom Bill (See Appendix A for the text of the Resolution) (Branch 2017).

The Academic Freedom Laws of Tennessee and Louisiana have many similarities. Both name the same topics as controversial—evolution, chemical origins of life, global warming, and human cloning—and state that teachers should help students critically assess these theories and topics. The Tennessee law belabors a focus on science in its wording, stating that students should be helped to “understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught” (Tennessee General Assembly 2012a, 2012b). In spite of the focus on science, the law does state that teachers and administrators should create an environment in which students are encouraged to “explore scientific questions, learn about scientific evidence, develop critical thinking skills, and respond appropriately and respectfully to differences of opinion about controversial issues” (Tennessee General Assembly 2012a, 2012b), so opinions are overtly acknowledged in addition to scientific evidence as at play in these controversial issues in science education. The Louisiana law does contain one important permission that is not explicitly stated in the Tennessee law, that teachers must teach material presented in the adopted textbook and “thereafter may use supplemental textbooks and other instructional materials to help students understand, analyze, critique, and review scientific theories in an objective manner, as permitted by the city, parish, or other local public school board” (Louisiana State Legislature 2008). The Tennessee law contains no mention of the use of supplemental teaching materials. Both laws state in identical language that the law is not meant to promote or discriminate against any particular set of religious beliefs, stating that the law “shall not be construed to promote any religious doctrine, promote discrimination for or against a particular set of religious beliefs, or promote discrimination for or against religion or nonreligion” (Louisiana State Legislature 2008; Tennessee General Assembly 2012a, 2012b). Neither law contains any specific directive for teachers regarding what content of the four controversial topics is to be taught or how the topics should be presented to students.

The laws passed by Tennessee and Louisiana and the bills proposed in other states all follow the language suggested for “Academic Freedom” legislation by the Discovery Institute, the Seattle, Washington think-tank that promotes intelligent design creationism (Discovery Institute 2007; National Center for Science Education 2013). These laws claim to promote the “academic freedom” of teachers and the development of “critical thinking” in students. Organizations that engage in science education advocacy such as the National Center for Science Education, the American Civil Liberties Union, and most professional organizations of scientists and science educators argue that Academic Freedom bills are meant to promote doubt of established scientific theories that are socially controversial and that they are aimed at creating a scenario in which teachers who present non-scientific alternatives to these theories in public school science classrooms can do so with legal protection (Branch 2012; Weinberg 2012). These proponents of science education continue to emphasize that while the social controversies surrounding these theories are important and may be worthy of inclusion in public education, the place for such inclusion is not in science classes as the controversies are not scientific. While the Discovery Institute and other anti-evolution organizations state that they do not advocate for the inclusion of intelligent design or other versions of creationism in public schools, they do argue that there are scientific controversies within mainstream science regarding evolution and climate change in particular and that the science is, in fact, not “settled” (Discovery Institute 2017; Ham and Foley 2016; Klinghoffer 2017). They claim that acknowledging and studying these controversies in science improves science education and helps students develop critical thinking skills, while those in opposition to Academic Freedom Bills argue that the controversies surrounding these issues are exclusively social and political. In response anti-evolution advocates claim that mainstream science has a political agenda as well, one that is exclusively liberal (Caudill 2013; Discovery Institute Center for the Renewal of Science and Culture 1998; Forrest and Gross 2004; Gunn 2006; O’Leary 2017; Pennock 2001).

Academic Freedom bills and laws illustrate a shift in the rhetoric employed in the evolution-creationism debate in the past ninety years. In the Scopes trial of 1925, defense attorney Clarence Darrow argued for the academic freedom of John T. Scopes to teach science while William Jennings Bryan advocated for the right of parents as taxpayers to determine what their children should be taught in public schools (Bryan 1925; Laats 2010; Larson 2003; Moore 2002; Moore, Decker, and Cotner 2010; Scott 2009; Scott and Branch 2006; Singham 2009).

This assertion of the academic freedom of teachers was made again in the 1968 case of *Epperson v. Arkansas*. Since the beginning of the intelligent design movement the concept of academic freedom has appropriated by anti-evolution and anti-science advocates, and while educators felt “persecuted” by anti-evolutionists and anti-evolution laws through much of the twentieth century, now the anti-evolutionists’ claim is that they are victims of academic persecution at the hands of “Darwinists” (Berkman and Plutzer 2010; Caudill 2013; FACT n.d.; Moore 2002; Moore, Decker, and Cotner 2010; Luskin 2013). The anti-evolution movement uses this concept of academic freedom to promote the teaching of doubt of evolution as well as non-science alternatives to evolution, all in the name of promoting the publicly supported and valued skills of civil debate and critical thinking.

Religious Fundamentalism and Anti-Science Movements

A literal reading of the book of Genesis and social and moral opposition to evolutionary theory are not the only contributions of fundamentalist and evangelical Christianity to anti-evolution and anti-science movements. Following the Scopes trial, many fundamentalist Christians “self-segregated” to some degree as they wished to avoid the sins and evils of “modern” culture (Harding 2000; Israel 2004; Long 2011; Stevens and Giberson 2011). Through the 20th century fundamentalist Christians established what Randall Stephens and Karl Giberson (2011) call a “parallel culture” in the United States, and this parallel culture has contributed to the success and longevity of the anti-evolution movement in the United States. One primary function of the parallel culture is that it provides insular social networks. David Long (2011) writes that one primary stumbling block to science education is that acceptance of evolution does not simply rely on strong scientific evidence and good classroom pedagogy. Regardless of the quality of science education, acceptance of evolution can come at a major social cost as most fundamentalist Christian students have families and social networks that are embedded in the church (Long 2011). Stephens and Giberson (2011) attest to the extensive nature and power of these social networks, and as an example they offer a case study of a man who is a college graduate and works for a secular university who has never had a friend who was not also a born-again Christian.

Though the fundamentalist parallel culture may have begun as a separatist movement, it has been deliberately and increasingly intertwined in mainstream American culture for decades (Fitzgerald 2017; Harding 2000; Howell 2015; Stevens and Giberson 2011). In the 1980s Jerry Falwell’s Moral Majority led to a new level of academic and legal sophistication in the anti-evolution movement, as Falwell and other leaders like him including Jim and Tammy Faye Bakker, Pat Robertson, and others created a large umbrella movement for evangelical and fundamentalist Christians (Fitzgerald 2017; Harding 2000). In this movement theological differences between sects of evangelical and fundamentalist Protestants of various types were diminished, while the moral and political goals of the movement were standardized and emphasized (Fitzgerald 2017; Harding 2000; New 2012). Followers were encouraged to leave

the separatist ideology behind and instead to become participants in mainstream society—people were encouraged to seek post-secondary education and become evangelists in the workforces of education, medicine, business, or any other professional field (Fitzgerald 2017; Harding 2000; New 2012). In the years of separatism the parallel culture established primary and secondary schools, universities, publishing houses, media outlets, retail establishments, law firms, museums, and other services that allow for the production and dissemination of educational materials, entertainment, and social support to cater specifically to fundamentalist ideologies and goals as well as to maintain and expand the fundamentalist movement. This parallel culture of fundamentalist Christians and all of the educational, economic, and political institutions established within it have proven to provide a successful foundation for participation in mainstream culture, as Christian fundamentalism has been inserted and in some ways integrated into popular culture, and fundamentalist Christians have been active participants in social and political discourses since the 1980s (Fitzgerald 2017; Harding 2000; Howell 2015; New 2012).

In addition to the social networks established by the parallel culture, fundamentalists have established many systems and services that parallel those available in mainstream culture such as schools and universities. Intellectual elites have always been mistrusted in American society, and in the 1960s the civil rights and feminist movements as well as “cultural liberation” in general led to a heightened fundamentalist distaste for academia (Fitzgerald 2017; Harding 2000; Stevens and Giberson 2011). The establishment of K-12 private schools gives fundamentalist parents the option to have their children educated in schools that develop curricula that contain religious components and that align with the fundamentalist Christian worldview, which is not possible in public schools due to state curricular mandates and due to the Establishment Clause of the Constitution (Fitzgerald 2017; Butler 2010; Harding 2000; Long 2011; Stevens and Giberson 2011). This allows parents to enroll their children in schools with teacher-led prayer and Bible reading and to avoid evolution and “politically correct” education. Colleges and universities are also part of this parallel culture. Though the post-secondary fundamentalist education institutions began as seminaries and Bible colleges, now the United States has several evangelical and fundamentalist liberal arts colleges and universities that train students to enter the secular workforce or graduate and professional degree programs in a variety of fields (Fitzgerald 2017; Harding 2000; Long 2011; Stevens and Giberson 2011). Susan Friend Harding (2000) asserts that these colleges and universities were essential in helping Jerry Falwell

reach his goal of encouraging members of his Moral Majority to participate socially and politically in mainstream society—providing students with a fundamentalist education that qualifies them to join the secular professional workforce. These accredited colleges and universities train students to become professionals in business, education, medical professions, science, and other professional fields just as public and private secular colleges and universities do. In an accreditation concern in the 1990s, Jerry Falwell’s Liberty University had to remove creationism from its science education courses under threat of graduates being denied teacher licensure, so the university created a required course on creationism that education majors must take in addition to the required science courses, and consequently these students graduate with qualifications to teach science in public schools (Harding 2000).

Many creationists have credentials that are assumed to serve as a guarantee of the validity of their work. For example, Henry M. Morris held a Ph.D. in hydraulic engineering and was a professor at Virginia Polytechnic Institute and State University when he co-wrote *The Genesis Flood* (1961) with John C. Whitcomb (Fitzgerald 2017; Harding 2000; Scott 2009). The science in this book had been debunked before the book was even published, but to much of the public this “flood geology” appeared to be a legitimate scientific alternative to accepted biological and geological explanations of earth’s history (Caudill 2013; Numbers 2006). Although the “irreducible complexity” in Michael Behe’s *Darwin’s Black Box* (1996) has been debunked, much of the public still believes it is a scientifically valid argument against the “randomness” and “chance” of evolutionary biology (K. R. Miller 2008; Numbers 2006; Scott 2009). This is at least in part due to the fact that Michael Behe holds a Ph.D. in biochemistry and is a tenured professor at Lehigh University with many peer reviewed publications—although, as stated previously, none of his peer reviewed publications have anything to do with his intelligent design work (Forrest and Gross 2004; Lebo 2008; K. R. Miller 2008; Scott 2009). Creationists even have many of their own natural history and science museums, the best known of which are the Creation Museum and Ark Encounter operated by Ken’s Ham’s Answers in Genesis in Kentucky. Creationists have books, magazines, and websites, and many even publish their own “peer reviewed” research. These books, journals, and websites use the language and discourses of science and many appear as though they could be comparable to scientific publications. However, though the process of peer review has been borrowed from mainstream scientific publication practice, creationist and other fundamentalist Christian journals differ in that there is

an explicit expectation that authors and reviewers adhere to the standpoint of a young earth and a special creation based on a literal reading of the Book of Genesis (Creation Ministries International n.d.; Lisle 2014; Snelling 2008).

The fundamentalist parallel culture has been quite successful in the media from the mid-20th century to the present (Caudill 2013; Fitzgerald 2017; Harding 2000; Howell 2015; Larson 2003; Numbers 2006). In the popular news media, the anti-evolution movement's efforts to portray evolution and various permutations of creationism as equal sides of a scientific or political debate have been successful. This is partially due to the tendency in the news media to portray all sides of debates as equal in order to remain "fair," "balanced," or "impartial" (Caudill 2013; Lebo 2008; Scott 2009). Additionally, fundamentalists have taken advantage of media technology to disseminate their messages through radio shows, television shows, and feature films and documentaries as well as through online and print publishing. Organizations such as Answers in Genesis, the Institute for Creation Research, and the Discovery Institute have news, blogs, educational materials, and their peer-reviewed "science" content available online and in print. These well-funded organizations produce output that looks much like research that is published in science and academia. The use of this media allows messages to reach the general public in a variety of ways and allows these organizations to produce work that appeals to numerous audiences, including students, parents, educators, and individuals with varying levels of scientific literacy and interest in creationism. One important advantage that anti-evolutionists enjoy is that not only do their publications reach the public much more than peer-reviewed scientific journals, but creationists tailor their publications for consumption by a lay audience. This results in creationist literature, shows, and films being more accessible and "making more sense" than scientific information to people with little background in science (Caudill 2013; Forrest and Gross 2004; Scott 2009; Numbers 2006; Scott and Branch 2003, 2006).

A final and important component of the fundamentalist parallel culture that has influenced anti-evolution and anti-science movements includes other organizations that provide services tailored for conservative Christians. Christian bookstores and other specialty retailers of Christian products are quite successful. There are many museums such as Answers in Genesis' Creation Museum and Ark Encounter in Kentucky that aim to fill the same role as secular natural history museums but with a presentation of natural history through the fundamentalist worldview. In addition, creationist think-tanks continue to provide educational materials that

promote various types of creationism, resources for teachers in both public and private schools, and legal advice such as how to introduce and promote academic freedom legislation. Groups such as the Thomas More Law Firm, which provided legal counsel for the defendants in the *Kitzmiller v. Dover* case, or the Family Research Council, perform similar activities and services as other law firms and non-profit organizations and universities as they provide services, advocacy, and other forms of outreach, but they all do work that supports the promotion and maintenance of conservative Christian ideals in American society.

American Values and Science Education

It is often assumed that anti-evolution and many other anti-science viewpoints are exclusively maintained by fundamentalist or evangelical Christian ideologies, specifically those beliefs that require a literal reading of the Bible. While this is true in the case of young earth creationism, several of the values that are central to the anti-evolution and anti-science movements not only appeal to conservative Christianity but also to notions of American identity. These values include democracy and the rights of voters to determine policy, freedom of religion, freedom of speech, and common sense and individualism.

The value of democracy is clearly seen in the anti-evolution movement's legislative efforts in the 1970s and 1980s with "balanced treatment" and "equal time" laws, and later with the movement to "teach the controversy" that was encouraged in Cobb County, Georgia, and Dover, Pennsylvania, and later refined and embodied in the Academic Freedom bills and laws in Louisiana and Tennessee. These laws appeal to American values of democracy and the concept of fairness, as they promote the presentation of "both sides" of the evolution-creation debate to public school students (Caudill 2013; Gunn 2004, 2006; Forrest and Gross 2004; Lakoff 2002; Scott 2009; Scott and Branch 2003, 2006, 2008). While the representative democracy and the protections in the Bill of Rights do not allow for a majoritarian democracy in practice, the idea of majoritarianism that was promoted by Bryan in the 1920s remains popular today (Berkman and Plutzer 2010; Bryan 1922, 1925; Caudill 2013; Lakoff 2002; Lakoff and Johnson 2003; Scott 2009). George Lakoff (2002) states that political conservatives generally advocate for more majoritarian forms of democracy in local contexts—they believe that states and local school districts should be able to choose their own educational curricula and content. Therefore, national educational reform movements and Supreme Court decisions that override the desires of local and state voting populations are unpopular among anti-evolutionists and anti-science movements, and they call into question the ideals of democracy and fairness for many Americans who do not identify as members of the Conservative Right as well. This value of democracy is even seen at the national level, as in 2001 when President George W. Bush advocated for the

teaching of creationism in public schools and asserted that students should learn “both sides” of the debate (Forrest and Gross 2004; Goertzel 2010; Scott 2009).

Freedom of religion and freedom of speech as outlined in the First Amendment are important to creationists and to all Americans. The argument that evolution education violates religious freedoms by influencing children to leave the church or to abandon important Biblical principles was argued by William Jennings Bryan (1922, 1925) and continues to be a popular notion among young earth creationists (Ham 1999, 2002; Ham and Foley 2016; Sarfati 2010). While in the 1920s Bryan argued that Scopes, in the context of being employed by the state, should not get to enjoy full freedom of speech (Bryan 1925), freedom of religion and speech are used by the anti-evolution movement in several contexts today. For example, many creationist parents wish to have their children “opt out” of evolution education in public schools—an activity named the “OOPSIE compromise” by Eugenie Scott and Glenn Branch (2006, 2008), which stands for “Opt-Out Policies Specifically Including Evolution.” Teachers such as Rodney LeVake have argued that the prohibition of teaching intelligent design or other alternatives to evolutionary theory is in violation of their freedom of speech, though LeVake was unsuccessful in his 1991 lawsuit (Caudill 2013; Scott 2000; Peterson, Shumaker, and Foley 2001). The academic freedom bills promoted by the Discovery Institute also embody the American value of the freedom of speech, as these bills claim to “protect teachers who help students” in critiquing scientific theories that are considered controversial (Discovery Institute 2007).

The value of common sense in the United States is a pervasive theme in the anti-evolution movement. Historically Americans have had a distrust and at times even a dislike of experts (Apple 2014; Berkman and Plutzer 2010; Bryan 1922; Butler 2010; Caudill 2013; Forrest and Gross 2004; Gunn 2006; Numbers 2006; Robertson 1980; Scott 2009). While education has been considered important, not all Americans place a high value on formal education (Caudill 2013; Lakoff 2002; Robertson 1980). This is seen in much of American mythology, as the explorers, pioneers, settlers, and well-known forefathers of the United States were considered intellectually advanced, successful, and prosperous, though many of them did not participate in much, if any, formal schooling (Robertson 1980). The anti-evolution movement often employs a bit of conspiracy theory in its characterizations of the field of mainstream professional and academic science (Butler 2010; Luskin 2013). This serves to undermine the authority of science in public knowledge and bolster the value and importance of each person’s common sense,

which exists independently of educational attainment or content-area expertise. In particular the anti-evolution movement seeks to discredit the established foundation of evolutionary theory as a central concept in the biological sciences by accusing science of “discrimination”—the Discovery Institute claims that this discrimination is responsible for the failure of any intelligent design theories to gain recognition in the mainstream science community (Egnor 2009; Lisle 2014; Luskin 2011, 2013). According to this allegation, mainstream science and scientific publications discriminate against any ideas that disagree with evolutionary theory and these ideas are unable to gain publication or traction in mainstream scientific practice and publication due to this discrimination. Furthermore, in spite of not having validation in mainstream science, these anti-evolution or anti-science notions are presented as valid alternatives to science because the people presenting them often have legitimate post-secondary and graduate educational credentials and those consuming these ideas have the “common sense” to understand their alleged validity as well. Beyond the use of the notion of common sense to discredit the validity of scientific evidence and acceptance of evolutionary theory, the value of common sense leads to the notion that anyone with common sense can figure out whether evolutionary theory offers a valid explanation of diversity and change over time in nature.

The priority of common sense knowledge is closely and perhaps inextricably linked to the values of democracy and individualism in America. It is democratic to allow everyone’s viewpoint to have equal merit, and every individual is entitled to formulate his or her own opinion. Individualism is of primary importance in Christianity, as individual responsibility and individual salvation are central to Christian beliefs and practices (Fitzgerald 2017; Israel 2004; New 2012; Stevens and Giberson 2011). Individualism is one of America’s most celebrated values independent of its importance in Christian ideologies and practices as well, and the idea that all individuals have valid viewpoints is prevalent in society today (Caudill 2013; Lakoff 2002; Lakoff and Johnson 2003; Robertson 1980). According to James Oliver Robertson (1980), the basis of American society is the free and independent individual. American heroes—even war heroes who by definition need a military in order to accomplish their goals—are individuals who acted alone in their heroism. Robertson (1980, 71) asserts that not until the American Revolution was an explicit goal of a country the “individual pursuit of happiness.” Individualism and individual desires and accomplishments have, as a result, been of primary importance in American identity and in American understandings and interpretations of history.

The significance of individualism in American history and myth has been essential to creationism since the 1920s (Bryan 1922, 1925; Caudill 2013; Robertson 1980). Concepts of individual autonomy and egalitarianism and democracy are useful to creationists and other anti-science movements because they give power to all citizens to influence educational policy, and because they bolster arguments for teaching students “all sides” of the evolution-creationism debate in order to allow students to “decide for themselves” which theory they choose to accept. For this reason laws that require or encourage students to learn “both sides” of the evolution-creationism debate remain popular among both creationists and those who believe in evolution (Berkman and Plutzer 2010; Gallup n.d.; Long 2011; Swift 2017). Individualism influences the common distrust and disdain for experts in American society through the implication that the value of the individual translates to the equal value of not just all people, but all opinions. Americans place a high value on both “common sense” and “education,” though formal education is not necessarily held in higher regard and is sometimes even considered less valuable than non-conventional or self-education (Robertson 1980). In this context, everyone’s “common sense” becomes as valid as expertise, and a creationist taxpayer deserves the same voice as an expert in evolutionary biology when it comes to determining educational policy and curriculum. It honors the American values of common sense, democracy, and the individual to present students with information from all sides of the debate and to allow them to decide on their own which explanation they prefer and ultimately what they accept to be true.

Individualism plays a significant role in the Discovery Institute’s Academic Freedom bill campaign. Whereas John T. Scopes (*State of Tennessee v. John Thomas Scopes* 1925) and later Susan Epperson (*Epperson v. Arkansas* 1968) argued that laws that prohibited the teaching of evolution violated teachers’ academic freedom, now creationists have appropriated the use of the notion of academic freedom to promote the inclusion of non-scientific alternatives to evolution in public schools. The Discovery Institute and other creationist groups argue that teachers should have the academic freedom to teach alternatives to evolution in public schools, and students should develop critical thinking skills through questioning “controversial” scientific theories. Mainstream scientists and the courts have demonstrated that none of the “alternatives” to evolution are scientific and therefore these alternatives are not appropriate to include in public school science curricula. Nevertheless, creationists portray mainstream science as being opposed to academic freedom, critical thinking, and even free thought and freedom of expression

(Chaffee 2015; Discovery Institute 2007). The concepts of academic freedom and critical thinking are central to notions of progressive educational pedagogy and reform—all Americans value freedom, and critical thinking is preferable to “rote memorization,” which is not at all progressive and would not be seen as contributing to meaningful learning nor to scientific discovery and progress (Dewey 1937; Freire 2000; Mead 1917; Scott and Branch 2003). Edward Caudill (2013, 8) states that in the tradition of William Jennings Bryan, creationists “adroitly have cast themselves as Jeffersonian egalitarians, antielitists and rebels forsaking convention and embracing new frontiers in science.”

Science Loses the “Culture War”

The evolution-creationism debate and other anti-science controversies have often been termed “culture wars” in the United States (Discovery Institute Center for the Renewal of Science and Culture 1998; Humes 2008; Laats 2010; Lebo 2008; K. R. Miller 2008). Numerous moral values and ideologies have been consistently invoked in the evolution-creationism conflict. The importance of the individual and related values of fairness, equality, and majoritarianism help maintain the success of the anti-evolution and other anti-science movements in popular culture. Additionally, Americans have a traditional distrust of “experts” and value “common sense” highly, so in a battle of underdogs with “elitist” scientists the anti-evolutionists often win in popularity. Though the intelligent design and other anti-evolution movements have appropriated the rhetoric and habits of science to bolster the prestige of their arguments, they still accuse mainstream science of “dogmatic Darwinism” and “bullying” in an appeal to the antipathy that Americans tend to have of experts (Klinghoffer 2017; Luskin 2009, 2013). Among young earth creationists many moral issues are equated with evolutionary science. Though current young-earth creationist organizations such as Answers in Genesis or the Institute for Creation Research sometimes promote the inclusion of their creationism in public schools and even argue that inclusion of creationism would be constitutional, they do encourage parents to choose private or homeschooling options whenever possible (Mitchell 2014; Mohler, Jr. 2013; J. D. Morris 1991; Weinberger 2005). Rather than focusing on political activity and

activism, organizations such as Answers in Genesis produce creationist books, films, and even natural history museums to reach people outside of the constraints of public education. Ken Ham's Answers in Genesis and other young earth creationist organizations frequently equate evolution and the learning of evolutionary science with not only a loss of faith but also with what they perceive as a loss of morality—a suggestion made by William Jennings Bryan in the 1920s—if humans are no more than animals, what is to stop humans from behaving like animals (Bryan 1922, 1925; Ham 1999, 2002; Toumey 1994)? Ken Ham has linked “evolutionary thought” to racism, eugenics, and the Holocaust just as the intelligent design movement has, but Ken Ham also accuses evolution of perpetrating many other issues that he sees as moral and social problems such as teen pregnancy, abortion, homosexuality, pedophilia, divorce, humanism, secularism, relativism, and others (Frankowski 2008; Ham 1999, 2002). One of the most important problems for anti-evolutionists is the implication that evolution negates the “human exceptionalism” that they find in their Biblical or religious beliefs. Denial of evolution and of climate change are very important to those who are attached to ideas of human exceptionalism, as they find that evolution threatens the “specially created” status of humans and that climate change threatens the idea that humans have the right to dominion over the planet.

It is clear that anti-evolutionism is part of a broader culture of science denial, and the re-definitions of creationism, of science, and of evolution result from a social movement powered not only by a Biblical literalist Christian identity, but often more broadly by notions of American identity. When Galileo's ideas troubled The Church, Galileo was jailed (Numbers 2006). However, the Church is not in charge in the United States, and following the Enlightenment, Western cultures started to value and privilege “scientific knowledge” over other types of knowledge (Foucault 1972, 1980, 2000; Rouse 2010; Ruse 1999). Although the Establishment Clause was present, Christian religion was privileged in American society through much of the country's history and in many ways it continues to be today. As the wall of separation between church and state that was envisioned by Thomas Jefferson became more of a reality through the 20th century, creationists have sought ways to package their ideas as “science” in order to maintain their inclusion in public education and in order to elevate their status in a culture that privileges scientific over religious knowledge (Caudill 2013; Numbers 2006; Robertson 1980; Scott 2009).

In considering the American values of democracy and the individual, it is clear that science is at a disadvantage in many ways in the conflict with creationist and other anti-science movements. Rhetorical disadvantages come with casting the issue in terms of egalitarianism. People tend to talk about evolutionary theory and creationism or intelligent design theory as though the word “theory” has the same meaning in the two different contexts. It does not, but much of the public believes it does, and the media consistently reports it as if it does (Caudill 2013; Lebo 2008). The anti-evolution and other anti-science movements benefit from a portrayal of their claims as having the same credibility as evolutionary theory and other accepted, predominant theories in the field of science. This false equivalence is also seen in the debate format, in which individuals defend viewpoints that are portrayed as equal simply by virtue of the structure of the debate—while debates allow for the competition of opposing viewpoints, it is typically assumed that the viewpoints are “sides” of issues that can be compared (Pigliucci 2002; Scott and Branch 2008, 2006).

Science literacy has been politically important in the United States since the 1950s when attempts were first made to define the term (Committee on Science Literacy and Public Perception of Science et al. 2016; DeBoer 2000; Hurd 1958). Though science literacy is a prominent and commonly stated goal in public education and in education policy and reform, there has yet to be a consensus regarding how science literacy should be defined. Most definitions include some combination of economic, personal, democratic, and cultural rationales for the importance and goals of science literacy . The Committee on Science Literacy and Public Perception of Science (2016, 32–33) determined that though numerous definitions have been offered by scholars and professional organizations in the past six decades, the following seven aspects are commonly proposed in definitions of science literacy: foundational literacies, content knowledge in science, an understanding of scientific practices, an ability to identify and judge appropriate scientific expertise, epistemic knowledge, a cultural understanding of science, and certain dispositions and habits of mind. The American Association for the Advancement of Science defines science literacy as follows: “the science-literate person is aware that science, mathematics, and technology are interdependent human enterprises with strengths and limitations; understands key concepts and principles of science; is familiar with the natural world and recognizes both its diversity and unity; and uses scientific knowledge and scientific ways of thinking for individual and social purposes” (American Association for the Advancement of

Science 1989, xvii; G. D. Nelson 1999). Widespread and common misunderstanding of the nature of science further contributes to the disadvantages that science faces in a society that values democracy and individualism. Regardless of how science literacy is defined science education outcomes, surveys, and other research indicate that the general public in the United States does not enjoy a high level of scientific literacy, and only about 28% of Americans are considered to be scientifically literate (J. D. Miller 2016; National Science Foundation 2014; Pew Research Center 2015b). In general Americans do not understand how science works (J. D. Miller 2016; Pew Research Center 2015a). They do not know that facts inform theories, and that theories are tested and retested over time and modified as understandings and explanations change and are refined or replaced. The public does not have a thorough understanding of the processes of peer review and revision employed by scientific journals to maintain expectations of rigor in methodologies and in the drawing of conclusions in mainstream science. As a result, the general public tends to view all publications as equally valid—and many creationist publications superficially look comparable to the work of mainstream scientists. This provides an important public relations advantage to creationists, who tailor their publications for general public consumption while scientists do not (Caudill 2013; Forrest and Gross 2004; Scott and Branch 2006; Scott 2009; Stevens and Giberson 2011). As a result, creationist arguments tend to be more appealing, more understandable, and more palatable than scientific ones, and every individual's "common sense" allows him or her to assess the available evidence and decide whether evolution or creationism is more appropriate.

A final disadvantage that scientists face is that they are not generally viewed by society as individuals at all. First, the American distrust and disdain for experts is often manifest in the idea that scientists are "bought" by the government, and that government research funding results in scientific research serving foregone conclusions that are outlined by academic or government "elites." This conspiracy theory is common in anti-evolution as well as other anti-science movements, including climate change denial and anti-vaccine movements (Goertzel 2010). Creationists have the advantage of being individual "frontiersmen" who are not beholden to the government and whose research is, therefore, intellectually adventurous (Caudill 2013). Second, scientists exist in an often insular occupational environment that does not typically involve a lot of political or public relations work, and research scientists are often quite far removed from the practical applications of the scientific advances that trickle down to the general public through

medicine, technology, food, and other tangible outcomes (Caudill 2013). One challenge that science has faced in popular culture lies in the fact that the uses of science in everyday life are not immediately and overtly reflective of the research that has gone into their creation. For example, the evolutionary biology research used in developing antibiotics and vaccines is not readily evident to the public, nor is it attributable to one individual scientist who discovered and developed the technologies to save us from bacterial infections or common communicable diseases. The science of antibiotics and vaccines was and continues to be developed by numerous contributors and experts in several different scientific disciplines, and this reality results in scientists in general losing their individualism from a public standpoint. Creationists, on the other hand, have the advantage of being accustomed to and skilled at public relations and evangelism. These are components of the daily function of religious entities, so it is a standard part of the creationist toolkit and some of the larger creationist think tanks like the Discovery Institute are able to delegate public relations, media, and other activities to professionals in these fields. This is not to say that there are no evangelists for science because there are some well-known individuals who could be characterized as such, including Richard Dawkins, Bill Nye, and Neil DeGrasse Tyson. While most Americans know a bit about these public figures as well as famous scientists in history such as Charles Darwin, Marie Curie, Sir Isaac Newton, and others, few current scientists have what would be considered “household names.” Given that “discoveries” and scientific paradigm shifts rely on detailed, documented, and repeated studies, there are rarely “superstars” or “heroes” who are recognized in popular culture. Instead, in the popular understanding scientists become a faceless mass while most Americans can name several famous Christian evangelists or creationists.

The creationist movement has socially and politically relied on the American value of individualism with a focus on majoritarian ideals of egalitarianism and democracy. American values of common sense and fairness create an environment in which anyone is qualified to be an expert on any topic, or at least one in which an individual’s common sense can override expertise when the notions of experts are unappealing. In the evolution-creationism debate, this puts science and scientists at a disadvantage when in a popularity contest with anti-evolution and other anti-science movements because science as a process is not democratic and scientists are generally seen as “elites” who are not to be trusted as they may create an oligarchy that will revoke the rights of the majority. While science and the work of scientists is often seen as

apolitical, anti-science movements have politicized scientific information and knowledge by claiming that the outcomes of scientific research are biased and serve the interests and agendas of funding agencies, particularly when studies are funded by government entities. Additionally, scientists rarely have the desire or the skill to evangelize for science as effectively as creationists evangelize for non-science (Caudill 2013)—and as a result, a large proportion of the American public maintains creationist and other anti-science viewpoints.

Science in American Society

According to James Oliver Robertson in *American Myth, American Reality* (1980) modern science was developing at about the same time as the European discovery of the New World, so science has been part of American mythology throughout the country's history. Robertson (1980) asserts that the spread of science is comparable and even analogous to the spread of Christianity. In this analogy scientists are ministers; laboratories, hospitals, experiment stations, and universities are churches; theoreticians and pure scientists are monks, nuns, and theologians; teachers, technology developers, and inventors are secular clergy; and museums, planetariums and exhibitions are places of ritual and “exegesis of its tenets, accomplishments, and promises to a lay public” (Robertson 1980, 280). In the late 19th century the belief in science merged with the belief in progress. Robertson (1980, 281) states that “the two mythologies became one. And the occasion for their coming together was the impact, in America, of the work of an Englishman, Charles Darwin.” Darwin's concept of natural selection described in *On the Origin of Species* (1859) was appealing to the American ideals of practicality and progress, and the idea was applied not only to natural life but to societal life and progress as well. Though today Darwin's proposed mechanisms of natural selection and the concept of “survival of the fittest” are better understood and regarded as less scientifically significant than Darwin initially suggested, they continue to create controversy. Darwinian evolution was linked to notions of Social Darwinism, which included both ideas of “moral” fitness and productivity among individual Americans as well as the less popular applications seen in racist policies, eugenics, and the Holocaust (Numbers 2006; Robertson 1980). In spite of this, the concepts of evolution

and change over time inspired and helped maintain the myths of science and progress in American culture, and these myths have been central to the success and longevity of the creationist movement since the 1920s.

One of the primary ways in which creationists use the myths of science and progress is through their modification of uses and meanings of scientific terms to both elevate the status of their own explanations of the diversity of life and to undermine the validity of accepted science. For example, creationists have misused the word “theory” since the time of the “Scopes Monkey Trial” (*State of Tennessee v. John Thomas Scopes*, 1925). In the trial and in speeches regarding Tennessee’s Butler Act, William Jennings Bryan equated evolutionary theory to “guesses that lead to godlessness” (Bryan 1922, 1925; Caudill 2013, 27; Israel 2004; Larson 1997, 2003; Mencken 2006). This definition of a scientific theory as a “guess” has continued in legislatures, courtrooms, and classrooms for nearly a century. In 1996, in the early years of the intelligent design phase of the anti-evolution movement, a bill was proposed in Tennessee that would prohibit teaching evolution as “fact,” and similar bills were proposed in many states (Moore 2002; Moore, Decker, and Cotner 2010). This bill did not pass, but it remains common to hear the assertion that evolution is “just a theory.” The placement of “theory” in opposition to the concept of “fact” is now a critical component of the Discovery Institute’s “Teach the Controversy” campaign that was highlighted in the *Kitzmiller v. Dover Area School District* case and continues in the promotion of Academic Freedom Legislation today (Ross 2017; Scott and Branch 2003).

In addition to redefining key terms of science, creationists have re-written science in general to make it a political rather than an intellectual enterprise (Caudill 2013, 12). This re-writing of science has been aided by the “parallel culture” that fundamentalist and many evangelical Christians developed following the Scopes trial and through much of the 20th century. As a marginalized group whose values did not align with much of mainstream American life, many fundamentalist and evangelical Christians created a parallel culture that includes schools, universities, publishing houses, media outlets, and social systems and networks (Caudill 2013; Harding 2000; Stevens and Giberson 2011). In this parallel culture creationists have been able to publish and promote their non-scientific alternatives to evolutionary theory in packages that include books; magazines and journals; websites; documentaries, radio, and television shows; and museums that appear scientific—this allows them to promote the notion

that creationist theories and ideologies are in legitimate competition with mainstream scientific paradigms. Re-defining science to include the supernatural explanations in addition to natural explanations is even part of the “Wedge Strategy,” the set of goals of the Discovery Institute that were outlined at the “Mere Creation” conference at Biola University in 1996 (Caudill 2013; Forrest and Gross 2004; K. R. Miller 2008; Pennock 2001; Scott 2009).

Another method by which creationists exploit the myths of science and progress to promote their beliefs is by labeling actual science as “religion” (Demar 2002; H. M. Morris 2001; O’Leary 2017). Many creationists frame evolutionary biology as religion by referring to it as “Darwinism” and describing it as a dogmatic religion that is unwilling to compromise, unwilling to acknowledge the completely reasonable “scientific” work of creationists or intelligent design proponents (Demar 2002; Ham 1999, 2002; J. D. Morris 1991; O’Leary 2017). This is highly effective in the anti-evolution campaign because dogma is certainly never seen as progressive, and even liberal religions are rarely seen as progressive. Proponents of intelligent design and other forms of creationism such as Michael Behe of “irreducible complexity” who holds a Ph.D. in biochemistry and is a tenured professor at Lehigh University, William Dembski of “specified complexity” and the “law of conservation of information” who holds Ph.D.’s in both mathematics and philosophy, and Phillip Johnson, the primary founder of the intelligent design movement who was a lawyer and law professor, promote the image of creationism as scientific and progressive. These anti-evolution leaders are often well-credentialed just like the people who work in science education and research. To the public, mainstream scientists are portrayed as closed-minded bullies who will not allow dissenters—and in American myth it is evident that dissenters are the ones who drive progress (Robertson 1980). Edward Caudill (2013, 11) states that “the creationist campaign has shrouded itself in apparent open-mindedness and adventure, claiming to venture intellectually to places—such as a 6,000-year-old Earth and seven-day creation—which they accuse mainstream scientists of avoiding. Their self-proclaimed adventurousness slips easily into the national frontier myth.”

The power of conspiracy theory is evident in the success and longevity of the anti-evolution and other anti-science movements. According to Ted Goertzel (2010, 494), conspiracy “flourishes in politics, religion, and journalism, in which practitioners can succeed by attracting followers from the general public.” Conspiracy theories are rampant in anti-science, from the conspiracy that evolution is a dogmatic atheistic religion in which scientists want American

children to be indoctrinated, to the economic conspiracy that climate change is a hoax perpetrated against fossil fuel industries and American workers, to the “big pharma” conspiracy that vaccines are forced upon Americans to generate revenue for pharmaceutical companies at the expense of the health of American children. According to Goertzel (2010, 495) conspiracy is part of the “regular repertoire” of lawyers, so it is unsurprising that such conspiracy theories drive much of the support for anti-science legislation. Fear of science is not new, in 1736 Benjamin Franklin’s four year old son died of smallpox after Franklin declined to have his son inoculated (Best, Katamba, and Neuhauser 2007; Goertzel 2010). In addition to the conspiracy theories launched against scientific findings, the peer review process in scientific publications is frequently a target of anti-science conspiracy theory as well (Goertzel 2010; Luskin 2013). The conspiracy theory extends beyond peer review to academics and scholarship in general, as even social scientists “have forfeited much of their potential influence because they are too often perceived as advocates for a cause rather than as objective researchers” (Goertzel 2010, 496). In response few scientists participate in advocacy, as they are not trained in issues of advocacy and public relations and as participation in science advocacy sets scientists up for public assaults on their professional credibility (Goertzel 2010; Scott 2009; Scott and Branch 2006).

Debates are popular among creationists, and debates with scientists used to be quite common. Now most evolution-creationism debates are held by students, though occasionally professionals still participate. For example, well known science celebrity and advocate Bill Nye debated Ken Ham of Answers in Genesis in 2014 (Answers in Genesis 2014). Scientists often decline debate invitations from creationists and science advocacy organizations such as the National Center for Science Education discourage participation in debates with creationists, because the format of debates presents the debaters as equally qualified individuals who are defending equally valid positions and most science advocacy organizations seek to avoid creating a scenario in which science and creationism are presented as equivalent alternatives (Pigliucci 2002; Scott 2009; Scott and Branch 2006). While it is understandable that scientists wish to avoid promoting this misconception, this refusal to debate also creates a situation in which creationists are able portray themselves as more “open-minded” and progressive than scientists. This was seen in the Kansas State School Board Hearings of 2005. The Kansas State Board of Education aimed to change the way evolution and origins of life were taught in public schools in Kansas, with an ultimate goal of introducing intelligent design or other creationist

alternatives to evolution using the “Teach the Controversy” approach (Humes 2008; K. R. Miller 2008; Olson 2006). Scientists boycotted the hearings but many people affiliated with the Discovery Institute attended and spoke about their alternatives to evolution, and as a result the creationists not only garnered a good deal of media attention but they also were able to present themselves as the citizens who are most concerned about improving science education, while the “dogmatic” and “closed-minded” members of the scientific establishment were not participating (Humes 2008; K. R. Miller 2008; Olson 2006). Ultimately the School Board passed changes to the state science standards that allowed for presentation of intelligent design in public school science classes and “science” was redefined so as not to be restricted to natural interpretations (Humes 2008; K. R. Miller 2008; Olson 2006)

Creationist use of the myths of science and progress rely heavily on another myth that Robertson (1980) discusses, the myth of the frontier. Creationists portray their mission as “open-minded” and intellectually “adventurous” while the dismissal of their claims by mainstream scientists is characterized as “conventional,” “closed-minded,” and “establishment” (Robertson 1980). Given that scientific knowledge is typically the more privileged knowledge in our society, creationist alternatives to established, mainstream scientific understandings have historically played the role of the “underdog.” Americans consistently favor underdogs, and in popular notions of history and folklore the country’s founders are perceived as underdogs who triumphed. This status gives Americans a sense of pride in the accomplishments of these adventurous, brave individuals (Robertson 1980). Creationists take advantage of this underdog status by portraying science as corrupt—mainstream science including university faculty and academic journals are described as censoring or discriminating against dissenters. Creationists allege that their work is not published in mainstream science journals due to a conspiracy to keep them out (Buckna 1997; Luskin 2013; Thomas 2016).

Edward Caudill (2013, 72) states that “Unlike the 1920s fundamentalists, creationists of the 1980s and 1990s promoted themselves as the real defenders of America’s frontier spirit, venturing into scientific realms shunned by the hidebound, timid mainstream scientists, who were assailed as being locked blindly into conformity.” Following the case of *Epperson v. Arkansas* (1968) in which the prohibition of teaching evolution was declared unconstitutional and the case of *Lemon v. Kurtzman* (1971) in which the “Lemon test” was established, creationist redefinitions of creationism as “creation science” and later as “intelligent design” were changes

that were inspired by legal and public relations concerns within the anti-evolution movement (Caudill 2013; Forrest and Gross 2004; Scott 2009; Scott and Branch 2006). Creationism needed to not only be characterized as science in order to be included in public school science education, but it needed to be seen as progressive and on the “frontier” of science in order to justify its absence in any part of mainstream, accepted science (Caudill 2013; Frankowski 2008). The “Teach the Controversy” approach that is promoted in “Academic Freedom” bills such as the ones passed in Louisiana, Tennessee, and Alabama also employs the myth of the frontier. While creationist assertions are considered “fringe” ideas in the scientific community, creationist publications assert that their alternatives to evolution are on the frontiers of scientific inquiry. This emphasis on the frontier myth rather than the content of creationist alternatives or their failure to contribute to evolutionary biology helps maintain the continued public confusion regarding which explanations of life are actually scientific and which ones are not and it bolsters the assertion that mainstream science deliberately conspires against the anti-evolution movement’s scientific “pioneers.”

Evolution Education in Public Schools

In *Evolution and Religion in American Education: An Ethnography*, David Long (2011) details his ethnographic interview study that included public high school biology teachers and college freshmen who were enrolled in introductory biology courses at a state university. Long concludes that views on science are not solely based on the quality of science education that students receive but that social and political contexts influence acceptance of science as well. He stresses the importance of the social cost of accepting science such as evolutionary theory when one lives in a social context of science denial. Michael Berkman and Eric Plutzer's *Evolution, Creationism, and the Battle to Control America's Classrooms* (2010) discusses the results of a nationwide survey of over nine hundred public high school biology teachers regarding the teaching of evolution in public schools. This survey is particularly important as it is the first nationwide study of its kind. Due to differences in methodologies and contents of previous surveys, it had not been possible to compile reliable or meaningful nationwide data on questions about how evolution was taught in public schools (Berkman and Plutzer 2010).

Long (2011) concludes that students who are creationists upon entering college are likely to remain creationists regardless of how much science coursework they complete. Furthermore, it is not uncommon for science education majors to be creationists, which creates the possibility that these teachers may, either on purpose or inadvertently, promote creationism or at least doubt of evolution in their own classrooms. Long (2011) interviewed one teacher who explicitly tells her students that she is a creationist, and she refers to this as just an example of her "flair" in the classroom. Berkman and Plutzer's (2010) survey indicates that 14-21% of teachers surveyed reported teaching creationism in their classrooms, which is a large proportion considering the long and comprehensively documented history of court cases that have concluded that the teaching of all manifestations of creationism as science is unconstitutional. Berkman and Plutzer's (2010) survey data do not indicate if the teachers who participated received explicit instruction in their teacher training regarding issues of addressing socially controversial topics and maintaining constitutionally sound instruction. However, no state explicitly includes religious alternatives to scientific theories in their state science standards, so it may be assumed

that the teachers who present creationism are at least aware that this particular content is not part of the regular science curriculum.

Berkman and Plutzer's (2010) data as well as earlier surveys indicate that anti-science viewpoints were taught in many public school science classes either through the promotion of doubt of evolution or the explicit endorsement of creationism prior to the development of Academic Freedom bills and the passage of the Academic Freedom laws in Louisiana and Tennessee. In addition to the relatively common inclusion of creationism in science instruction, Berkman and Plutzer's (2010) study concludes that teachers spend minimal time on evolution in public high school biology classes—about fourteen hours on average in a full general biology course—and they often deliberately schedule any study or discussion of evolution near the end of the term so that if something has to get “pushed off” the calendar due to interruptions or time constraints at the end of the course, evolution will be the topic that is compromised. In addition, most of the teachers surveyed avoid the topic of human evolution entirely (Alters and Alters 2001; Berkman and Plutzer 2010; Scott and Branch 2003; Singham 2009). The data indicate that although legally it is well established that evolutionary theory has a place in public school science education, many teachers avoid teaching it. This may be due to fear of upsetting students or inciting “controversy,” or it can be due to anti-evolution sentiment on the part of the teacher (Berkman and Plutzer 2010). This is unfortunate for the state of evolution acceptance in the United States because for many students, high school is the end of their formal education and if they have not learned evolutionary biology by graduation then they will never study it at all. This becomes more problematic when considering Long's ethnography, as he observed that the college level introductory biology courses also failed to focus on evolution as a central concept of the biological sciences and most failed to mention human evolution at all (Long 2011; A. Kramer, Durband, and Weinand 2009). A survey study conducted by Andrew Kramer, Arthur C. Durband, and Daniel C. Weinand (2009) investigated the understanding of evolution of college lowerclassmen, upperclassmen, and graduate students enrolled in various physical anthropology courses at The University of Tennessee for ten years, and the findings indicate that neither college experience in general or biological sciences classes specifically were correlated with increased understanding of evolution. Therefore, even college graduates with course credits in biology may have very little formal study of evolution.

In the teaching of evolution or creationism in public schools, Berkman and Plutzer (2010) find that few teachers report feeling pressured to teach either topic. They conclude that this is likely due to social and political alignments between teachers and the communities in which they work (Berkman and Plutzer 2010). It is common for teachers to work in their hometowns, close to their hometowns, or in communities that are similar to those in which they grew up. As a result, creationist teachers often teach in creationist communities, and teachers who teach evolution thoroughly are likely to work in communities that support this approach. Long (2011) discusses homeschooling, as a large proportion of families who homeschool teach creationism. Homeschooling is popular in many fundamentalist and evangelical Christian populations as these families wish to promote what they refer to as their “worldview,” and they find that much of the content of public education is not aligned or compatible with the values and knowledge that comprise this worldview (Kahan et al. 2012; Long 2010, 2011; Mitchell 2014; Mohler, Jr. 2013). In fact, creationist organizations such as Answers in Genesis often encourage families to avoid public schools and they offer specifically tailored homeschooling products complete with curriculum, books, supplemental materials, and other supplies (Answers in Genesis n.d.). Homeschooling and private schooling options are available to parents when they feel that public schools promote more science or more liberal ideologies than their “worldviews” can accommodate, and this may also impact the trend of public school teachers not feeling pressured to modify course content (Berkman and Plutzer 2010; Mohler, Jr. 2013).

Berkman and Plutzer (2010) outline what they call a “principal-agent problem” between legislators and “street-level bureaucrats,” teachers. Their survey indicates that teachers with less experience, fewer than five years in the classroom, are more likely to know the state laws and the curriculum standards and are more likely to abide by the legal mandates and standards (Berkman and Plutzer 2010). Teachers with more years of experience are less likely to either know the curriculum or to abide by it (Berkman and Plutzer 2010). As a result, while it is often assumed that more experienced teachers do a better job the data indicate that these teachers are more likely to be the ones that “go rogue” and teach non-scientific alternatives to topics such as evolution in public school science classes (Berkman and Plutzer 2010). The data also indicate that teachers spend more classroom time teaching concepts they are confident that they understand well (Berkman and Plutzer 2010). This does not bode well for the coverage of evolution in public school classes as according to Berkman and Plutzer’s (2010) survey and to

Long's (2011) ethnography there is no guarantee that state universities do a very good job of teaching evolution in introductory undergraduate biology courses.

Long (2011) asserts that learning and knowledge are political, and the state of science denial in the United States as illustrated by lack of acceptance of evolution and climate change makes it evident that if the issue could simply be resolved by giving people more information, then this controversy and culture war would not continue. Long (2011) characterizes this as an issue of what he calls "the capital 'T' version of Truth." In his ethnographic study of college freshmen, Long (2011) concludes that no amount of scientific "Truth" could make a creationist's "truth-pile" sufficient to result in acceptance of evolution. The majority of participants in Long's study believe that both creationism and evolution should be taught in science classes, and this sentiment is common nationally (Gallup n.d.; Long 2011). While Long (2011) does not offer a solution to the problem of anti-science sentiment among students or teachers, he suggests that the idea proposed by many in education that science classes should be "belief-free zones" is unrealistic. The ideologies that necessitate a belief in creationism are too deeply rooted in other components of students' worldviews to be changed just by adequate science instruction. Berkman and Plutzer (2010) suggest that one step toward improving evolution instruction in public school science classes may involve a change to the course requirements for science education majors by adding a required course on evolution. Berkman and Plutzer (2010) document that teachers who took at least one course specifically focused on evolution in college consistently spend more time on evolution instruction as teachers and they are less likely to see merit in approaches such as "teach both sides" or "teach the controversy." Though the idea of discouraging college students who are enthusiastic about education from pursuing teaching careers is disheartening, Berkman and Plutzer (2010) hypothesize that perhaps such a course would serve as a deterrent to individuals with anti-science viewpoints in pursuing degrees in science education.

Chapter 2:

Theoretical Frameworks

Related Scholarship in Anthropology and the Social Sciences

According to Fenella Cannell (2006, 2), much of the anthropology of Christianity tends to assume a concept of “modernity” that follows the religiosity of the past, “a sense of being just ‘after’ religion.” Cannell states that in the study of Christianity in the social sciences, Christianity has been seen as a contributor to the inevitable secularization that occurs as modernity advances. The influence of Max Weber and others has promoted a sense of current Western social and economic structures such as capitalism as a product of Protestantism (Cannell 2006). Though in recent years there has been some statistically significant increase in atheism and in the lack of religious affiliation in some Western societies, it does not appear that religion is really declining with modernity (Cannell 2006). Cannell (2006, 44) states that Weber’s hypothesis that “secularization paradoxically proceeds through Protestant ethics and institutions” has become confused with the conviction that religion and modernity are mutually exclusive, opposed to one another, and that modernity is prevailing. Furthermore, Cannell (2006, 45) goes on to state that “anthropology has on the whole been less successful at considering Christianity as an ethnographic object than at considering any other religion in this way.” This problem was originally outlined by Susan Friend Harding (1991), as she describes the framing of fundamentalist Christians as a “repugnant cultural other.” Harding (1991) further states that modernist standpoints tend to characterize fundamentalist Christians as “opponents” of modernity and reason. While cultural relativism in anthropological and other social science

inquiry is extended to groups of people “othered” by discourses of race, sex, class, ethnicity, or colonialism, the “repugnant cultural other” does not enjoy this consideration (Harding 1991). In fact, Cannell (2006) and Harding (1991, 2000) both report that in working with and researching conservative Christian groups, many peers in academia assumed that they must have been “converted” by these groups in order to feel compelled to study them. James A. Beckford (2003) asserts that in the last quarter of the twentieth century religion was a topic that received little attention in social science, and he critiques the scholarship of religion by stating that “all too often theorists have taken religion as a relatively unproblematic unitary and homogenous phenomenon that can be analyzed and compared across time and space without proper consideration of its multi-faceted and socially constructed character” (Beckford 2003, 15).

The persistence of the anti-evolution and anti-science movements and their involvement in educational policy and practice is an issue of religion and politics in addition to an issue of science educational content and pedagogy. However, little anthropological inquiry has focused on the questions that are investigated in this project. Two ethnographic works have been published that focus on creationist groups—Christopher Toumey’s (1994) *God’s Own Scientists: Creationists in a Secular World* investigated a creationist study group that included several professional scientists, and David Long’s (2011) *Evolution and Religion in American Education: An Ethnography* investigated college freshmen enrolled in introductory biology courses as well as public high school teachers. These studies utilized the theoretical work of Clifford Geertz, and while these studies have informed the development of the research questions and methods in this project, the theories of social constructionism and Foucault’s power/knowledge are better suited to inform the analysis in this study given its focus on the rhetorical and political aspects of the evolution-creationism controversy and other anti-science controversies in American culture.

Social Constructionism and Power/Knowledge

The primary theoretical frameworks that inform the analysis of data in this project are social constructionism as outlined by Peter Berger and Thomas Luckmann (1965) and Michel Foucault's (Foucault 1977, 1980, 1982, 2000; Rabinow 1991) power/knowledge. Berger and Luckmann (1965) assert that knowledge is derived from and maintained by social interactions, and that related perceptions of reality contribute to the construction of "truths" that are accepted by societies. Foucault (Foucault 1977, 1980, 1982, 2000; Rabinow 1991) asserts that knowledge and power are connected, and in fact that knowledge becomes "truth" through its impact on society.

Beginning in the 1970s and 1980s social constructionism and the work of Foucault and others were engaged by social science scholars in science and technology studies. Social constructionism in the study of science has served to deconstruct the Enlightenment ideal that science is a fully objective process by which humans discover "truth" and acquire "knowledge" (Ruse 1999). Social constructionism is often used to investigate the roles of culture and language in the practice of science (Latour 2004). However, in recent years some scholars have lamented the social constructionist critique of science, as the claim that science is a human and socially constructed endeavor has been appropriated in popular culture to promote anti-science beliefs (Butler 2010; Latour 2004; Numbers 2006). One of the most popular and longest-lived strategies of anti-science movements such as anti-evolution or climate change denial has been the emphasis on any doubt in science (Forrest and Gross 2004; Scott 2009). Doubt of scientific certainty is often achieved in popular culture through the assertion that science is a human endeavor and therefore the outcomes of scientific inquiry are influenced by the personal "philosophies" of scientists (Answers in Genesis 2014; Buckna 1997; Ham 1999, 2002; H. M. Morris 2001; Thomas 2016). This argument is frequently used to elevate creationism to the status of evolutionary science, as creationists argue that their interpretations of data are as valid as the current scientific consensus but that a difference in philosophy—a foundation of Biblical inerrancy as opposed to the limitation of explanations to natural causation—results in the differing conclusions. In general, anti-evolution and anti-science movements use social

constructionist arguments to draw scientific paradigms into question while at the same time advancing their own alternatives to the prevailing theories with which they disagree and elevating them to the academic or intellectual status of science. Some scholars assert that this (mis)use of social constructionism is linked to the conspiracy theory that is often present in anti-science movements as well (Butler 2010; Latour 2004). In this study, social constructionism and particularly the popular or lay use of social constructionism is most useful in the investigation/analysis of discourses and rhetoric of participants with creationist or other anti-science viewpoints.

The concept of science as a social construction and a human enterprise (Falcao 2010; Kuhn 2012; Pigliucci 2002; Ruse 1999) has been used by the anti-evolution and anti-science movements to discredit scientific knowledge (Answers in Genesis 2014; Butler 2010). For example, young earth creationists assert that scientists who accept an old earth and the process of evolution evidenced by the geological and fossil records, radiocarbon and other dating methods, or other scientific findings simply have a “starting point” or “philosophy” of naturalism, atheism, or some other standpoint that allows for this interpretation (Answers in Genesis 2014; Ham 1999, 2002). Young earth creationists, on the other hand, use the same data to come to conclusions that the earth is between six thousand and ten thousand years old and that there is evidence of a worldwide flood because their starting point or philosophy is based on the Bible as a literal account of history (Answers in Genesis 2014; Ham 1999, 2002). Social constructionism also allows for redefinitions of science that are common in the anti-evolution movement, such as the assertion by Ken Ham of Answers in Genesis that there are two kinds of science. Ham defines an “operational science” which includes scientific inquiry such as laboratory experiments, and “historical science” which includes the study of fossils to determine the ancestry of different species, radiocarbon dating, and other facets of science that have informed evolutionary theory and the current accepted understanding and explanation of earth’s history (Answers in Genesis 2014; Ham 1999, 2002). The focus on science as a socially constructed, human endeavor is not limited to young earth creationists, this notion is used frequently in anti-science movements. Social constructionism allows anti-evolution and anti-science viewpoints to diminish the validity of mainstream scientific consensus and at the same time claim their own alternatives to mainstream science as valid alternatives of comparable merit.

Foucault's power/knowledge (Foucault 1977, 1980, 2000; Rabinow 1991; Rouse 2010) is frequently employed along with social constructionism in qualitative studies of discourse (Keller 2005). Foucault (Foucault 1977, 1980, 1982, 2000) asserts that knowledge is linked to power—knowledge is required in order to have power and it can be used to regulate behavior. Foucault asserts that power is not a thing that is possessed, but rather it is created and maintained by all of the participants in a social structure, both by those in power and the powerless (Foucault 1980, 1982). Power and power relations are present in all social relationships and can be conceived of as reaching all parts of societies in a “capillary” manner rather than in a “top-down” manner (Gledhill 2000). Knowledge that is linked to power is considered to have authority as “truth,” and since the Enlightenment scientific knowledge has been the privileged or “powerful” knowledge in Western cultures (Foucault 1977, 1980, 1982; Rabinow 1991). Therefore, a certain amount of power is conferred to those with knowledge that is considered “scientific.” In the context of science education and educational policy the struggle for this power has been ongoing since the Scopes trial of 1925, as is evident in the rhetoric and strategies of the anti-evolution movement. In this study the relationship between power and knowledge is key to understanding the ongoing conflict between the anti-evolution and other anti-science movements and mainstream science. This relationship is particularly important in the analysis of discourse and rhetoric in this study, as some of the most enduring components of the conflict have focused upon the definition of science and the roles of scientists in influencing public policy, educational policy, and public education.

Discourse and Power

According to Stuart Hall (1992, 291), discourse is “a group of statements which provide a language for talking about—i.e. a way of representing—a particular kind of knowledge about a topic.” Discourse sets up and limits the ways in which topics can be constructed (Hall 1992). Discourse does not consist of one statement but of several that work together to create a “discursive formation” (Cousins and Hussain 1984; Foucault 1972; Hall 1992). Discursive formations “refer to the same object, share the same style and support ‘a strategy...a common institutional...or political drift or pattern’” (Cousins and Hussain 1984, 84–85). For Foucault discourse is about the production of knowledge through language. Discourse is produced by “discursive practice”—the practice of producing meaning (Foucault 1972). All social practices have a discursive aspect because they all produce meaning, and discourse enters into and influences all social practices (Cousins and Hussain 1984; Foucault 1972; Hall 1992).

Hall (1992, 292) describes discourse as similar to ideology. Ideology is characterized as “a set of statements or beliefs which produce knowledge that serves the interests of a particular group or class” (Hall 1992, 292). Foucault (1972) uses the term “discourse” rather than “ideology” because he makes a distinction between true statements as “science” and false statements as “ideology.” Foucault argues that “statements about the social, political, or moral world are rarely ever simply true or false; and ‘the facts’ do not enable us to decide definitively about their truth or falsehood, partly because ‘facts’ can be construed in different ways. The very language we use to describe the so-called facts interferes in this process of finally deciding what is true and what is false” (Hall 1992, 292). Although Foucault makes a distinction between true, scientific discourses and false, ideological discourses, his use of the term “discourse” avoids the problem of determining which discourses are true/scientific and which are false/ideological. However, this sidestep allows for the consideration of power in discourse because according to Foucault (1977) power, rather than facts, is what distinguishes truth from falsity or science from ideology. In *Discipline and Punish: The Birth of the Prison* Foucault (1977, 27) states that “we should admit rather that power produces knowledge (and not simply by encouraging it because it serves power or by applying it because it is useful); that power and knowledge directly imply one

another; that there is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations.”

In discussing discourse, knowledge, and power, Foucault (1977) acknowledges that groups with different or competing interests can employ the same discourses though this does not imply that those discourses are neutral. Hall (1992, 294–95) states that “Not only is discourse always implicated in power; discourse is one of the ‘systems’ through which power circulates. The knowledge which a discourse produces constitutes a kind of power, exercised over those who are ‘known.’” Foucault’s notion of discourse undermines the distinction between true and false statements, though in his interpretation of the relationship between power and knowledge, the issue of whether a discourse is true or false is less important than the issue of its efficacy. When a discourse is effective, Foucault (2000, 131) refers to it as a “regime of truth,” proposing that “each society has its regime of truth, its ‘general politics’ of truth—that is, the types of discourse it accepts and makes function as true.” The important components of a truth regime include the techniques that separate true from false statements, how true and false statements are sanctioned, and the status that is given to those who speak what is recognized as truth (Foucault 2000; Weir 2008). According to Lorna Weir (2008), Foucault placed primary emphasis on scientific and quasi-scientific truth, but truth practices in contemporary societies are more heterogeneous than this. Weir introduces the concept of “truth formula” as an added level of abstraction to the concept of “truth regime”. The “truth formula” involves how things are made to appear, how they come to be represented, and how the relation between things and words is formulated, stating that “in our contemporary truth regime, discourses of truth may enter into stable relations, or may engage in contests for domination” (Weir 2008, 368).

Foucault (1972, 224) illustrates the social construction of scientific truths in his discussion of the work of Gregor Mendel in *The Archaeology of Knowledge*, stating that

People have often wondered how on earth 19th century botanists and biologists had not managed to see the truth in Mendel’s statements. But it was precisely because Mendel spoke of objects, employed methods, and placed himself within a theoretical perspective totally alien to the biology of his time...Mendel spoke the truth but he was not *dans le vrai* (within the true) of contemporary biological discourse: it was simply not along such lines that objects and biological concepts were formed.

While Foucault does not dispute the validity of scientific knowledge, he acknowledges that knowledge is governed by boundaries established by the discipline and by political structures in the society that are integral to the conveyance of power to those who hold particular types of knowledge (Bazzul and Carter 2017). The risks of the application of social constructionism to science are also present in the analysis of scientific knowledge in terms of Foucault's notions of power/knowledge, and Foucault (Rabinow and Rose 2003, 29) addresses this in his interview entitled *The Ethics of a Concerned Self* when he states, "When you tell people there may be a relationship between truth and power they say: 'So it isn't truth after all!'" Foucault (1982) argues that power can only exist when it is put into action, and it is this continually contested enactment of scientific power through education that maintains the anti-evolution and anti-science movements' investment in influencing science education policy.

Knowledge, Truth, and Power

In the study of the history of science, historical epistemologists divide knowledge into science and common sense (Kuhn 2012; Weir 2008). According to Weir (2008, 370),

Historical epistemologists conceptualize scientific truth as provisional, with science characterized by internal rupture as it overturns previously accepted theories and cosmologies. The orientation of scientific work to truth unsettles scientific discourse rather than leading to the constitution of cumulative, permanent truths. The quality of being a self-correcting discourse normatively oriented to truth...is what separates scientific discourse from what they variously call “common knowledge,” “common sense,” or “common culture” (using these terms synonymously), based on the acceptance of the intuitively obvious.

Truth in science is tentative and constantly modified. The process of science allows for the incremental self-correction that is inherent in scientific progress (Weir 2008). However, even with this precarious claim to truth by science, in modern Western cultures science is generally accepted as truth rather than ideology. The “regime of truth” is the system of power that produces and sustains “truth,” and the concept of the “regime of truth” gives a means of analyzing the position and impact of scientists, as their work is often accepted as “truth” without acknowledgement of the power that is conveyed to science as a result of the societal acceptance of scientific knowledge as “truth” (Foucault 2000; Weir 2008). According to Weir (2008, 381), scientific or “veridical” truth has been in conflict with the “symbolic” truth of the intelligent design movement. Weir (2008, 381) states that “the truth regime of advanced modernity is characterized by struggles for domination among its truth oriented knowledges. Veridical and symbolic truth have stable relations when the former is confined to science and the latter to religion, politics, and law, but they also enter into competition and struggle for interpretive dominance, as in the recent case of ‘intelligent design’ in the United States.” While intelligent design may be the most recent symbolic truth to engage in a struggle for power with science, evolutionary theory has for nearly a century been engaged in this struggle with the various incarnations of the anti-evolution movement. In addition to anti-evolution, other anti-science

movements, particularly those that deny climate change, are engaging in the same conflict in order to establish their truths as dominant.

Sociologist of education Stephen J. Ball (2013, 35) states that

The practitioner, the professional, is also brought into being by the knowledge that makes them expert. A key constituent in the formation of the modern state is the production of state professionals who operated on the power/knowledge cusp. Knowledges are produced within power relations also in the sense that some groups or institutions have been able to speak knowledgeably about “others”, subaltern groups, who were concomitantly rendered silent— men speak about women, deracialized whites about racialized others, heterosexuals about homosexuals, the West about the Orient.

Cannell (2006) and Harding (1991) assert that modernist viewpoints tend to see devout Christianity as a precursor to modernity or as a “repugnant cultural other.” In the context of this analysis and the regimes of truth that privilege scientific or “expert” knowledge over other types of knowledge that may be classified as “ideology,” in education scientists or other experts may be labeled as groups that “can speak knowledgeably” about laypeople, about fundamentalist Christians, or about anti-science groups. Anti-science publications frequently claim that their scholarship is the victim of discrimination at the hands of mainstream science, and it is clear that the narrative that has been constructed has rendered anti-science groups as subaltern. Through all of United States history and up to the present day, Christianity is seen as the mainstream, most practiced religion of the American people. It still enjoys a good deal of privilege through the popularity of religiously-driven policies in many states as well as the recognition and incorporation of Christian principles, practices, and holidays in public life. However, through the twentieth century Christianity lost a good deal of its influence in public education as interpretations of the Establishment Clause could no longer allow for compulsory prayer or Bible reading in public schools, and repeated attempts at mandating the teaching of Biblical creation were all declared unconstitutional. As a result, while it would be difficult to argue that Christians in the United States are a “subaltern” group, the place of Christianity or any other religion is subaltern to that of science, scholarship, and expertise in the realms of knowledge and education.

An analysis of discourses of science and anti-science is essential in the study of anti-science movements, their political activities, and the negotiations of power that have been

ongoing between science and fundamentalist and evangelical Christianity through the past century. Today the controversy remains though some anti-evolution and anti-science movements are no longer explicitly or exclusively religiously motivated, and the discourses used by science and by anti-science remain central components of the maintenance of the controversy in popular culture. As John Gledhill (2000, 199–200) states, “A focus on social movements encourages us to look at the politics of culture as a process by which groups in ‘society’ construct or reconstruct identities for themselves in their struggles and negotiations with dominant groups and the state. As we have seen, such processes are never entirely free-floating and may involve no radical rejection of the semiology of domination.” This is seen in the struggle for power that the anti-evolution and anti-science movements have waged against science, as these movements have utilized markers of powerful knowledge such as advanced post-secondary education, peer-reviewed publication, and the language of science in order to compete with the accepted scientific consensus regarding issues of evolution and climate change. In the United States, the competing ways-of-knowing presented by science and religion have resulted in a campaign for the redefinition of science that includes anti-and/or non-scientific explanations of nature. It remains difficult for the American public to reconcile the power of scientific knowledge and the non-democratic and impersonal nature of the scientific method of inquiry with the deeply important American values of individualism, democracy, and common sense.

Chapter 3:

Data Collection Methods and Analysis

Overview

The purpose of this research was to explore the ways in which ideologies and rhetoric regarding American values and identity inform understandings of scientific inquiry and knowledge and influence educational policy and curricula. This project investigated the educational purposes and impacts of the Tennessee Teacher Protection and Academic Freedom Act through ethnographic analysis of legislative proceedings and interviews of legislators and public and private high school science teachers. Interviews explored the perspectives of legislators and teachers regarding impacts of the law as well as attitudes regarding the influence of political, social, and religious ideologies on science education.

Study Participants and Setting

The first population of study includes legislators in the Tennessee House of Representatives and the Tennessee Senate in 2011 and 2012, when HB0368/SB0893 was proposed and passed. Purposive sampling, or identification of potential participants based on specific criteria (Bernard 2011), was used to identify legislators who sponsored and otherwise participated in the passage of the bill. Legislators in the Tennessee General Assembly (in both the House of Representatives and Senate) who sponsored, co-sponsored, or voted against passage of the bill were contacted via email and phone and invited to participate in the study (see Appendix B for the recruitment letter). In addition to these groups, legislators who were vocal in discussions of the bill in meetings of the House of Representatives and the Senate were also invited to participate. This sampling method was intended to recruit both supporters and opponents of the bill. Thirty-three legislators were invited to participate, and eight responded positively to the invitation, though ultimately four legislators were interviewed. All interviews were conducted via video call or phone.

The names of legislators involved in the passage of the bill and videos of the legislative meetings regarding the bill are available publicly on the website of the Tennessee General Assembly, so all potential participants were informed that the provision of confidentiality may not be possible. This was discussed with the legislative participants in the informed consent process and documentation in order to ensure that legislators understood the potential for their identification as participants in the study even if pseudonyms were used in the resulting dissertation (See Appendix C for the informed consent statement). All legislative participants consented to the disclosure of their identities. However, one legislative participant verbally expressed concern about the use of his identity at the beginning of his interview and expressed a desire for tentative consent that would be contingent upon his comfort in answering the interview questions. Through the interview this participant never chose to revoke consent. Legislators were not remunerated for participation in the study.

The second population of study included public high school science teachers in eastern Tennessee. Purposive sampling was used, and teachers with an interest in evolutionary biology

education and who have worked in schools since the passage of the Tennessee Teacher Protection and Academic Freedom Act were identified through participation in Darwin Day teacher workshops held on the University of Tennessee-Knoxville campus in 2013, 2014, and 2016. These teachers were contacted via email and invited to participate in the study (see Appendix B for the recruitment letter). In order to respect the confidentiality of the participants in Darwin Day, the coordinator for the Darwin Day teacher workshops distributed the email to teachers on behalf of the researcher, and therefore the number of teachers invited is not known. Three teachers responded positively and one interview resulted from this recruitment method. The researcher also distributed the recruitment email to all of the science teachers in a public school system in eastern Tennessee, using the email addresses that were provided on the school system website. In total, 122 teachers were contacted using this direct invitation method, eleven teachers responded positively, and nine interviews were conducted. Following the initial recruitment, snowball sampling was used. The initial participants were asked to identify other science teachers they knew who may volunteer to participate in the study (Bernard 2011). This allowed for identification and participation of teachers with a variety of attitudes about the Tennessee Teacher Protection and Academic Freedom Act and about evolutionary theory. Two teachers were identified and recruited using snowball sampling. A total of twelve public school teachers participated in the study. In some cases, interviews were conducted in private study rooms in the Hodges Library at the University of Tennessee—Knoxville, and some interviews were conducted at the schools where teachers work, typically in classrooms or laboratory spaces during teachers' planning times, lunch, or after the close of the school day.

The third population of study included private high school science teachers in eastern Tennessee. Though private schools are not directly impacted by the Tennessee Teacher Protection and Academic Freedom Act, the inclusion of private school teachers in this study allowed for more meaningful analysis of ideology and rhetoric in debates about educational content and practice through the inclusion of teachers who have chosen to work in educational environments that offer curricular alternatives to the state-mandated standards that govern public schools. Purposive sampling was used, and science teachers at Catholic, Protestant, and secular private high schools were identified. Teachers were contacted via email and invited to participate in the study (see Appendix B for the recruitment letter). Four teachers were invited to participate, and two responded positively and were interviewed. The interviews were conducted

in common areas at the schools where the teachers work during the teachers' lunch, administrative, or planning time during the school day.

Written informed consent of all teacher participants was obtained (see Appendix C for the informed consent statement). To help ensure confidentiality, the names of the schools or school systems in which the teacher participants work is not disclosed. To provide confidentiality, pseudonyms are used in this dissertation. Each teacher who participated in the study received a ten dollar gift card. This remuneration incentive was considered appropriate as it allowed the researcher to express gratitude for the teachers' participation in the study, and given that teachers are not considered a vulnerable population and the economic value of the remuneration was small it would not be coercive to potential participants. While there is some controversy regarding the ethics of payment for participation, this incentive was approved by the University of Tennessee Institutional Review Board and adheres to ethical guidelines, and this remuneration is reasonable given that teachers invested their time in this project. The American Anthropological Association does not explicitly give guidelines regarding incentives or remuneration for participation in research—in fact, the topic is not addressed at all in the organization's most recent statement on ethics (Head 2009; AAA Committee on Ethics 2012).

Data Collection Methods

Semi-structured interviews were conducted with legislators and teachers (see Appendix D for the interview guides). Semi-structured interviews used an interview guide, or a list of questions and topics that were covered in each interview, but it allowed for other possibly unanticipated leads to be followed when they arose in the course of an interview as well (Bernard 2011; Flick 2009). The semi-structured interview structure ensured that all questions were covered in a single interview while still giving participants the opportunity to discuss related issues that were unanticipated by the researcher. Topics discussed in the interviews included knowledge about the Tennessee Teacher Protection and Academic Freedom Act, perceptions of the purposes and impacts of the law, opinions about the teaching of topics named in the law, and attitudes about science education in Tennessee. Interviews also included discussion of the participants' political, social, and religious ideologies in order to allow for investigation of the relationship of participants' ideologies to their attitudes about the Tennessee Teacher Protection and Academic Freedom Act and science education. Further discussion involved how these alignments coincided with or diverged from participants' perceptions of American identity and values commonly involved in the evolution-creationism debate, such as democracy and fairness, religious and academic freedom, the authority of scientific knowledge, and the roles of legislators, teachers, voters, and communities in determining educational policy and content. Aside from political and religious affiliations, no other demographic information was requested of the participants (e.g. age, gender, race, etc.).

Additional items of discussion in interviews of public school teachers allowed for investigation of the impact of the Tennessee Teacher Protection and Academic Freedom Act on educational practices and outcomes, including classroom experiences regarding the teaching of topics named in the law, methods and materials employed in the classroom, and how teachers perceive the passage of educational policy in general and this policy in particular. Additional interview topics for private school teachers included the nature of the science curriculum taught and, when applicable, its relationship to the school's religious or other founding principles and ideologies. The standpoint of the teacher and school on evolution and various types of

creationism were discussed, as well as the teacher's perceptions of students' understanding of science and future pursuit of post-secondary science education. These interviews also included discussion of the way teachers perceive the differences between the science curricula used by the private school and the curricula used by public schools in the area.

All interviews were audio recorded with the consent of participants. Data were processed into textual material; audio recordings of interviews were transcribed and notes were entered as Microsoft Word documents.

For the study of the legislative meetings regarding the Tennessee Teacher Protection and Academic Freedom Act, videos of the meetings are available online in the archives of the Tennessee General Assembly (Tennessee General Assembly 2012a, 2012b). Video documentation of all discussions of the bill prior to its passage are available, including meetings in the Education Subcommittees, Education Committees, and full meetings of the Tennessee House of Representatives and the Tennessee Senate. The researcher created transcriptions of these videos for analysis.

Data Analysis and Interpretation

Use of Computer-Assisted Qualitative Data Analysis Software NVivo

Following data collection and the processing of interview audio files and videos of legislative meetings into textual material, all transcripts were imported into the computer-assisted qualitative data analysis software NVivo for coding. NVivo is commonly used in qualitative data analysis and in studies that employ grounded theory methodology (Bringer, Johnston, and Brackenridge 2006). NVivo was chosen for this project as it allows for the use of various coding techniques and multiple coding cycles, and it allows for axial coding as connections can be made and codes can be categorized and otherwise manipulated (QSR International n.d.). NVivo does not require that all data be collected prior to the start of analysis and it provides easy access to the original data, making it ideal for the employment of grounded theory methodology in this study (Bringer, Johnston, and Brackenridge 2006; QSR International n.d.). The use of NVivo for data analysis also allows for oscillation between open coding and deeper analysis. For example, in coding for “academic freedom” NVivo allowed for location of all references to the concept of academic freedom in the data as well as deeper analysis of the different definitions of academic freedom and the different understandings of how academic freedom is enacted. Strauss and Corbin (1998) assert that assigning conceptual names to data in order to categorize it is the first step of developing theory according to grounded theory methodology. In NVivo these categories are represented by “nodes,” and in later analytical stages nodes can be rearranged/condensed and grouped into “parent” and “child” nodes to aid in conceptualizing relationships, similarities, and differences in the data as related to the larger categories and themes. Additionally, NVivo allows for nodes (codes) and coded data to be linked back to the original data, which facilitates a focus on analysis of data in its original context as is necessary in grounded theory methodology. Nodes (codes) can be viewed separately or comparatively, and the “Coding Stripes” feature in NVivo is helpful in developing links between categories in later coding cycles as axial coding is employed. Coding stripes help highlight similarities, differences, and co-occurrences in the data

that aid in refining the nodes (codes) and understanding relationships in order to reach the theory-building and explanatory stage of data analysis and interpretation (Bringer, Johnston, and Brackenridge 2006).

Data Analysis Methodologies and Techniques

Grounded Theory Methodology

Data were analyzed using grounded theory methodology, which calls for analysis that is “grounded in the data” and leads to development of theory (Strauss and Corbin 1994). In the application of grounded theory methodology, Anselm Strauss and Juliet Corbin (1994, 273) assert that “theory may be generated from the data or if existing (grounded) theories seem appropriate to area of investigation then they may be elaborated and modified as incoming data are meticulously played against them.” Grounded theory methodology employs systematic coding procedures, is interpretive, and is sometimes referred to as the “constant comparative method” (Glaser and Strauss 1967; Strauss and Corbin 1994). Grounded theory methodology is commonly used in qualitative studies in the fields of anthropology and education. Following the work of John Dewey and George Herbert Mead, Strauss and Corbin (1994, 279) assert that “theory is not the formulation of some discovered aspect of a preexisting reality ‘out there’.” Rather, truth is enacted and theories are resulting interpretations created from the perspectives that are studied or adopted by researchers (Addelson 1990; Clarke 2005; Strauss and Corbin 1994). Through the constant comparative activity of grounded theory methodology, the interpretations and perspectives of the study participants are incorporated into the interpretations of the researcher, and the researcher must acknowledge and review his or her own interpretations through the process of data analysis as well (Strauss and Corbin 1994).

In discussing the development of theory, Strauss and Corbin (1994) state that grounded theories are abstractions but that they are “grounded” in the perspectives of the participants, and researchers have a commitment to develop or use theory that will have at least some practical

applications and that will be relevant to the study participants. Though grounded theory methodology typically advocates theory generation, the methodology is also appropriate for elaboration of existing theories (Vaughan 1992) and for the application of existing theory to research questions in ways that may be novel. Hennick et al. (2011) note that research that applies pre-existing theories in different contexts or social circumstances, or that elaborates or modifies earlier theories can be just as substantive as original theory development. Prior anthropological studies of creationism and education (Long 2011; Toumey 1994) have primarily relied on the work of Clifford Geertz (1973) as a theoretical framework in the investigation of creationist and other anti-science viewpoints. These studies focused more on description and understanding of anti-science sentiments, whereas this study was intended to focus more on the maintenance of the political conflict regarding science and public education. For this reason, social constructionism (Berger and Luckmann 1965) and Michel Foucault's (1980; Rabinow 1991) work on power and knowledge provided the framework for interpretation of the data in this study.

Discourse and Frame Analysis

In the analysis and interpretation of data this research employed political and rhetorical discourse and frame analysis. In the comparative analysis of legislators' and teachers' perceptions of science education and educational policy it is evident that the rhetoric and discourses employed by these groups in discussing science education are quite different from each other. Furthermore, the rhetoric and discourses employed by other stakeholders in the passage of the Tennessee Teacher Protection and Academic Freedom Act, including academic scientists, private sector scientists, and others is markedly different from that of legislators and teachers. Gee (2011) asserts that discourses are the "social languages" that people use to enact specific socially recognizable identities. The longevity of the evolution-creationism debate and of the anti-science movement's persistent influence in public education and in American media and politics indicate the necessity of frame analysis in the investigation of legislator and teacher discourses.

The origins of the framing concept are in cognitive psychology and anthropology (Van Gorp 2007; Bateson 2000), and “the major premise of framing theory is that an issue can be viewed from a variety of perspectives and be construed as having implications for multiple values or considerations” (Chong and Druckman 2007, 104). Framing refers to the ways people conceptualize issues and how issues are represented in discourses. Baldwin Van Gorp (2007, 62) states that frames contribute to the “interpretation and evaluative definition of the social world” in a social constructionist approach to frame analysis. Frames provide a context within which messages can be interpreted and the use of frames can seem so natural that the social construction is not overtly evident, and this allows frames to serve as mechanisms of power (Van Gorp 2007). Erving Goffman (1974, 1981) asserts that frames are a central component of culture and are institutionalized in various ways. Furthermore, frames are relevant not only as collections of individual perceptions and discourses but they represent the outcomes of the cultural process of creating and negotiating shared meanings (Gamson, Fireman, and Rytina 1982; Gamson 1992; Snow et al. 1986). As a result, frame analysis is useful in coding and revealing alignments and contentions between legislators involved in creating educational policy, teachers who are responsible for implementing policy, and teachers who have sought work in schools not bound by state-mandated standards. Additionally, this rhetorical focus allows for investigation of how legislators and teachers similarly and differently employ various discourses involved in the evolution-creationism debate, including the traditionally privileged scientific discourse as well as discourses that appeal to popular American morality and values (Apple 2014; Foucault 1980; Lakoff 2002; T. E. Nelson, Wittmer, and Shortle 2010; Rouse 2010).

Data Coding Processes

The coding of data was completed in several cycles. Johnny Saldaña (2016, 55) states that the purpose of coding is to “fracture or split the data.” Through the coding process data can be organized and deconstructed so that the researcher can make connections, synthesize meaning, and develop explanations (Grbich 2013; Saldaña 2016). Herbert Russell Bernard (2011) describes data analysis as initially a process of searching for patterns in the data and then

as a development of ideas and theory that can explain why the patterns in the data exist. In the initial coding stage, techniques were used to organize the data and provisional coding was completed (see Appendix E for a list of codes used in data analysis). Grammatical coding methods are techniques for organizing and managing data. The grammatical method of attribute coding was used to organize the data according to the vocation of the participants and speakers in the legislative meetings (Saldaña 2016). Elemental coding methods are the foundational approaches to coding data. In order to organize the data the elemental method of descriptive coding was used to split the data according to characteristics of the participants and speakers in the legislative meetings.

Following the use of attribute and descriptive coding to organize and inventory the data, provisional coding was conducted. Provisional coding is seen as an exploratory method or technique in which codes are developed prior to the data collection (Layder 1998; Miles, Huberman, and Saldaña 2014). These deductive codes are informed by the literature including academic, legal, and media publications regarding the history of the evolution-creationism debate and other controversies in science education. These codes are also informed by the theoretical frameworks to be employed in data analysis and interpretation, specifically social constructionism as outlined by Peter Berger and Thomas Luckmann (2011) and Michel Foucault's (2012, 1980, 1984) power/knowledge. While one of the main tenets of grounded theory methodology is that coding and consequently theory should arise from the data, scholars of grounded theory take different standpoints on the application of prior theories or models. Strauss and Corbin (Corbin and Strauss 2015; Strauss and Corbin 1998) encourage the use of discipline-based knowledge and extant theory as long it is appropriately applied to the particular study data. The codes used in the provisional coding stage include the concepts of academic freedom, theory, fact and truth, fairness and equality, common sense, freedom of religion and religious persecution, and scientific and philosophical naturalism. Other deductive codes included Social Darwinism, a Christian Nation, human exceptionalism, and taxpayer or voter rights.

The second cycle of coding consisted of inductive coding, which allows for unanticipated codes to emerge from the data (Bernard 2011). Affective coding methods investigate participant emotions, values, and other subjective qualities of experiences (Saldaña 2016). The affective method of values coding, which focuses on values, attitudes, and beliefs that represent the

perspectives of worldviews present in the data (Saldaña 2016) was employed. Values coding is useful in studies that employ discourse analysis (Gee 2011) and values codes help in making connections between values, attitudes, and beliefs and the social institutions and cultural and religious affiliations that influence them (Charon 2013; Saldaña 2016). Another affective coding method, evaluation coding, was employed as interviews and legislative meetings included perspectives and judgments of the impacts, significance, and worth of educational approaches and policies (Rallis and Rossman 2003; Saldaña 2016). The elemental method of In Vivo coding was used to capture “behaviors or processes which will explain to the analyst how the basic problem of the actors is resolved or processed” (Strauss 1987). In Vivo codes are those that use words or phrases from the data as labels, and In Vivo coding is a foundational coding method for grounded theory methodology as it prioritizes the participant’s voice. In this study In Vivo coding was particularly important due to the comparative nature of the investigation of legislator and teacher perceptions and the rhetoric that these two groups use in framing issues regarding science education.

In keeping with grounded theory methodology, in the third coding cycle axial coding was employed. Axial coding involves making comparisons at the category and subcategory levels (Bringer, Johnston, and Brackenridge 2006; Corbin and Strauss 2015; Strauss and Corbin 1990, 1998). The goal of axial coding is, according to Saldaña (2016), to “strategically reassemble” the data that was deconstructed by coding. Kathy Charmaz (2000, 2014) asserts that in axial coding the “axis” is a category and the process of axial coding aims to link categories with subcategories, to specify properties of categories, and to determine relationships between categories. Strauss and Corbin (1998, 136) state that one of the primary goals of axial coding is to achieve “saturation,” which they describe as the point in the data collection or analysis “when no new information seems to emerge during coding, that is, when no new properties, dimensions, conditions, actions/interactions, or consequences are seen in the data.” When saturation is achieved analysis can move from being primarily descriptive to being more explanatory. Axial coding leads to the identification of primary themes present in the data as the organizational and grouping aspect of the axial coding technique makes themes become evident. Saldaña (2016) is critical of the notion of “coding for themes” in data analysis, as he conceptualizes themes as “outcomes” of the coding process in data analysis. Carl F. Auerbach and Louise B. Silverstein (2003, 38) define a theme as “an implicit topic that organizes a group of repeating ideas.”

Theoretical coding coincided with and followed axial coding in the third coding cycle. Theoretical coding is often referred to as “conceptual” or “selective” coding and is crucial to grounded theory methodology (Strauss and Corbin 1994; Saldaña 2016). In theoretical coding all of the categories of codes and major concepts are integrated around a central or core category which suggests a theoretical explanation to the research question (Corbin and Strauss 2015). In grounded theory methodology, at this point in the analysis the central or core category is a condensed and synthesized statement that can suggest the possible relationships that exist between categories in order to generate a theoretical explanation from the analysis (Charmaz 2014; Corbin and Strauss 2015; Saldaña 2016).

Chapter 4:

Results

The Role of Government in Public Education

Legislator Perspectives on the Role of Government in Public Education

Regarding the role of government in education, most legislators and teachers interviewed reported that the state legislature should not enact policies that result in micro-management of daily school or classroom operations. Representative Bill Dunn (Republican, Knox County) who sponsored HB0368/SB0893 stated that the Tennessee General Assembly rarely seeks to intervene in the development of curriculum and typically defers to the State Board of Education for curriculum development. He sees the role of legislators as largely that of a liaison, as legislators hear from local schools and school boards, teachers and teachers' unions and advocacy groups, as well as from parents and other voting constituents regarding educational policy. Representative Dunn emphasized that while many legislators advocate for whatever the majority of their constituents wants, he believes that "the people send us down here to represent them. That doesn't mean you just take a poll on everything and if the majority say this is what should be taught then you do it. We are a republic where you send someone down and you hope that they have the good sense and the discerning skills where they will decide what is good and best and then be able to communicate that with their constituents so they understand why you're doing what you're doing." Representative Jeremy Faison (Republican, Cocke, Jefferson, and Greene Counties) who was a co-prime sponsor of the bill stated that the role of the legislature

“should be very limited...I believe we as a state government need to stay out and allow the local school boards to have a lot more autonomy in doing things they think is best.” Similarly former Senator Andy Berke (Democrat, Hamilton and Marion Counties) stated that “I have a great deal of concern about the General Assembly getting into the macro level of curriculum...They’re not experts, they’re not elected to be experts, what they are supposed to do is put together a framework where talented people can, you know, set up a system for kids to thrive in. So anytime the General Assembly gets involved in the macro issues of curriculum it’s troubling because, you know, curriculum is changing.” Representative Joe Pitts (Democrat, Montgomery County) expressed concern similar to former Senator Burke regarding the legislation of curriculum, stating that the legislature’s role

shouldn’t be getting down in the weeds and dictating that schools teach cursive writing, for example, like we did two or three years ago. We shouldn’t be in the weeds with curriculum or dictating textbooks, dictating policy necessarily that really has nothing to do with education but has everything to do with the social agendas. You know, all they do is just make matters worse. Let’s stick to funding education appropriately, making sure that every child has the opportunity to go to a good school, and then if we need to intervene we will. There’s an opportunity to enhance, not to tear down.

In addition Representative Pitts stated that “teachers need a seat at the table, certainly. It’s trite but it’s true, you’re either at the table or on the menu.” In general all of the legislators interviewed stated that the role of the legislature in education should not involve interference in curriculum, as school boards and content area experts should be making those decisions. However, two of the four legislators interviewed sponsored and voted for HB0368/SB0893, which could potentially have significant impact on the teaching of several components of K-12 curriculum in life and earth sciences.

Teacher Perspectives on the Role of Government in Public Education

The teachers interviewed all stated that legislators do not tend to understand education or science well enough to make informed policy decisions regarding the teaching of science in

public schools. Three of the teachers interviewed felt that they do not stay informed enough about state education policies to speak about the actions of state legislators, but eleven unanimously felt that legislators do not know what daily classroom experiences are like and that what legislators think goes on in schools and classrooms is not reflective of reality. According to Mary Anning, “I don’t think they are teachers or even scientists. I think one man was a doctor, but no, I don’t think people that don’t teach or don’t have any education background should be making decisions about education at all.” Joan Procter stated that many state representatives seem to think that since they attended elementary, middle, and high school they now know how teaching and administration should be done in schools. Ms. Procter stated,

I think they all think they understand it, and when they go to schools and they visit I think they walk in a classroom for five minutes in a school that’s been prepped for them to come and they have no clue. They have no clue...And I don’t think the people in the legislature understand evolution. I mean if I had to go to school to understand it completely, then I don’t know why someone who hasn’t had a science class since high school thinks they understand it well enough to pass rules on how I should teach it.

Rachel Carson declared, “I don’t think they have a freaking clue!” As an example of how disconnected policy and practice can be in public education, Esther Lederberg told a story of teacher evaluations that were instituted that allowed students to complete anonymous written surveys to evaluate their teachers. While this is common practice in university settings, Ms. Lederberg stated that she and her colleagues knew that this process would not go as the state legislature expected and that the implementation of it was “a disaster.” Ms. Lederberg said that one student reported placing his empty potato chip bag in the envelope with his survey. In addition, she explained,

I had one girl one day, they were working on an assignment and this one girl did not want to work on it and I was like, “Okay, you need to get to work.” And she was like, “Do you like getting paid?” And I was like, “Uh, yes, but that’s not really related so you need to get to work.” And she was like, “If you like getting paid, you shouldn’t make me do this assignment.” And I was like, “I don’t know what you are talking about but you need to get to work.” And she said, “Well, I have to fill out a survey on you, don’t I?”

In addition to unrealistic expectations three teachers mentioned that in the current educational climate it does not seem that legislators consult with teachers in meaningful ways, listen to teacher concerns, or communicate well with teachers when new policies are enacted. Two teachers mentioned that state legislative policies result in micromanagement of educational practices and classroom time, and Vera Rubin stated that the state legislature needs to “loosen the reins” on teachers. Ms. Rubin and Maria Merian both described policies that have impacted the use of time in the science classroom, including laws that mandate time spent on reading and on physical activity. Ms. Rubin and Ms. Merian talked about the ways they incorporated the mandatory physical education time by documenting student movement during laboratory activities or by doing campus walks, and they explained that often the curriculum content of the week does not really call for such physical activities but that they must find creative ways to incorporate the physical activity into their lesson plans regardless.

According to Florence Bascom and Nettie Stevens, the goals of the legislature do not align with the goals of educators, and legislators do not hold the same or even appropriate priorities for public education. These teachers believe that religious and financial motives are more at play than a concern for improving public education—and in particular they think that a conservative Christian religious agenda and a desire to employ a business model and move toward privatization in public education are primary motives for legislators in educational policy decisions in Tennessee. In discussing legislator agendas Florence Bascom stated, “I think most of our politicians are against evolution. And they have, oftentimes, a religious agenda. I think the whole school choice thing to me and my mind is that they are trying to put the public money into religious education. That’s what it appears.” According to Nettie Stevens, “I think politically they are trying to turn education over into big business so that people can make money. I think that’s the bottom line. These big companies have found a way to bring money in from our public schools. Testing is the first, and then charter schools.”

Private school teacher Barbara McClintock stated that the development of curriculum and assessments should be done by teachers rather than legislators. The school in which she works allows academic departments to choose their textbooks and other materials and to establish the curriculum and pacing for their classes. Although Ms. McClintock stated that in the public schools there should be some standardization to ensure continuity in the content presented across schools, she also stated that one of the benefits of working in private education is the freedom to

develop curriculum and content. Dr. Jane Goodall chose to work in private education due to current educational policy, as she has a Ph.D. in a science field but she does not have a degree in education. She has not pursued the coursework that would be required to obtain a teaching license in the state of Tennessee so in spite of her extensive education in science, she would not be considered qualified to teach in a public school in the state. These teachers cite educational policy as the primary reason that they choose to work in private rather than public education.

In discussing education policy and the actions of legislators, some teachers indicated that while many policies have direct impacts on schools and classrooms when specific changes and actions are mandated, in many cases teachers disregard policies. Florence Bascom explained that she and some of her colleagues are politically active and that she has time for this because she has many years of teaching experience and because her children are adults, giving her more free time outside of work. She expressed the sentiment that younger and less-experienced teachers often do not keep up with policy changes because “teachers don’t have time, they are inundated and they are so passionate about what they do.” Joan Procter stated,

We don’t listen. Seriously, whatever happens in Nashville, we just kinda go—once that door is closed, now I’m not going to do anything illegal, and I’m not going to do anything to get myself fired. But this is my classroom, and my goal is to educate my students. And what evidence is out there is what I’m going to tell them whether it’s popular or not. Now I do have to feed my family. I’ve got a car payment. I’ve got a house payment. I’m not going to do anything to jeopardize my job, but I don’t really listen to policy because I just take my job seriously and I think it’s my job to educate. I’m going to do the best I can at that.

In discussing the role of legislators in public education and the impact of educational policy on her career, Grace Hopper stated several times, “I just do what I want.” She explained that she was glad to see that some teachers were consulted in the construction of the upcoming new science curriculum standards, but she still feels that “Tennessee could do a lot better.” She stated, “I know that Lamar Alexander has been, he’s the education guy. Warped perspective, he never sent his kids to a public school. So I have written Lamar about climate change, and [I told my husband], ‘I’m gonna write Lamar Alexander a letter and let him know that I think Betsy DeVos is a piece of shit!’ And he’s like, ‘Don’t do it!’” While all the public school teachers reported a thorough understanding of the current state curriculum standards for the courses they teach, most reported that they do not keep up with policy regularly or take policy changes

seriously unless they mandate specific changes and actions that are implemented at the district or school level.

Perspectives on the Tennessee Teacher Protection and Academic Freedom Act

Legislator Perspectives on the Tennessee Teacher Protection and Academic Freedom Act

Of the legislative participants interviewed in this study, Representatives Bill Dunn and Jeremy Faison voted for passage of the Tennessee Teacher Protection and Academic Freedom Act and former Senator Andy Berke and Representative Joe Pitts voted against it. In discussion of HB0368/SB0893 in the meeting of the Tennessee House of Representatives on April 7, 2011, Representative Faison stated,

I just want to tell you guys, Tennessee wants government to be common sense and less government. And this whole situation right here has to do with critical thinking. We watch these beautiful children up here, there's a couple hundred that come up here earlier today and I looked at them and I thought about this bill coming up and I thought, "you know what? I want them to be critical thinkers and to be able to look at stuff objectively."

In the interview Representative Faison reflected on the impact of the law and stated that he expected a "very nominal impact because we did not introduce creationism into the classroom." He went on to state that "I would say what you would see a difference is, is there would be an impact if we would introduce the theory of creationism along with the theory of evolution...if we brought that to the classroom you would see an impact then and I think you would have children that are smarter because they have learned to critically think and realize one side of the coin is probably not always the exact right side and that you need to balance it out." Representative Faison also stated that he views the teaching of creationism as an alternative to evolutionary theory to be constitutional as long as the two are not taught as fact and students are not mandated to believe in either option.

In contrast to Representative Faison's and other legislators' overt enthusiasm for the prospect of allowing creationism to be taught in science classes, Representative Dunn consistently asserted that religious theories were not to be taught or promoted in science classes under HB0368/SB0893. He often read an excerpt from the bill that states the bill "only protects the teaching of scientific information and shall not be construed to promote any religious or nonreligious doctrine" (Tennessee General Assembly 2012a, 2012b). When asked in the meeting of the House of Representatives on April 7, 2011, if the bill would allow the presentation of creationism in science classes, he responded that

You're bringing up a question that a lot of people ask, and obviously there was a Supreme Court Decision in the 1960s thanks to Madalyn Murray O'Hair that effectively removed God from the classroom. There's been court decisions since then dealing with the Establishment Clause that have said things such as creationism and more recently intelligent design cannot be taught, that it's considered to be religion and so this does not change the course of what can be taught...and obviously you couldn't have a bill telling someone to do something that the court says you cannot do.

His final response to the question of whether creationism would be allowed was, "You can't teach the whole creationism A to Z, no." He went on to discuss Piltdown Man, the well-known paleoanthropological hoax that is commonly used to discredit scientific study of evolutionary theory (Numbers 2006; Scott 2009). Representative Dunn stated,

In the study of evolution there used to be what was considered and called the Piltdown Man. And this was a discovery, I think, in England and they found a jaw and parts of a skull and the scientists put it together and the majority, it was almost unanimous, this is part of the evolutionary process, man at one time had a larger skull than we ever imagined. And so for decades that was taught. Well there were a few scientists who looked at it and said, 'You know what? That jaw kind of looks more like an orangutan.' And so eventually they did some studies and found out that it was actually a fraud. So there would be an objective scientific fact that could be introduced. It's not a whole new theory or creationism or whatever, but it's an objective scientific fact that that jaw actually came from an orangutan and skull pieces came from something else and the whole thing was a fraud. So it'd be more facts as opposed to a whole theory.

Similar to the language of the bill, Representative Dunn focused on the concepts of "strengths," "weaknesses," and "facts" in legislative meetings as well as in the interview. He characterized

the bill as outlining “guardrails” for teachers, as he had heard that teachers sometimes were inclined to “skip over” these subjects because they did not know what to do in the event that issues would arise with students or parents.

In the interview Representative Dunn did not name any particular positive outcomes of the Tennessee Teacher Protection and Academic Freedom Act, but he stated that student performance in science has been improving (National Center for Education Statistics 2015). In discussing the passage of the law and its outcomes, Representative Dunn stated,

If you look, Tennessee is zooming past everybody, and at such a level it’s just a little incremental thing, it’s such a way that other states are coming to Tennessee and saying, “What are you doing?” Now, if I was a good politician I would take credit for it, that my bill is the one that sent us there, but I’m gonna be honest about it, it wasn’t. But I bring that up because if you go back and watch the videotape of the committees on this bill you would see groups like the ACLU, you would see groups of scientists get up and say, “This bill will destroy science education in the state of Tennessee.” And obviously it didn’t, so it’s very concerning to me that groups such as science organizations who a lot of people have a lot of esteem for and look to them, that they would jump to certain conclusions and I think it sort of casts, it makes you wonder about their thought process. And what became clear to me is that the scientists are humans too. And a lot of times, while they’d like to say that they just look at data and facts, they’re affected by their emotions and preconceived notions just like a lot of people...In fact, I had, I think there were six Nobel Prize winning scientists who sent me a letter about how horrible this bill was and how it was going to destroy science. And actually I was right and they were wrong, so I’m smarter than the Nobel Prize winning scientists!

Former Senator Berke and Representative Pitts both voted against passage of HB0368/SB0893. In a meeting of the Senate Education Committee on March 14, 2012, former Senator Berke argued against passage of the bill, stating that

I talked to a lot of teachers over the last few years as every member of this committee has. This is not an issue that I’ve seen, just haven’t heard from anybody that this is really a problem...and when we start saying that “Hey, there are issues like human evolution that can cause debate, and therefore the General Assembly needs to say something can cause disputation and we, the General Assembly, needs to intervene,” I think we’re making a mistake. We’re getting ourselves involved in something that really has been handled perfectly appropriately by now.

Representative Pitts shared former Senator Berke’s opinion that the bill was unnecessary and did not actually address a real problem in education. In the interview Representative Pitts stated,

I just felt it unnecessary, first of all. Second, I felt it was too broad in what it tried to do as well as, it was a solution looking for a problem. There was no problem we were trying to fix, at least from my view, and I thought it just needlessly complicated a teacher’s life. You know, teachers are professionals, they’re not bringing hidden agendas to work every day. Their agenda is very open, they want to provide the best education experience for each of their students.

Representative Pitts equated the Tennessee Teacher Protection and Academic Freedom Act with other bills that he perceives as unnecessary, such as the “bathroom bills” that were proposed in Tennessee in 2017 and 2018 that would have required public school and college students to use the bathroom that corresponds to the sex listed on their birth certificates (Tennessee General Assembly 2017a, 2017b, 2018). In the interview he stated, “There’s people all the time that approach me and say, ‘Why are y’all talking about the Bible being the official book? Or why are y’all talking about bathrooms? You know, let’s get back to trying to create jobs for people and cover the 800,000 people in our state without health insurance. And you know, improving our worst performing schools instead of you know, having a bathroom monitor.’”

Representative Pitts also mentioned the tangible and intangible impacts of laws, and he offered the example of the tangible economic impact of North Carolina’s “bathroom bill” with losses of conferences, sporting events, concerts, and other events that were cancelled and relocated out of the state in response to the law. He stated that the intangible impacts of laws are “perception. You create the perception that you’re very narrow-minded, and now I’m not asking you to compromise your principles but certainly you’ve got to remember there’s people out there...that are different. Just because you’re different doesn’t mean you’re any less a person.” In the legislative meetings former Senator Berke expressed concern at the idea that the bill would allow teachers to address issues of the intersections of science and faith, and expressed the opinion that exploration of those questions should be reserved for the family and church rather than in public school classrooms. In discussing the impact of the law, he stated, “Bills like this erode the basic underpinnings of why we send our kids to public schools.”

Teacher Perspectives on the Tennessee Teacher Protection and Academic Freedom Act

Interviews revealed that only four of the fourteen teachers interviewed were familiar with the Tennessee Teacher Protection and Academic Freedom Act. Three of the public school teachers did not work in public education when the law was passed. Of the teachers who were familiar with the law, Joan Procter mentioned that she only knew about it because it was a topic of discussion in a graduate course that she was taking when the law was debated and passed. Esther Lederberg vaguely remembered passage of the law, but she found it irrelevant and disregarded it because she has no interest in teaching alternatives to scientific consensus. She stated that she does not need “leeway” in teaching socially controversial issues because she “is on board” with the science. Florence Bascom had heard of the bill but since it had not had any noticeable impact on her experiences at work she assumed it had not passed, stating, “I remember bits and pieces, but quite frankly, if you asked me if it got passed I would say no, it didn’t. I thought it got voted down. But didn’t Dunn, didn’t he promote a lot of controversial things that didn’t get passed? And especially back then it seems like I remember there were some pretty ridiculous things.” Nettie Stevens also only had a vague familiarity with the law, asking, “Wasn’t part of that to protect teachers who taught the other side as well? So if I teach creationism I’m okay?” She went on to say that the focus on critical thinking in the law is “what makes it sound good.”

Two teachers stated that they liked the idea of the protection afforded by the law, and though they do not have interest in presenting alternatives to evolution or climate change in their classes, they think the law may protect them from student or parent complaints regarding the evolution and climate change content in the curriculum. Only one teacher reported being impacted by the law since its passage. Grace Hopper explained,

I teach AP Environmental Science, and I had a really ambitious and awesome student who was going to meet with our senators up in DC and he wanted to take with him a bunch of letters from students expressing our concern about climate change...And so he kind of spearheaded this initiative and I, as the teacher, was kind of the middle person trying to get other teachers on board to have kids write letters...It all started because this

one kid's parent wanted him to be able to write an opposing view on that and we were just like, no. If they want to write something to the senator that's fine, but that is not what our initiative is. We are not doing that. Sorry.

In response to the parental complaint the school's administrators provided Ms. Hopper with a copy of the Tennessee Teacher Protection and Academic Freedom Act and instructed her that under this law students' dissenting views on the topics named in the law should be accepted. In discussing her thoughts on the law Ms. Hopper stated,

I don't like the fact that it would allow people to eliminate things from the curriculum like the evolution part...I teach life sciences so I always teach evolution and I worked with a lady years and years ago who refused to teach evolution in her biology class...I feel like if you are going to teach science you should teach science. And if you are teaching biology class the foundation of biology is evolution, and I feel like it is a disservice to the students and it just perpetuates, it perpetuates, I don't want to sound like a jerk, ignorance. And I don't think it's okay to allow them to do that, to give them the freedom to do that or the freedom to not teach one of the most important concepts in biology.

All of the public school teachers interviewed stated that they had no interest in teaching alternatives to evolutionary theory or climate change in their classes. Nettie Stevens stated that the Tennessee Teacher Protection and Academic Freedom Act reminds her of the "equal time" laws of the 1970s and 1980s. While she was confident that none of the science teachers at her school would include religious or non-scientific alternatives to socially controversial scientific theories, she thinks that there are many teachers in the state of Tennessee who would be happy to include creationism, intelligent design, climate change denial, or other alternatives to scientific consensus if they were allowed to do so. Grace Hopper thinks that this law and ones like it have the potential to "lower the intellect of our population." Mary Anning stated that she does not know any teachers who would want to present alternative theories or evidence against theories such as evolution or climate change, and that she would never consider including such content "because it's not science." Private school teacher Barbara McClintock stated, "I think that the country needs to be reminded of the fact that there is this thing called 'the separation of church and state.' And we are continually stuck in that, and this law steps on that. It steps on that all over the place."

Perspectives on Science

Legislator Perspectives on Science

Interviews and legislative meetings revealed legislators' perspectives on science and science education. In general, many of the legislators in the Tennessee General Assembly at the time of the passage of the Tennessee Teacher Protection and Academic Freedom Act perceived and characterized science as uncertain, unreliable, and worthy of skepticism. They did not fully understand the difference between scientific theory and colloquial use of the word "theory," and they perceived scientists and academics as bullies. In general the vocal proponents of HB0368/SB0893 expressed that they perceived a contentious and mistrustful relationship between the public and mainstream science experts.

In a meeting of the House Education General Subcommittee on March 2, 2011, two professors from the University of Tennessee—Knoxville testified in opposition to the passage of HB0368/SB0893. Dr. Gary McCracken was professor and head of the Department of Ecology and Evolutionary Biology and Dr. Andrew Kramer was professor and head of the Department of Anthropology at the time of this meeting. Following the professors' and others' statements in support or opposition to the bill, members of the committee asked the speakers questions. Representative Joey Hensley asked Dr. McCracken for an explanation of what he teaches his students about "how life started." Dr. McCracken described the predominant theory regarding the origin of life, and then stated, "And I've got to tell you, that is part of the nature of science, I can't tell you how life started." Representative Hensley stated that he thought the origin of life was part of evolutionary theory, and then he posed questions regarding the Big Bang Theory and the Second Law of Thermodynamics, which are also not part of evolutionary theory. After verifying that scientists have not yet been able to re-create earth's first life form in a laboratory, Representative Hensley asked, "Don't you think that would be something that, as smart as we are, that if that was possible someone could have done that?" In his final question to Dr. McCracken Representative Hensley asked, "I majored in biology myself in college and went to

medical school and, you know, took all of the biology classes, and I never saw where if you didn't teach evolution that that hindered any of the studies that we do today. Do you think that's gonna hinder biology classes, biochemistry classes, students learning those things?" Dr. McCracken responded that not teaching evolution would be detrimental to scientific literacy.

Representative Joe Carr presented questions to Dr. Kramer, and rather than exploring more facets of evolutionary and other scientific theories Representative Carr asked Dr. Kramer to define the term "theory."

Joe Carr: Thank you, and this is a genuine question, not a setup question, okay? Explain to me, tell me what the scientific definition of "theory" is.

Andrew Kramer: Alright, I will tell you exactly what it is.

Joe Carr: Well, I knew you could.

Andrew Kramer: And I appreciate the question because I think very often it is a word that is rife with controversy itself. Theory in the popular perception...

Joe Carr: If you could just tell me the scientific definition.

Andrew Kramer: I shall. "Theory" in the popular perception means "hunch" or "guess." In contrast, though, "theory" in science has a very very different meaning. And the one word synonym for "theory" in science is "explanation." So a scientific theory explains the facts we have in front of us. And evolution as a scientific theory explains the facts of commonalities in DNA, commonalities...

Joe Carr: And so, if I could interrupt you, because I want to fast forward. So I thought that's what it was and in the layman's term, Dr. Kramer, would it be inappropriate for the layman to say a theory is a scientist's best educated guess?

Andrew Kramer: No, I wouldn't say it's a guess.

Joe Carr: I didn't say that. I said "best educated guess."

Andrew Kramer: No, I wouldn't use the word "guess."

Joe Carr: So what would you say?

Andrew Kramer: The best educated explanation based on the facts in front of us.

Joe Carr: Okay fine, we'll split hairs then. So with regard to the best educated explanation available to the scientific community, is that correct?

Andrew Kramer: Yes.

Joe Carr: Why do you object, then, since it's not a certainty. The theory is not a certainty, why would you oppose critical analysis on the part of the students with regard to that best educated explanation?

Andrew Kramer: I don't.

Joe Carr: I think we're fine with the bill, thank you sir.

Andrew Kramer: But I would explain to you in that context that within the scientific theory of evolution there is debate about the processes by which various changes occur. And those debates are taken care of and are dealt with honestly and forthrightly by our Tennessee science teachers as was discussed behind me, as is represented throughout this room, and supported by their administrators. So in that context by keeping it within

science, keeping it within the accepted explanation for evolution there is no need, is what I was saying, for this bill.

Joe Carr: Well that may be true, and I appreciate your comments, but I think you and I need to understand and this committee needs to understand that what this bill does is it encourages students to critically analyze science and their best educated explanation. And I think that's what we're trying to do and I think that's appropriate and thank you for your time.

In a March 29, 2011, meeting of the House Education Committee Dr. Molly Miller of Vanderbilt University spoke in opposition to passage of HB0368/SB0893. At the time of the meeting Dr. Miller was a professor in the Department of Earth and Environmental Sciences. In her statement Dr. Miller asserted that evolution is a religiously controversial topic rather than a scientifically controversial one. She went on to explain that since the original language of this bill (and others like it) was known to be from the Discovery Institute, it could be inferred that the goal of the law would be to cast doubt on the validity of evolutionary theory so that students interpret the controversy surrounding evolution as scientific rather than as religious. Dr. Miller stated,

Let's consider quickly two theories that are accepted by almost all scientists. One is atomic theory, the idea that atoms are composed of protons, neutrons, and electrons. And the other is evolution. Neither one has any competing scientific theory that is really strong. I can't imagine that this legislative body would take time to debate whether atoms are made up of protons and neutrons or if there is some better explanation. It's not a controversial theory and neither is, it's not a controversial scientific theory and neither is evolution... This bill would hurt Tennessee students who need to be learning science every minute that they are in science classroom. If they're going to be able to compete they need to be able to distinguish between real scientific controversies and artificial controversies... And the strategy here probably is to declare evolution a controversial scientific theory and then evaluate it as a science controversy. It sounds terrific, it is just what we need, critical thinking development. But evolution is not a scientific controversy. It is no more controversial than thinking that there are protons and neutrons in atoms. What folks are bothered by in evolution has nothing to do with the science, it has to do with religion. It is a religious controversy, and a religious controversy is very important but really different from scientific controversy. So the doors of science classrooms really do need to remain open to critiquing scientific concepts as they are now in Tennessee, but they need to be closed tightly to evaluation of the supernatural, which is not science.

Representative John DeBerry expressed disdain for the assertions of academics and he also took issue with Dr. Miller's comparison of atomic theory and evolutionary theory, because he believed that atomic theory should be defined as an "exact science" and that evolutionary theory is a "theory" or an "opinion." He stated,

I find it offensive that you will, and walk in this body, whether I agree with you or this legislation or not, that you present yourself in such a way that you're saying that you, first of all, you put two things in front of us. You put the atom in front of us, you put evolution in front of us. It don't take a rocket scientist to know that you're talking about an exact science and you're talking about something that is a theory. And whether I agree or vote for this legislation or not I take offense with people who are coming into this body, into this committee, and presenting your opinion, which is exactly what it is, which is as good as my opinion, as though just because you have prefixes and suffixes on your name that all of a sudden you're some type of a standard. And I find that offensive.

Representative DeBerry's final statement to Dr. Miller concluded with the assertion that Dr. Miller and other academics in opposition to HB0368/SB0893 were waging an attack on free thought.

And obviously if you're going to fight this vehemently [sic] to make sure that no opposing thoughts, theories, facts whatsoever are able to enter the classroom, the minds of our young as they're being developed, so that they have a one-dimensional, one-sided view of everything which you and the scientists have deemed worthy. It apparently, what you're saying is you're going to decide on the mindset, the training, the intelligence, and the future of this nation from your classroom, from what you and your colleagues deem necessary and I find that totally anti-American and against everything we claim to stand for as far as being a free-thinking people. That we will allow one segment of the population, one demographic, and one profession to make a determination as to what everybody else thinks. And that's wrong.

Representative Joey Hensley stated to Dr. Miller, "You made a statement that there's no competing theory with evolution, so I take it that if evolution is proved untrue then people will have to believe that the earth was actually created like the Bible says. But I've heard from so many people that will accept this flawed theory which is what evolution is, and you bring it up as all scientists believe evolution, and that's not true. All scientists do not believe evolution."

Though Dr. Miller had not suggested that all scientists believe in evolution, she had

acknowledged that there is no mainstream scientific theory that serves as an alternative to evolutionary theory.

In the interview Representative Jeremy Faison explained his support for HB0368/SB0893 in terms of his thoughts on the evolution vs. creationism debate and his perception of the uncertainty of evolutionary theory in science, stating,

I think it's imperative when it comes to education that if something is not a scientific fact, it's not proven, that we ought to do our best to present the students with a well-rounded foundation. And basically in the history of the earth, well in the last 150 years there are two concepts of how this earth got here. There's the concept of Darwinism and what he brought to the forefront and the concept of creation. So neither one can be proven and when I say proven, scientifically proven. We understand that for something to be scientifically fact the scientific method says basically, starts, you know this, there has to be a hypothesis. And then with a hypothesis you have to have research. And then with the research you have to have a conclusion and then to be scientific you have to be able to re-create that in order for it to be a scientific fact. Neither creationism or evolutionism has ever been able to be re-created if you will or provided with a substantial amount enough that we can say, "All right, this is it." The deal about evolution is over the last hundred years, look at how evolution or the theory of evolution has evolved. As a matter of fact, it's an ever-changing target, it's hard for a scientist to ever say, "Okay, this is exactly what took, this, origin of species, we know now that we had a big bang theory, or this happened, or the sea came up." Nobody's ever said a word to where did the first explosion come from or where did the sea we all evolved from. We don't have, there's nobody ever proven that. Now there's a lot of smart people who say, "Oh, there's tens of thousands of scientists who agree." Well, that's nice. But it's still not been proven. So based on the fact that it's not a true scientific fact, because facts don't change, remember, facts are eternal. The truth is eternal. Since it is not based on a fact, why would we not allow our students to hear both sides of an argument? Or all the sides, maybe there's more than both sides.

Similar to these assertions that evolutionary theory is scientifically problematic or unfounded, in the meeting of the Tennessee House of Representatives on April 7, 2011, Representative Glen Casada asserted that the theory is adhered to in a religious or dogmatic way by scientists. He further claimed that interpretations of the importance of the theory in the field of biology are expressions of "faith." Representative Casada stated,

I pulled out an article and I encourage everyone to read this. It's called "The Evolution of Evolution" in *Scientific American*, which is a great magazine. I don't agree with all their thoughts but this is a great scientific article and in January, 2009 it talks about the latest face of creationism and they really attacked legislation like this across the states...But there were three comments in this that struck me...It starts off, the opening comment in the scientific journal, a scientific journal, if you will, is this: "Without evolution, modern biology, including medicine, biotechnology, wouldn't make sense." Now I want you to digest that as I go through and read two other statements. Statement Number Two: "Nothing in biology makes sense except in the light of evolution." And they do have one more faith, if you will allow me to use it, faith statement. And they conclude with this: "Without evolution it would be impossible to explain why the living world is the way it is rather than otherwise." Ladies and gentlemen, I would submit to you those are faith statements. I could see those statements being made in any church or any temple in this world. Those are not scientific, those are faith statements. I've got to admit I admire the faith of those truly evolutionists because they claim out of nothing came life. I admire that level of faith. Sometimes I don't have it in my own Christian walk. Out of nothing came something. All you are attempting to do, with that said, my understanding is you want to say in Tennessee you have a right to question their evolutionary faith. And that's just question, "Is it true? Show me the science."

Like Representative Casada, in the interview Representative Dunn expressed concern that scientists do not operate objectively in their work and that their emotions or other factors may impact scientific inquiry and conclusions. One of the primary concerns of opponents of HB0368/SB0893 was that it would allow teachers to introduce non-science such as religious, fringe, or pseudoscientific alternatives to mainstream scientific theories in public school science classes. In discussing the opposition of academic scientists to HB0368/SB0893 Representative Dunn stated,

It kinda goes back and shows that scientists are humans too. And so therefore they were a bit prejudiced when they looked at the bill. Instead of just looking at the evidence, the black and white words, the words that were actually gonna end up in the codebook, they were looking at things around it and then coming to a decision. And so it changed, even though their eyes read plain English what it said, they were trying to read something else into it. Which makes you wonder, do scientists do that, the same thing, when they find a bone fragment, is there peripheral things that are making them come to conclusions? And they can beat their chest all they want and say, "We only look at data, we only look at facts." This is a perfect situation where they let their own personal views affect what they're actually seeing and understanding.

In the meeting of the Tennessee House of Representatives on April 7, 2011, several legislators discussed their perceptions of science and their stances on evolution and climate change. A popular topic of discussion in this meeting was the change in scientific consensus and recommendations over time, with a specific focus on how scientific consensus, implications for society, and recommendations had changed in recent decades. For example, Bill Dunn discussed changes in climate science since the 1970s, stating,

In 1975, I was a teenager then, and I actually remember scientists telling us there was the coming ice age. And so I did some Googling, I found out that even *Newsweek* did a large story on the coming ice age. And when you read through it, when you read stuff, you know, “The evidence in support of these predictions has now begun to accumulate so massively that meteorologists are hard pressed to keep up with it.” And also, “But they are almost unanimous in the view that the trend will reduce agricultural productivity for the rest of the century.” And then they start talking about a drop of a half a degree. And this was in ‘75, the scientists were almost unanimous that we were going to a coming ice age and I think someplace else in this article they had this one little throwaway line that says, “Some scientists discovered a slight increase in temperature around the equator.” And obviously, you know, fast-forward to 2011, scientists are almost, we are told, unanimous in that the planet is heating up. What’s interesting, in this article there was talk about how do we keep the polar ice caps from expanding, from getting so much ice? They wanted to spread black soot on the ice so it would attract the sun’s rays and heat it up and melt it. And things have changed quite a bit in the last 30 years.

Representative Sheila Butt shared her own anecdotes regarding the change in scientific knowledge and consensus over time, stating,

I was taught things in science class in high school which have turned out not to be true. I remember so many of us when we were seniors in high school we gave up Aqua Net hairspray. You remember why we did that? Because it was causing global warming, that aerosol in those cans was causing global warming. Since then scientists have said that maybe we shouldn’t have given up that aerosol can because that aerosol was actually absorbing the Earth’s rays and was keeping us from global warming. So so many things that we learned in science class have turned out not to be true. What about eating chocolate? You know, I was told, “Don’t eat chocolate.” What do we know about chocolate now? Good dark chocolate is full of what? Antioxidants! Some chocolate is good for you!

Throughout the debate and discussion of HB0368/SB0893 in the Tennessee House of Representatives and House Education Committee and House Education General Subcommittee, Representative Bill Dunn and other legislators suggested that teachers may be bullied into omitting scientific facts from public school science classes. Academic scientists were named as the perpetrators of this bullying, and Representative Dunn and others stated that they had received bullying emails from academic scientists as well. In the meeting of the House Education Committee on March 29, 2011, Representative John DeBerry said in response to Dr. Molly Miller's statements that academics are condescending and judgmental of anyone who does not agree with them. Representative DeBerry stated,

As we've sat through this issue this year the only people that I see opening the door to evolution, or I mean debates against intelligent design and so on and so forth are those that are coming in and saying that if we don't think as you think that we're a bunch of idiots. And I'm taken aback from it. You're very clear about what you said. Because you voiced your "if" clauses very very carefully, very very academically, and in such a way that as usual academicians [sic] coming in saying that anybody who does not agree with them is some type of idiot.

In the meeting of the Tennessee House of Representatives on April 7, 2011 Bill Dunn stated,

Being the sponsor of this bill, I've received several emails, many emails, several phone calls, editorials have been written in the paper, people are extremely harsh, mean. Wife wanted me to call the TBI about one person who called our house. So obviously there's some people out there who may bully people into not speaking out on some issues and introducing scientific facts that they may not like. And so I personally have come under some of these attacks and I can imagine where a teacher in the classroom is trying to teach and sticking to the curriculum, this does not change our state curriculum at all, may feel threatened or bullied if they introduce certain scientific objective facts to the course.

Later in this meeting in response to a question from a legislator about the context in which a teacher would be eligible for the protection offered by HB0368/SB0893, Representative Dunn gave an example that specifically suggests that academic scientists would intervene in public education and bully teachers, stating that "if a child asks a question and the teacher's saying, 'Okay, if I share the scientific facts with them, is the University of So-and-So's department going to come down here and say, 'How dare you say that? Here's the script, you'd better just

stick to it.’” Representative Richard Floyd argued that this bullying by academics has been an ongoing problem in public education when he stated,

You know, you can't get effort mixed up with results. Ever since the early '60s, the late '50s, early '60s, when we let the intellectual bullies hijack our education system, we've been on a slippery slope. We are now spending \$.42 out of every dollar on education and fighting just to keep our heads above water to move our kids forward. Common sense is something that we've all got, I don't think we have a scientist in this body. I've met most of you, and most of you have common sense. So this is a common sense bill. Thank you for bringing this bill to protect our teachers from the other intellectual bullies, now I enjoy getting emails from some of those folks. I just send it back and thank them for verifying that what I thought was correct.

Representative Sheila Butt suggested that in public education prior to HB0368/SB0893, science teachers were expected or possibly required to ridicule children who have questions about evolutionary theory, stating,

What this bill does is protects a teacher, not mandates what a teacher teaches. It protects a teacher when a child asks a critical thought question about something like global warming or evolution. They have the right to ask that question and the teacher has the right to not make them feel stupid for asking it. And that's what happens in our education system today. If a child questions the theory of evolution oftentimes that child is made to feel ignorant or dumb or stupid and we need to make sure that doesn't happen in our classrooms in the state of Tennessee.

Like other representatives, Representative Glen Casada recounted emails from academic scientists in opposition to HB0368/SB0893 as bullying and oppressive. Representative Casada stated,

I was taken aback when I too got these emails, and they were just overwhelming, vicious emails. “How dare you question?” And, matter of fact, I got into a dialogue with one individual about that. And his conclusion was, “We're scientists, we know what we are talking about, and you have no right to question us.” That kind of mind thought really scares me because if you look at history when this was introduced by Charles Darwin several years ago, the religious community at the time was, felt that it was heresy and tried to attempt to suppress Charles Darwin. But there's now the new religion of evolution and they in turn are trying to suppress questioning and free thought.

Representative Casada also reported that he was called a “Neanderthal” by the academic scientists who emailed him in opposition to the bill.

Teacher Perspectives on Science

Teacher perspectives on science tended to acknowledge some of the concerns that legislators expressed regarding the nature of science, but in general the teachers interpreted these issues differently. For example, several teachers discussed changes in scientific knowledge and consensus over time. Robert Cade stated that in science “nothing is ever for certain.” Likewise, Dr. Jane Goodall described science as constantly changing with changes that are “incremental” rather than drastic in nature. In spite of the understanding that scientific knowledge is not static and that scientific knowledge is not simply an accumulation of facts, none of the teachers interviewed suggested that science is worthy of mistrust, doubt, or disregard due to the fact that over time scientific theories can change. All of the teachers interviewed who teach biology asserted that although the curriculum and textbook do not present the material as all connecting to evolution necessarily, that they understand evolution as the core theory of biological science. Furthermore, all of the teachers interviewed stated that they felt evolution and climate change, two of the theories named in the Tennessee Teacher Protection and Academic Freedom Act, were important not only as components of the science curriculum that would be tested by the state End of Course exams. Teachers explained that these topics are important for students to understand as they grow up and use their scientific knowledge when they seek medical care, when they make decisions about behaviors that can impact the environment, and when they vote. In relation to this, almost all of the teachers interviewed explained that they find critical thinking skills important because they do not want students to simply memorize definitions and facts, but they want students to be able to use the skills of scientific inquiry in the future to be able to assess the validity of information that claims to be scientific. Nettie Stevens explained, “I teach that from the very beginning, you know, ‘In this class we are only going to use evidence and facts that are scientific.’ I tell the kids, ‘You cannot make claims if you cannot back it up with evidence, and that’s what makes it scientific.’ And we have talked a lot this semester about how

to be a good consumer of stuff on the Internet because there is so much stuff out there that is just not accurate or true.”

Three of the teachers interviewed expressed concern that some students see science as anti-religion, which was a trend in the perspectives of legislators who vocally supported HB0368/SB0893 such as Representative Joey Hensley, who postulated that if evolution is proven wrong then the result will be acceptance of the Biblical account of creation. Barbara McClintock stated that science is “not something that you *believe in*,” and she and other teachers expressed the idea that science and religion are not comparable because religion specifically involves the supernatural and science specifically excludes the supernatural. All of the teachers who reported being religious stated that they had no difficulty reconciling their religious beliefs with science, and some teachers saw science as something that strengthened their religious beliefs. Furthermore, several teachers were frustrated and saddened by suggestions made by students or other members of the community that their acceptance of scientific theories such as evolution imply that they must not be faithful Christians.

Though teachers did not share in the disdain and mistrust of scientific expertise that was expressed by many legislators, some teachers did make statements that are typically used in the anti-science movement to promote doubt of science or to elevate the status of non-scientific alternatives to mainstream scientific theories. For example Vera Rubin, when explaining the importance of debate in her classes. stated that “this is the beauty of science, you can look at the same evidence and come to two different conclusions!” She stated, “I would rather present all the evidence and let kids come to their own conclusions because it’s their life, their choice, their reasoning.” Dr. Jane Goodall suggested this as well when discussing the presentation of evidence such as the similarities in bat wings and human arms in the study of evolution and creationism, and she stated that different worldviews and philosophies can lead individuals to come to different conclusions regarding the same evidence. Sylvia Earle described science as “a way of knowing,” and she stated that “even though science is a way of knowing and there are a lot of calculated and educational evidence, there is still a lot of that imagination side that went into connecting the dots.” In addition to the suggestion that scientific conclusions are influenced by factors outside of empiricism, one teacher defined the term “theory” in science as “our best guess.” She stated, “I just tell them it’s a theory. So that’s what we think, that’s our best guess. So, if you disagree with it then okay, that’s our best guess.” This characterization of the meaning

of “theory” in science is similar to that of Representative Joe Carr and other members of the legislature who characterized scientific theories as similar to “hypotheses” rather than as syntheses of scientific facts and knowledge that have an explanatory role.

Perspectives on Teaching Controversial Topics

Teacher Perspectives on Content and Pedagogy

In discussing the topics named in the Tennessee Teacher Protection and Academic Freedom Act—the chemical origins of life, biological evolution, global warming, and human cloning—the teachers indicated that the primary topics that cause controversy are biological evolution and climate change, as “global warming” is no longer considered the most appropriate term. The teachers stated that the chemical origins of life are not covered in depth in any of the high school science classes that they teach. Five teachers reported that human cloning is a topic sometimes used for class discussions and debates when issues relating to bioethics are covered, and all five stated that the science of human cloning was never the subject of debate but rather that the ethical implications of cloning were the focus of discussion. All teachers reported teaching the mainstream scientific consensus on evolutionary theory, though Dr. Jane Goodall also reported that she teaches young earth and other forms of creationism alongside evolution at her private Christian school. While none of the teachers reported anti-evolution sentiments, one teacher reported that she is skeptical of climate change and teaches this skepticism. Dr. Jane Goodall stated,

My husband used to be a climate scientist...And so when I would teach that topic we covered a lot of the data that was out there because he knows it, and he would share it with me, so we talked about things like the average global temperature not really rising in the last 18 to 20 years. And there used to be the idea of global freezing back in the late 70s and we were all going to turn into a big ice planet and those kind of things, so I bring up that there are news cycles with some of these science ideas and whenever I taught that or talked about it I focused on the idea of being skeptical on both sides of the argument, so find the data before you make a decision.

All other teachers reported teaching the mainstream scientific consensus on climate change.

Interviews revealed that nearly all teachers employ a focus on “evidence” when teaching about topics that can be controversial. This focus on “evidence” is often presented at the beginning of coverage of evolution or climate change, and some teachers discussed explaining the nature of science and the difference between belief and science as a framework for introducing course content to which students may have religious or other objections. Sylvia Earle explained that she always presents the evidence to students but tells them that the evidence is the science but the “orchestration” is the belief aspect that cannot be proven and lies outside the realm of science. Ms. Earle described this “orchestration” as an umbrella term for any beliefs regarding supernatural causation or involvement in the history of earth and life. All of the teachers interviewed reported that they do not teach human evolution in high school biology classes. Barbara McClintock stated that evolution is “easier to swallow” if human evolution is not included, and human evolution is not typically taught in biology classes at her private school due to time constraints and the prioritization of other topics. Ms. McClintock’s school does not teach any alternatives to evolution or other socially controversial topics. Dr. Jane Goodall’s private Christian school utilizes a textbook published by Bob Jones University Press, and this text strictly adheres to young earth creationism. However, Dr. Goodall reported that she uses more mainstream supplemental literature and that she teaches students about evolution as well. She stated,

When we talk about creation and evolution here there is a tendency for people to think of it as a two-sided argument and it is not, it is multifaceted because you can look at it as basically a range of ideas from, you know, on the one side purely naturalistic evolution, we all came from just straight up elements, and the other side is, you know, the young earth creationist, the world was made in seven literal days, yada, yada, yada. I usually ask my kids, “What do you think about this?” And the great majority of them are on the YEC side of things because that is where their family is. And so it can be sometimes a touchy thing...I consider myself an old earth creationist and when I say that to some of my colleagues and many of my students, they think that means that I go full out with the whole there are multiverses instead of the universe, and everything comes from the primordial ooze and yada, yada, yada. So you have to make distinctions because people often have not really been exposed to different ideas besides one extreme or the other and many people think of it as a black and white issue, and it’s not.

Dr. Goodall went on to explain that in the presentation of evidence for evolution, she states that students' worldviews shape their interpretations of evidence:

And then as we go through each of those points I bring in some of the evidence that you can use to interpret one way or the other. And sometimes the evidence is just evidence and depending on your worldview, for example I will talk about bat wings and human forearms being very similar in morphology and some people will look at that from—if they have the worldview that everything is completely naturalistic evolution then that is complete evidence that evolution is a thing, but if you are from a young earth creation view you would say that is complete evidence that God designed it perfectly the first time. But it's still the exact same evidence, it doesn't change...it's not necessarily the evidence itself, it's the way we interpret the evidence that determines what our theories are. So that ends up being really interesting. And the kids are, I always want them to be educated, not indoctrinated. So, not everyone on staff is in that same place. So I think that, that's a tricky situation even at a Christian school. Because I find myself often in the minority when I say the kids need to know all of the evidence...What I say to my students on a regular basis is that "I do not want you to leave uneducated and ignorant," because honestly the reason I do that is not to make me be amazing or anything like that because if they leave here and they find out that there actually is evidence that is against young earth creationism, I don't want that to precipitate a crisis of faith. I don't want them to say, "Oh, what else did they tell me that is not true?" And that is the disturbing thing for me. I don't want that, I don't want that on my conscience. So I try to be as evenhanded about it as I can be.

In discussing the teaching of evolution, most teachers expressed a preference for covering it later in the semester, once the students have established a positive relationship with the teacher and after they have had some study of genetics. Teachers also stressed the importance of a gentle, sensitive, and supportive approach. Esther Lederberg stated,

I have found if you are sensitive with the students and you acknowledge that it might be hard to think about, you know, it might be a challenge to what you had thought about before, so I think that as long as you are sensitive about it students will be receptive to it...I think if you handle things in a delicate way you can still teach the science and the students will be receptive to the science without getting too worked up about their religious beliefs that they may or may not have.

Some teachers reported feeling apprehensive about teaching such topics, as they anticipated that students may be resistant and that parents may complain about the topics or the ways in which

the topics are covered. As a result teachers are careful about the ways that they present this information. For example, Lillian Gilbreth stated that she often prefaces statements about climate change with, “According to scientists...” in order to frame and even distance herself from the information. Seven of the teachers stated that they stress the importance of learning material in order to perform well on the End of Course exam as a way to remove any notion of a personal agenda in the presentation of content that students or parents may find objectionable and in order to reduce instances of students “opting out.” In spite of these concerns about avoiding resistance and objections, all of the teachers reported that they enjoy teaching the topics named in the Tennessee Teacher Protection and Academic Freedom Act and three of the teachers reported that these topics were some of the most “fun” and “engaging” for students. While Grace Hopper did not claim to use a gentle or sensitive approach to teaching these socially controversial topics, she stated that she always thoroughly explains that the term “theory” in science does not have the same meaning that it does in colloquial usage. She explained,

Oh, it is just a theory! Well hell yeah it is just a theory, let’s talk about what a theory is! So I make sure they understand what a theory actually is. We look at lines of evidence for it and I make sure that they understand this is not a belief. You can believe all you want to believe but I am teaching you what we have facts to back up, like we have got data to back this up, this is the foundation for the entire field of biology, whether you branch off into anthropology or botany or whatever you do. So it’s not open for discussion, I just tell them it’s not. We are not doing it in here, keep that to yourself, I am here to teach you this stuff and you know, maybe you will see what others see. I always preface that, so I kind of cut it off and I don’t allow it really.

Public school teachers reported that human evolution is not included in the state curriculum for Biology I in Tennessee (Tennessee Department of Education 2009). Two teachers reported that a district-level administrator had informed them that teachers would be supported by the administration in the event of student or parental complaints about the coverage of evolution, but if they covered any part of evolutionary theory that is not explicitly named in the standards they would not be supported. In particular, the district specifically discouraged coverage of anything relating to the origins of life, human origins, or human evolution. One teacher also stated that in pre-service teacher education courses and in professional development training teachers are encouraged to use phrases such as “change over time” rather than

“evolution” in order to make the material more palatable to students who may be resistant. Esther Lederberg explained,

They do not like “evolution.” They like “change over time.” I went to a training once and they encouraged us to use “change over time” instead of “evolution” because it is a trigger word. If you say “evolution,” they’re immediately going to be on the defensive but if you say “change over time,” they’re like, “Yeah, organisms adapt over time,” you know? And it’s not threatening. And so they were like, “You can try that, and see if it makes it a little easier on the students.” Which I don’t think it’s honest because evolution is one of the most important theories of all time, you know? And so to be like, “We’re not going to say this word because it might make you uncomfortable,” I don’t know, I have weird thoughts about holding students’ hands too much, and I think it’s hurting them in the long run, you know?

Maria Merian referred to this trend of code-naming evolution or parts of evolutionary theory as “sidestepping,” and while many teachers did express that it seemed to result in students being more receptive to learning about evolution, that the practice is also misleading to students. In addressing the amount of coverage of evolution in public schools Florence Bascom stated,

Our biology classes do cover evolution and some teachers cover it more than others, as you would expect. I don’t think that there are very many questions on the End of Course exam issued by the state in regards to that so it has a tendency more and more to be not covered in as much detail as in the past because it is not on the test. And there are some teachers who take that approach and then there are those teachers who take the approach that they need this to be good citizens of the world. They need this knowledge. If you want them to be able to vote in an intelligent fashion on these issues then they need this knowledge.

In discussing approaches to teaching socially controversial topics, most teachers were opposed to the debate format in the context of learning science. While many of them were open to debates regarding science and ethics in their upper level or advanced placement courses, these teachers stated that students do not learn science by debating issues such as evolution vs. creationism or climate change vs. climate change denial. Three teachers were willing to host such debates in their classes, and all of these teachers asserted that these debates could be beneficial because they would allow students to understand “both sides” of these issues. Maria Merian stated that she was influenced to allow for debates by a mentor teacher, stating,

She had said something, she said, “You know, tell them it’s like being a lawyer. If you are a lawyer for the prosecution you have to know what the defense’s argument is and you have to know both sides of it. And if you teach it from that perspective, that you are trying to teach them the good, the bad, and the ugly of whatever topic it is, then that will serve you well. You know, to make sure the kids know there’s two sides to every story, this is what the right answer is for the questions on the test but that you can choose to believe what you want.”

Teachers who were not open to debates of science vs. anti-science did not acknowledge these controversies as two-sided, but as either multi-faceted or as simply not comparable. As Florence Bascom stated, “I don’t think you can debate those issues in the classroom, personally. It doesn’t get you anywhere...you can’t really debate religious issues because it’s all by faith. There’s no debate.”

Three of the teachers interviewed stated that they are not religious. Eleven teachers stated that they are religious, and they reported varying amounts of religious practice. All of the teachers who reported religious beliefs reported that they are Christian. Some stated simply that they are “Christian” and others were more specific, stating that they are Catholic or of the following Protestant denominations: Baptist, Catholic, Episcopalian, Lutheran, Mennonite, and Methodist. One teacher is the sponsor of a Christian club at her school. Private school teacher Barbara McClintock identifies as Christian. She stated that when she teaches evolution she always explains to students that she will not discuss issues of science and religion during class time but that she will gladly meet with students outside of class to discuss how she reconciles science and religion, though no student has ever taken her up on this offer. The public school teachers, on the other hand, stated that though they have no trouble reconciling the science of evolution with their religious beliefs, that they cannot discuss this with their students. Joan Procter explained,

I tell them, I say, “So if your religion, if you follow a religion that is different from what we are saying in science I need you to step out of the box and just while you’re in science class let’s look at evidence.” I said, “I’m not telling you that you can’t believe in any religion, I’m not telling you religions are wrong.” And so we go into why, religion is faith-based and how science is evidence-based and how you’re gonna have to come to terms with how those two meet in your head, you know, on your own. I said, “You can talk to your parents, you can talk to your pastor, but in class I can’t help you reconcile the two.”

Vera Rubin expressed the idea that while it is important for public school teachers to remain neutral on issues of religion in order to avoid promotion of or discrimination against any religious affiliations of students, it is also frustrating when she cannot answer students' questions. She stated,

I see science as a way to support my faith, my one student that tried to leave the class I remember going to talk to her like, "You're still going to be tested on this," and I was just trying to be fair with her. And she's like, "How can you believe in evolution when you say you're a Christian?" And I was like, "One, I can't really answer that because now we are getting into topics you know I can't discuss with you as a teacher." But that was one of those times where I'm like "I really wish I wasn't a teacher right now and I could be another person and talk to you about this."...I think the more open we can be with people and the more open discourse we can have, I feel would solve a lot of problems even outside of science education.

Public school teachers explained the same phenomenon regarding social and political objections to scientific theories such as evolution and climate change—while keeping teachers' social and political ideologies out of the classroom helps maintain neutrality, it can at times leave students with unanswered questions. None of the teachers interviewed reported disclosing their religious or political affiliations with their students and, in fact, these teachers explicitly stated that they could not discuss these topics with students and that it would be inappropriate to do so.

Teacher-Reported Objections to Controversial Topics in Science Classes

Teachers reported various objections to the coverage of socially controversial topics in science classes, though the teachers reported experiencing more objections to evolution than to climate change, and they reported no specific objections to the chemical origins of life or human cloning. Teachers reported that most objections come from students, but some come from parents and other members of the community as well.

Objections to evolution manifested in numerous ways for the teachers in this study. Robert Cade stated that he has experienced verbal opposition to evolution and related topics in

his classroom. For example, when discussing evolution a student once told him, “I don’t want to believe this crap.” In another instance when discussing a film that depicted a theory on the extinction of the dinosaurs a student claimed, “No, the Devil did that.” Two other teachers reported that students have declared, “I didn’t come from a monkey!” or asked, “Doesn’t evolution say we came from monkeys?” This is a common misconception about evolutionary theory, so neither teacher was surprised by this objection in their classes. Maria Merian stated that she does a “bellringer”—a short activity that students complete at the beginning of class—that asks students to answer the question, “What is evolution?” One student wrote, “It’s a fucking lie.” Ms. Merian stated that the student was penalized for the use of profanity but that the incident did not result in any class disruption. Mary Anning stated that students have suggested that she “must not be a Christian” if she believes in evolution, to which she responds that her spirituality is unrelated to the content of the biology course. Nettie Stevens reported an overt but non-verbal and unwritten resistance to evolution, stating that

One time I had a kid, I was talking about the theory of evolution on the first day, and he sat there with his Bible open on his book on his desk. And I just kind of ignored it, I didn’t make a big deal about it but I thought, it was almost like he had to protect himself against it, you know. And that’s what’s really hard, it’s almost like they teach those kids that we are such bad people if we believe in evolution, and I always talk to about how you can be a Christian and believe in evolution. There is overlap.

Several teachers reported that certain parts of evolutionary theory seem to be more troublesome to students than others. Teachers reported experiencing objections to topics that could be described as “macro-evolution” more than to topics that students interpret as under the umbrella of “micro-evolution.” Vera Rubin reported that she had several students who were resistant to learning about phylogenetic trees and speciation after having no issue learning about other parts of evolutionary theory in prior weeks. One student opted out of class for one day due to her unwillingness to attend when “macro-evolution” topics were discussed. She described another student who also wished to opt out of all classes in which evolution was covered, stating

I’ve even had one student say, “I’m not even going to sit in the room.” Like, her mom was in the principal’s office telling me, “You need to give her an alternative assignment.” And there’s not an alternative. It’s not like I can give her anatomy to study while we go

over evolution. There isn't an alternative. She's going to be tested on it on the state exam. She doesn't get to say, "I have a religious issue with this so I'm not going to take these questions on the test." You're going to take the test, if you choose to not sit in the lecture because you have an issue with it you are hurting yourself. Which is what I kinda say to my students that do kind of tangle with these things is, "You don't necessarily have to agree with what I'm teaching but just know that this is what the state is going to test you on." Which kind of sucks that you kind of have to say that...But it also kind of gets to a point where, I think it's a good skill to teach them that you can't just throw in the towel because you disagree with something and that state test does kind of help with convincing them to at least sit down and listen even if you don't agree with it.

In this case the student decided to stay in class for the coverage of evolution. Two other teachers reported having conversations with students or parents who wished to explore opt-out options, but they reported that these students ultimately decided to remain in class as well.

Classroom objections to climate change are less frequent for the teachers who participated in this study. Florence Bascom stated that students are more often overtly resistant to learning about evolution and the geologic timescale, while they "will roll their eyes" but not actively challenge the climate change content that is covered in environmental and earth science courses. Grace Hopper encountered a student who resisted climate change by prefacing her answers to all classwork and test questions with, "If this were real..." This student also frequently argued that solar flares were responsible for climate change. Ms. Hopper stated that the fourth time this happened she became frustrated and found several articles from reputable popular science magazines that debunked the solar flare argument, and she attached these articles to the student's test before returning it after grading. The student never offered the solar flare argument again, though Ms. Hopper reported that she did not know if the student ever accepted the science of climate change.

The two private school teachers and two of the public school teachers reported having no experience with parental or community objections to the teaching of socially controversial topics. All other teachers had experienced some form of parental or community objection. Two teachers reported receiving emails from disgruntled parents—in one instance a parent requested that creationism be taught alongside evolution, and in the other instance the parent stated that his child should not learn evolution at all as it doesn't align with the family's beliefs. In both instances the teachers responded to the emails with the explanation that while students are not mandated to "believe" in evolution, the state science standards and the End of Course exam do

cover evolution so students will need to learn about evolution in order to perform well on the final exam. Neither teacher reported any follow-up from parents in these cases. Joan Procter reported that she once found a DVD of a creationist documentary, *The Young Age of the Earth* (1996), on her desk when she arrived at work. All of the science teachers at her school received a copy, though none of them were ever told who provided the videos. Nettie Stevens stated that a parent who was a physicist once gave her several PowerPoint presentations on CD's and suggested that she use them in her classes. Upon reviewing the presentations Ms. Stevens discovered that they were anti-plate tectonics, which is not accepted in mainstream science or included in the Tennessee state science standards (Tennessee Department of Education 2017, n.d.).

While most teachers reported that they felt that their school and district-level administrators would support them in the event of complaints about the teaching of socially controversial topics in science classes, two experiences were reported in which teachers were not fully supported by their administrators. Nettie Stevens reported an issue that began with a parental complaint about the biology textbook, as it referred to religious accounts of creation as “myths.” This parent wanted the textbook to be banned. In response to this Ms. Stevens stated, “My take on it was if you look at the word ‘myth’ it actually refers to something referring to the gods, which is not scientific. And so the way that it was used was, it was used in a literary sense correctly. But people who were Christian and read that word ‘myth’ were very offended by it. Ms. Stevens, a parent, and two school administrators were tasked with doing a thorough review of the textbook although textbooks go through a year-long approval process at the state and county levels in Tennessee prior to adoption. A district-level supervisor suggested that Ms. Stevens use a marker to black out the word “myth” in each textbook. Ms. Stevens told her students that they could do that if they liked, but she did not modify the textbooks. Ms. Stevens reported that during a meeting a school-level administrator on the book review committee stated, “I think we all know where I stand on this issue, and I am not going to comment,” making it clear that she was on the side of the parent and did not wish to support the teacher in the controversy. Ultimately the case resulted in a school board vote, about which Ms. Stevens stated,

It was horrible, it dragged me through the mud. My name was never brought up specifically, but they had numerous people come talk to the school board. They had people from UT come support me. They had people speak out against me, and all the local newspapers reported it. I saved all the newspaper clippings and it was a *stack* because I remember showing it to my parents saying, “You won’t believe this. Look at what’s happened and look at how I have been dragged through the mud.”

Ms. Stevens stated that the School Board vote was close but that it resulted in the decision not to ban the biology textbook.

Ms. Stevens also reported that in her first year as a teacher in Tennessee after several years of experience in other states, she once invited a parent of one of her students to give a presentation to her biology classes, as this parent was a paleoanthropologist and expert on human evolution. This invitation was recommended by a district-level supervisor for high school science education. Ms. Stevens explained,

He was supposed to come out, and this was horrible. He was supposed to come out and do a lecture for my students...When I started telling some of the surrounding teachers that I was excited he was coming out they said, “Oh you had better be careful and you’d better run it past the principal first.” Again, I was a brand-new teacher and I didn’t know I had to ask permission. When I went up to the [administrator] she said, “I would not touch it with a ten-foot pole.” She said, “You need to un-invite him.” I had to send him an email and say, “I’m really sorry, but my [administrators] won’t support this and they told me that human evolution was not part of our curriculum and I could not do it.” They said if I wanted him to come after school and do something down at the gym where people choose to come that’s fine, I could not do it during class time. So I was very, very embarrassed. His daughter was in my class at the time and I had to write to him and literally un-invite him. I felt horrible about the whole thing. I learned a lot the first couple of years I came here, and I learned very quickly you just don’t attempt anything that could be construed as controversial.

Ms. Stevens expressed that guest speakers frequently visit her school to talk about topics in multiple content areas that are outside the state curriculum standards, and that she is certain that this situation was solely due to the fact that the topic was evolution.

In addition to explicit attempts to influence or change educational content and practice, other community feedback regarding the teaching or acceptance of socially controversial science topics was reported by two teachers. Dr. Jane Goodall stated that the community of her Christian

private school largely holds the belief that if a person is not a young earth creationist, then he or she cannot be a true believer. She stated, “Some are very, they are very concerned. I’ve had some people that have really discussed things with me because they are very concerned about what that implies for me.” Nettie Stevens reported that she was once approached in a department store by a member of the community who had questions about the teaching of evolution. Ms. Stevens stated,

It was a parent of a friend of mine. It wasn’t a parent of a student. She stopped me in Stein Mart one day and said, “You don’t teach evolution, do you?” and I said, “Well, yes I do.” And she goes, “Well you don’t believe that, do you?” I said, “Well, yes, I accept it as a scientific theory.” But that was embarrassing to me, here I am in the middle of a store, and I’ve got this lady getting real aggressive with me in the store, you know?

In general the teachers interviewed reported that most objections to evolution are religious, though the students, parents, and others who object to evolution often offer the common creation science or intelligent design arguments as alternatives to evolutionary theory. Most teachers reported that arguments against climate change tend to be more driven by political and economic ideologies that disagree with the implications of climate change, though Grace Hopper also mentioned that while she finds debunking arguments about evolution to be “elementary,” the anti-climate change pseudo-science can often seem much more compelling. Barbara McClintock stated,

Like with climate change, the religious side of it is people saying that God is in charge and he wouldn’t mess up his creation. No he is not, you are, we are, people are. And then there is also the economic side of it of if you want me to protect the climate from all of these things that means that I cannot sell my cars and I cannot sell my gas and I can’t do all these things that are making me the big bucks. And so that does, I have taught students who are in the coal industry, whose parents were in the coal industry, and it is a very fine line you have to walk when you’re talking about stuff like that with them... You know, the religious side of it is more gentle on their own self-confidence. Because if they are saying, “I don’t want to believe in climate change because it is going to hurt my wallet,” that sounds a little self-serving. And it is. And so often all they do is they refer back to the Bible and what I have said to them, to my students, I have brought this up, because a religion teacher told me this. Someone who had his Ph.D. in theology. The Bible was handed down from an oral tradition and words that we translated or were translated into “day” actually meant “age” so it could be eons. The seven days, it could

be seven eons, it could be different times. So you can't, I don't say this in class, but people take the Bible too literally and all of their arguments go back to this verse, that verse, but this verse is only what they want to take out of it. They didn't read the verse before or the verse afterwards which totally negates what they are trying to say.

Several teachers reported seeing value in having students explore "both sides" of issues, specifically the mainstream science and prevailing anti-science viewpoints on issues such as evolution and climate change. All teachers reported that they had at some point or frequently told students that they can believe whatever they choose, but that they must learn the mainstream science curriculum content in order to complete the course and be successful on the final exam. However, teachers also expressed frustration at the ongoing controversy regarding evolution and climate change as they all reported that they feel that these topics are important for students to understand as they grow up and become adult citizens. In discussing the ongoing evolution vs. creationism controversy Esther Lederberg stated,

I think people unfortunately are very distrustful of science. And I think they are very stubborn in their religious beliefs, and I think there is a lot of misconception when it comes to evolution about what it says and what it doesn't say. I think that people are just going along with what they are taught, you know? I think the people who are religious are hearing aspects of evolution, maybe some are correct, maybe some are incorrect, at their churches and then they are on the defensive. And I think that as intelligent as we want to think of ourselves, and critical thinking as we want to think of ourselves, I don't think a lot of people are as smart as they think they are...It's almost like a blatant, I don't want to say a celebration of ignorance but it almost seems that way, you know?...Like there is fear in being educated, "If I learn about it I might start believing it," which might be true like if you actually knew what evolution said.

Nettie Stevens shared Esther Lederberg's frustration and expressed that embedded in religious objections to evolution that there are often negative implications about educators, stating,

It's just, wow, we are still fighting this fight just to teach basic science...I am Catholic. I am Christian. And I always, when I moved here I got this impression that because I strongly believe or accept evolution, whatever you want to say, that I was this evil person and I must not be a Christian. And it really was hurtful to me, and I had a really hard time coming to grips with that. And it was like, you don't have to be one or the other, they overlap and there is this place in the middle where you can be a Christian and you

can accept evolution. So I try to be really understanding of my students' religious backgrounds. But I have had students challenge me on the age of the earth, "But in the Bible it says..." So I keep trying to bring them back to the scientific evidence. But it's hard because these kids have grown up for years hearing that this is not true, and you are going to go to school and they are going to try to teach you things that aren't true, and we are made out to be the bad guys.

Similarly Florence Bascom stated, "So there are some science Ph.D.'s out there who don't believe in evolution. I mean, *believe*. It's not something you *believe* in. It's something that, you are given facts." Of the persistence of the climate change controversy in schools and popular culture many teachers explained that the real controversy is in the ethical implications of this science rather than in the validity of the science itself, though students and the general public tend to misunderstand this. Sarah Elliot stated that resistance to climate change continues because the implications of it for the future are "dismal" and "scary." Grace Hopper stated,

Climate change, that again is just the ultimate I think, selfishness, to refuse to see what is going on around you that is just so obvious if you pay any attention to what is going on in the world. To just refute that it is happening and particularly to refute that it has anything to do with what we are doing just because you are so afraid to change or you are so unwilling to change your lifestyle or what you are doing. I find it to be like the height of arrogance and ignorance. That's my opinion about all of this.

Perspectives on Critical Thinking

Legislator Perspectives on Critical Thinking

In the interviews and legislative meetings legislators frequently equated critical thinking with skepticism or rejection of evolution and climate change. For example, in the meeting of the House Education Committee meeting on March 29, 2011, Representative Joey Hensley stated, “Our educational system, if someone disagrees with evolution they’re really not free to question that. Professors and teachers, if they disagree with evolution then they run the risk of losing a job.” He gave a similar statement in the meeting of the Tennessee House of Representatives on April 7, 2011, though he did not specify that only evolution should be questioned.

Representative Hensley stated,

This bill just allows students, it allows teachers, to have questions, to have critical thinking about scientific theories, about other things taught in the schools. And that’s what we want to encourage students to do. We want to encourage our teachers to be able to allow questions, to have very good scientific questions answered. Every theory doesn’t have answers. And we have heard from a lot of people that seem to imply that certain theories are just fact when they’re not facts. There’s so many things that need to be questioned about theories. And this just allows that, and it allows the students, it allows the teachers, in many schools the teachers do not feel like they can question theories, especially K-12 education, higher education, many professors and teachers just feel like that they are bullied, just like we have been bullied by so many advocates on a certain side of this issue. But I just commend Chairman Dunn for bringing this legislation and this encourages critical thinking, and that’s what we need in our schools.

In this meeting Sheila Butt expressed a similar concern that there are unfair consequences for students who disagree with accepted scientific theories, stating, “I’m tired of people saying, ‘If you don’t completely accept the theory of evolution you are not very bright.’ Nobody has the right to make our children feel that way, and this protects a teacher from making a child feel that way, and we need to pass this bill.”

In addition to the idea that HB0368/SB0893 would give students a right to reject scientific theories such as evolution or climate change, legislators expressed the idea that actively challenging these theories in science classes is beneficial to learning. In a meeting of the House Education General Subcommittee on February 23, 2011 Hedy Weinberg, Executive Director of the American Civil Liberties Union of Tennessee, spoke in opposition to the passage of HB0368/SB0893. Following her statement Representative John DeBerry posed the question, “I vowed not to ask a question but I’m constrained because of a couple of things you said that troubled me. You said, ‘Challenge the theory of evolution.’ Why would you not challenge any theory? Ms. Weinberg responded, “You can, and you can discuss, and you would hope that...” Representative DeBerry interrupted her response, stating, “The very nature of a theory is it’s not proven.” Ms. Weinberg then responded to this assertion, stating, “Totally correct, and that’s what this is all about.” The sentiment that accepted scientific theories should be challenged in public schools was expressed by other legislators as well. In a meeting of the Tennessee Senate on March 19, 2012, the Senate sponsor of HB0368/SB0893, Bo Watson, stated, “The idea behind this bill, Mr. Speaker, is that students should be encouraged to challenge current scientific thought and theory. Students should be encouraged to debate, to improve their critical thinking skills, and to improve their communication skills.”

In the meeting of the House Education Committee on March 29, 2011, Representative John DeBerry suggested that opposition to HB0368/SB0893 by academic science experts was censorship of free thought and that scientific knowledge is comparable to religious belief as he characterized both as requiring “faith.” In his response to Molly Miller he stated,

What you presented to us today was the only way to protect the position that you hold, you can only compete by eliminating the competition. Unless you eliminate and make sure that no other side is allowed in in any shape, form, or fashion than that which you and your colleagues have quote end-quote “scientifically” deemed adequate for consumption...In religion, since you brought up the word “religion,” Chairman Dunn didn’t call the name “religion,” you used the term “religion.” Since you brought up the word “religion,” in religion there’s a saying that “a faith that can’t be tested is not worth having.” And so I’m saying that if your beliefs are as strong scientifically as you seem to believe they are, what’s the problem with them being tested?

In the interview Jeremy Faison explained that he conceived critical thinking as being intellectually “well rounded” and that learning about different or conflicting “philosophies” is beneficial to students. Representative Faison stated,

The idea that there is an Almighty, if you will, that’s very separation of church and state, you know a lot of educators would say, “You’re bringing in the Bible into the classroom.” And so they are a lot more comfortable with bringing Darwin into the classroom than they are bringing moral absolutes, if you will, or an absolute from a religious standpoint. But if we want to raise critical thinkers, why would we not allow them? See, that’s my whole question, nobody will answer me that. Why would we still not talk about it, though? I mean, what harm does it do to get a student’s mind well-rounded in understanding the philosophies of many different aspects? That would be, that’s my whole question. I’m not saying teach it as a fact. But also on the other hand, why do you feel like you can teach us Darwinism as a fact? Because you know and I know it’s not been proven. So if it’s not been proven why, why not just, what’s wrong with allowing it, are you so scared that a child would be able to think for themselves or come up with their own?...Listen, we all grow, we all change in our views. We all have a moral compass that develops over time. The only way your moral compass can develop is by the books you read and the people you meet. But if you want to blackout everybody who doesn’t agree one hundred percent with who you are at that time, you’re never going to be a better person and you’re not going to grow, you’re not going to change, you’re not going to keep experiencing things in life.

Like the assertions of other legislators, Representative Faison’s argument was based on the assumption that scientific theories such as evolution lack sufficient evidence and are worthy of skepticism or doubt.

Another prevailing concern of some legislators in discussions of HB0368/SB0893 was that training in critical thinking is lacking in public education. In the meeting of the Tennessee House of Representatives on April 7, 2011, Representative Sherry Jones discussed the concern that public schools do not have time to foster critical thinking skills because teachers must instead focus on competencies to help students perform well on the high stakes standardized testing that resulted from and expanded following the passage of No Child Left Behind in 2001. Representative Jones stated,

As far as critical thinking goes, my teachers have told me for a long time that we do not allow enough time in schools for critical thinking because we have to teach to No Child

Left Behind. If you don't make your numbers there then your school looks bad and so I'm all about having some time for critical thinking. And all of the discussions that we want to hold in classes are really too time-consuming for us to do, you know some of this may fit in and...teachers are the ones who are trained to teach so we certainly can't tell them how to teach.

Representative Mike Kernell expressed similar concerns in this meeting, stating,

I'll be quite frank. I both wanted to be a scientist at one time, I wanted to be an anthropologist at one time...What I do hope this bill means is that instead of teaching to the test in order to satisfy a race to the top, where teachers have got to sit there and eliminate recess, eliminate nap for the young kids, eliminate field trips, because they're worried about the students' progress on a test. I hope that with this bill our science teachers now will have a right to take field trips, to examine scientific thought, to teach students how to do scientific experiments. And the sponsor is right, what we think is a fact today might not be what's thought of as a fact tomorrow. Science can only do so much. It constantly changes based on the evidence and based on reproducible experiments. And I hope the science teachers now can go outside the box and teach away from the test and actually teach students how to think critically. And that cannot be done by simply reading chapters in a book.

Like Representatives Jones and Kernell, in the interview Representative Bill Dunn suggested that education reforms in Tennessee and a focus on achievement on standardized tests in recent years may impact not only emphasis on critical thinking in public education but may have contributed to little reported impact of the Tennessee Teacher Protection and Academic Freedom Act in the years immediately following its passage. Representative Dunn stated,

Something else that was going on at this time was we were doing major educational reforms in Tennessee. And really it was those reforms that made it to where Tennessee is the fastest improving state three years in a row. And so a lot of it was that the teachers were more focused on teaching the standards, staying on track, going forward, and I think that kind of overshadowed this. That suddenly the teachers were so focused on their things that there wasn't as much free time to come in and do movies or have the class go off in a different direction. So there was just a lot more direction, I know there was a young teacher I was talking to recently, and he said when he was in high school he was shown *Remember the Titans* at least twenty times. He said, "That would not happen now, because we're focused." And so I think part of everything is with these reforms teachers are a lot more focused. They hit their points. They move on. They really try to complete the year. And so there might not be as much time as where the class could go off on all

kinds of directions and you could take up a whole class period with people debating subjects and doing that kind of stuff.

Teacher Perspectives on Critical Thinking

Interviews of teachers revealed several prevailing ideas regarding the way teachers conceptualize critical thinking and work to promote and foster critical thinking in science classes. All of the teachers interviewed stated that their students do not tend to have strong critical thinking skills, but they also expressed concern that laws like the Tennessee Teacher Protection and Academic Freedom Act do not help to promote critical thinking, and that laws like this imply a legislative misunderstanding of the nature of high school education and the intellectual and academic capabilities of students. Lillian Gilbreth, the teacher who most recently had completed her undergraduate studies, also stated that in her teacher education coursework it seemed that there was an expectation of higher level critical thinking than was practically possible for most of the high school students with whom she had worked, and that many of the pedagogical techniques for fostering critical thinking were not applicable in her classroom given the capabilities of students. Barbara McClintock and Jane Goodall, both private school teachers, developed and teach forensic science classes at their schools in which the main goal is for students to use critical thinking skills to apply scientific knowledge and solve problems. Both teachers state that these courses are more readily suited to the development and application of critical thinking skills than some of the basic science classes with more proscribed content. While public school teachers rarely have the opportunity to design and teach elective courses, they all had concrete viewpoints on practices that do and do not foster critical thinking skills in science classes.

Most public school teachers assumed that the Tennessee Teacher Protection and Academic Freedom Act implies that teachers should foster student debates in the study of the “controversial” topics named in the law. While two teachers stated that they do allow some debates regarding issues of biological evolution, climate change, and human cloning, several of the teachers were vehemently opposed to these types of debates. The two teachers who use the

debate format in their classes both have less than ten years of experience in teaching. In explaining why she thinks debate is productive Vera Rubin stated, “I love debate because you’re not going to learn. If you can’t see somebody else’s side, you’re not actually strong on your side.” The six teachers who discussed their opposition to the debate format each had more than ten years of experience in teaching. In general these teachers expressed a concern that debates regarding most of the topics named in the law would not be scientific debates but religious, political, or social ones—and in addition to being inappropriate in science classes there is not time to incorporate such debates without losing instructional time for required course content. Esther Lederberg stated,

I think critical thinking is important for sure, I just don’t know that incorporating religion into evolution is the way to go about it. I think there are lots of ways probably that you could encourage critical thinking about evolution...look at data, look at fossils and have students look at the change in fossils over time and all of these other things where they are drawing conclusions I think would be a much better way than saying here are your religious beliefs, here’s evolution, let’s battle these out.

Two of the teachers who are generally opposed to debate stated that they do sometimes have class discussions regarding controversial topics, but that these topics are not typically the ones named in the Tennessee Teacher Protection and Academic Freedom Act and are more related to issues of bioethics, politics in climate science, and other topics. These teachers also specified that they only have such discussions in their advanced placement courses or classes that are populated by upperclassmen, as these students have more maturity and open-mindedness, more background in social studies (specifically government or economics classes), and they are more able to discern reputable information from pseudo-science or anti-science, and these qualities make for more productive discussions.

Thirteen of the teachers interviewed stated that one of the primary ways they encourage critical thinking is by teaching students to be discerning about information they find online. Sylvia Earle referred to the internet as “a distraction,” and she and others expressed concern that students are often unable to determine whether online information is from a reputable source. These teachers reported that students lack proficiency in understanding sources of information, as Rachel Carson stated that she frequently reminds students that websites such as Wikipedia are

not adequate for academic research, and that students often do not know how to identify the sources of information and they will frequently claim, “The reference is Google. I found it on Google.” These teachers all reported modeling the acquisition of reputable scientific information by providing students with academic as well as popular articles from reputable sources. In addition to providing literature, teachers reported that they focus on teaching students how to identify information sources and bias in these articles.

In general, teachers stated that learning about science—how scientific inquiry operates in addition to course content—encourages critical thinking more than the addition of deliberate or specific “critical thinking” activities. For example, Maria Merian stated, “The evidence for evolution inspires critical thinking.” Barbara McClintock stated, “We have allowed people to just shut off their brains and just listen to what somebody teaches them without thinking critically about it. If you think critically about something you are being a scientist. And we have allowed them to just shut down and just absorb everything.”

Perspectives on Strengths and Weaknesses in Public Education in Tennessee

Legislator Perspectives on Strengths and Weaknesses in Public Education

In the interviews legislators had various perspectives on the strengths and weaknesses of teachers, students, and public education in general in Tennessee. Representatives answered that the primary strength in public education is the teachers. Representative Faison stated,

I would say our strengths are our teachers. The teachers I know in my district are amazing teachers. And they are incredibly intelligent. So that would be our strength is our local public school teachers. They're educated well, and if we would get out of the way and quit mandating what all they should do and how to teach than they probably do a little bit better job. Haha! But you know, our weakness is probably too much government control. I don't know if that's just in science, that's just education in general. But I would say a weakness is that we are worried, we are scared for some reason, to teach critical thinking. We're told in science books right now to accept Darwinism as a fact and you and I both know it's not a fact.

Representative Joe Pitts also acknowledged the skills and the professionalism of Tennessee teachers when he stated that he tries to visit every school in his district when the legislature is out of session, and that teachers do not bring "hidden agendas" to work but that their agenda is "to provide the best education possible for each of their students."

Representative Bill Dunn stated a concern that teacher groups do not always have the best interests of students in mind. While he was not critical of teachers at the classroom level, he was skeptical of the work of unnamed teachers and other public education advocacy groups and unions. In discussing his work on a school voucher bill he stated,

What's interesting is if you look at my campaign literature from 1994, twenty-two years ago I was talking about this, about parental choice. And it wasn't as popular back then. It's gotten more popular now. But the political reality is these children trapped in these

failing schools don't have a lot of political clout, and the teacher's unions and the local schools see children as dollar signs. You know, "The kid comes here, we get the money." In fact, I pointed out in my remarks on the House Floor that for about six years I've carried this legislation and in all that time I've never had somebody in the public school system say, "Please don't take our kids." It was always, "Please don't take our money." So we'll see, you know. After the elections we'll have a better idea of are the votes there or not and then we'll just determine from there how to go forward.

Representative Joe Pitts stated that funding for STEM (science, technology, engineering, and mathematics) education had helped Tennessee public schools greatly in recently years. He expressed concern that the popularity of promoting STEM education sometimes resulted in sacrifices in other content areas, such as the arts, which was troubling to him. Representative Pitts stated,

Well you know with the Race to the Top funds that caused us to begin thinking about STEM, science, technology, engineering, and math. And by virtue of getting that half billion dollars we put some needed resources in that. So I think that's been a positive. There's been some less desirable results out of that but that's been a positive to me. It's kind of raised the profile of STEM and that's become sort of a word in everybody's vocabulary. We've got a long way to go, certainly. I think that we can hopefully do it. In terms of to the detriment of arts and other liberal arts kinds of topics, we're not all going to be engineers, we're not all going to be mathematicians, we're not all going to be science teachers or computer science majors. But I think it does kind of develop a critical skill set for thinking and working in teams, etc. So I think that's one of the strengths of our state. But I think we're seeing sort of an evolving of that and more people are talking about STEAM vs. STEM and adding the "A" for "Arts." So I think we've been able to protect the arts as far as funding and making sure schools have funding to provide music and arts programs, performing and visual arts, etc, not all just one sided.

While as the mayor of Chattanooga former Senator Andy Berke is not as in touch with current educational policy as he was during his years as a senator, he stated several overarching concerns about the quality of public education and its impact on people's lives in the long term. He stated,

Our outcomes consistently aren't as strong as other states, we have to make sure that we have a workforce that is ready to get the jobs of the 21st century. Also, that people have the educational background to enjoy their lives, it's not just about workforce, it's about quality of life that comes from getting a high, you know, a high achieving education.

And so, you know, our outcomes are not as strong as others' and so we constantly need to figure out how we improve... There are lots of factors that go into this that have to do with pay and investment. They have to do with the quality of teacher preparation. Do we have the kind of teacher preparation programs in place that feed into our schools? Are we supporting principals in ways that encourage high-quality teachers to come and stay at our schools? Are we promoting parents being involved? Schools can do all kinds of things, if parents don't want their children to achieve in science they are not going to. So we have to have parents who are supportive of moving into the science world and that being a critical part. And so it's a big endeavor.

Teacher Perspectives on Strengths and Weaknesses in Public Education

In discussing the strengths and weaknesses they see in science education, teachers more often discussed weaknesses and challenges than strengths. The primary strength that was named was teachers. Eight teachers discussed the ways that teachers share teaching materials that they make and highlighted the fact that typically the textbooks they use are so outdated that teachers do not use them. Instead, teachers stay abreast of current trends in science and utilize academic journal and popular science articles and websites for reading materials. Esther Lederberg stated, "I think one of the strengths is the teachers...they have all been so willing to work together, work really hard to help students as best they can, try new crazy things that the state wants us to do, and sharing information."

Several primary weaknesses and challenges were discussed in terms of high school science education. The only teachers who stated that they regularly use textbooks in the classroom were the private school teachers. All of the public school teachers interviewed stated that they did not use the textbooks unless absolutely necessary, as most of the books are terribly outdated. These teachers stated that the only courses that did not have outdated textbooks were the advanced placement courses. They cited the requirements of the College Board, the non-profit organization that provides curriculum and testing for advanced placement courses, which mandate that these classes must have textbooks that are no more than ten years old. Many teachers reported having textbooks for other classes that were up to fifteen years old, and most of these teachers also reported that there were only enough textbooks for a classroom set, so

students could not take books home for study or reference. In addition to issues with outdated textbooks, some public school teachers reported inadequate laboratory facilities and materials, though this was not a problem for all teachers.

Ten of the public school teachers interviewed discussed curriculum as problematic in science education. In discussing the Biology I curriculum Mary Anning stated, “I think the curriculum is hilarious,” and if she were allowed to design high school biology curriculum that she would include very different content. Teachers reported much of the curriculum is worded vaguely and many of the standards are quite broad and not clearly defined. Teachers also stated there is more content in the standards than can be realistically covered in the time frame of one high school course. In addition to these pragmatic concerns with curriculum, six teachers discussed their concern that the content is irrelevant for students. These teachers stated that high school is often the last time students study biology as not all students go to college and those that do may not study biology at the college level. As a result the teachers feel the content does not cover basic information that would be helpful to students in their daily lives. An example that was cited by several teachers is that Biology I requires a significant focus on photosynthesis, including the chemical equation for photosynthesis. The teachers stated that students are unable to relate this type of content to their lives, and that more relatable and practical content would serve to make these classes more engaging for students as well as helping prepare students for the everyday application of science in their lives—in healthcare and nutrition, in understanding current events and environmental politics. Three teachers offered examples of topics they would include in the curriculum were they to re-write it, and all three cited the following topics: body systems, anatomy, health, biodiversity, plants, and animals. In addition to content problems in the curriculum, eight teachers mentioned that in terms of socially controversial topics the standards tend to use code language. For example, in the biology curriculum “natural selection” and “change over time” are frequently used in place of “evolution,” and several teachers characterized this as “sneaky,” “dishonest,” or “misleading.” In the curriculum for earth and environmental science classes the phrase “human impacts on the environment” is used instead of “climate change,” which one teacher described as a way to make the topic seem “neutral.” In the 2018-2019 academic year new curriculum standards will be implemented for science in the state of Tennessee. Several teachers had not read the new standards yet. Those who were familiar

with them expressed the concern that while the standards may be reorganized and reworded, the course content will in practice be no different than what has been in place already.

Related to the concerns about the curriculum is a concern about testing. All of the public school teachers cited numerous problems with standardized testing. One teacher mentioned that End of Course exams are often given far before the end of the term, so students may take a final exam for a course up to three weeks before the course is complete. This causes problems with the delivery and coverage of content as well as with classroom management, as teachers must complete the content in even less time than the semester allows and then they must spend days or weeks in the classroom with students who “check out” after the End of Course exam. Other problems with testing include the number of school days that are spent on testing rather than on instruction, and problems with test administration and scoring in recent years such as online testing program crashes, delays in score reporting, and other issues. Another concern these teachers discussed is the cost of standardized testing, as End of Course tests are purchased by the state from for-profit vendors. Florence Bascom stated, “We are spending millions of dollars on those tests when we can’t even afford a textbook that is relevant and current. That’s mind-boggling.”

In discussing the challenges that students face in science education, three teachers mentioned that students often lack the skills in mathematics and statistics to fully understand many concepts in science classes. This impedes students’ ability to read and understand data, and a lack of confidence in math capabilities impedes students’ willingness to try to understand concepts that employ equations, mathematical models, and charts and graphs. The most cited weaknesses of students were lack of curiosity and a misunderstanding of the nature of science. Ten teachers discussed this issue, and almost all of these teachers attributed these problems to standardized testing. Barbara McClintock stated that her students are more focused on making sure they have the correct answers to test questions and the grades they need to get into college than they are on learning science, and they respond that they “can just google” things when they need information. Robert Cade discussed similar struggles in his classroom, as he frequently finds that students “just want a definition” and that they are resistant to open-ended assignments. For example, he reported that his students were resistant to writing laboratory reports, they expressed feelings of anxiety about the task, and they requested that he give them worksheets to complete instead. He stated that in addition to the multiple-choice, one-answer-only climate that

is maintained by standardized testing, that often teachers must resort to using assessment methods such as multiple choice testing as well due to large class sizes and a lack of time to grade and assess other types of student work. Vera Rubin characterized the curriculum and testing measures as conflicting, as the curriculum standards require that the nature of science be taught using an inquiry-based approach while the standardized testing implies that knowing correct answers to specific questions is the objective. Like Ms. Rubin, Florence Bascom and Nettie Stevens stated that students are often anxious about having “answers” and that students tend to assume that there is only one correct answer, when in many instances there may be many correct answers or no correct answers. The teachers interviewed suggested that testing impacts students’ ability to use information, as they are often unable to see connections, solve problems, and move from memorization to understanding and application of knowledge—these skills are not often needed in the context of multiple choice testing, and the nature of such tests implies that for every educational standard there is one correct answer. All of the teachers interviewed expressed a desire for students to see science as a process rather than a collection of information, though they state that current assessment trends in public education curb curiosity and encourage students to focus on answers rather than inquiry.

Chapter 5:

Discussion

Overview

The interviews of legislators and teachers and the transcripts of legislative meetings indicate several themes in the study of similarities and differences in legislator and teacher perspectives regarding science education, curriculum, pedagogy, and science education policy. The data indicate that legislative supporters of the Tennessee teacher protection and academic freedom act tend to use rhetoric and frame issues in ways that align with the anti-science movement in the United States. These frames outline an ongoing struggle for power in the determination of educational content between science experts and legislative bodies representing their constituencies. Furthermore, the frames most commonly employed by legislators in interviews and legislative meetings focus less on the science-related objections to theories such as evolution and climate change and appeal more to American values and ideologies regarding American identity. These values include democracy and the rights of voters to determine policy, freedom of religion, freedom of speech, and common sense and individualism.

Anti-Science Political Framing in the Era of Academic Freedom Legislation

While most research on framing in the social movement literature has a focus in psychology or media, an analysis of political frames in social movements can be beneficial in understanding broader issues of ideology and cultural values as well (Van Gorp 2007). Van Gorp (Van Gorp 2007, 70) states that “constructionism emphasizes the interactive process in which social reality is constructed,” and that framing theory allows for the connection of the social construction of ideas with political process factors (R. Benford 1997; Oliver and Johnston 2000). Dennis Chong and James Druckman (2007, 104) state that “the major premise of framing theory is that an issue can be viewed from a variety of perspectives and be construed as having implications for multiple values or considerations. Framing refers to the process by which people develop a particular conceptualization of an issue or reorient their thinking about an issue.” According to Pamela Oliver and Hank Johnston (2000) an understanding of both ideologies and frames is essential in the study of social movements.

Resonance is of vital importance in social movement issue framing. According to Chong and Druckman (2007, 111), “There is nothing inherently superior about an applicable or strong frame other than its appeal to audiences. Strong frames should not be confused with intellectually or morally superior arguments. They can be built around exaggerations and outright lies playing on the fears and prejudices of the public...The strength of arguments in political debate and their fairness and relevance as arguments must be judged separately.” Though prior attempts to mandate the inclusion of religious or otherwise non-scientific alternatives to scientific theories in public schools have thus far all been declared unconstitutional in violation of the Establishment Clause, Academic Freedom laws have yet to be legally challenged. The persistent success of the anti-evolution movement can in many ways be credited to its success in public relations and the media (Caudill 2013) and also to the political framing of science and education in ways that appeals to American sensibilities and values.

Anti-Science Framing of Issues in Science Education

Academic Freedom bills and laws illustrate all three of the core framing tasks in the political action of social movements. The first core framing task, diagnostic framing, refers to the development of a frame of injustice and the identification of victims and perpetrators of the injustice (R. D. Benford and Snow 2000). The oppression and bullying of teachers and students at the hands of scientific experts was explicitly outlined by the legislators in favor of HB0368/SB0893 and the antagonists were frequently indirectly identified and sometimes explicitly identified. One such explicit identification was made when Representative Bill Dunn hypothetically described the “University of So-and-So’s department” as intervening in teachers’ behavior in the classroom, and Representative John DeBerry described the political advocacy of science experts as “totally anti-American and against everything we claim to stand for as far as being a free-thinking people.”

The second core framing task, prognostic framing, involves the solution and strategies for implementation of a solution to the injustice, and in the case of anti-science the Discovery Institute currently has the best-funded, most streamlined, and most influential approach to combating the teaching of evolution and climate change in public education (Caudill 2013; Forrest and Gross 2004; Scott 2009; Snow et al. 1986; Weir 2008). The goals and agenda of the Discovery Institute were outlined in “The Wedge” in 1996 (Discovery Institute Center for the Renewal of Science and Culture 1998). Following the defeat in *Kitzmiller v. Dover Area School District* in 2005 (Jones III 2005) in which mandating the teaching of intelligent design was declared unconstitutional, Academic Freedom legislation has become the newest political and public relations strategy and thus far it has been successful in several states in spite of the fact that the scholarly status and reputation of intelligent design has not improved.

The third core framing task, motivational framing, is the “agency component” or the “call to arms” for a social movement (R. D. Benford and Snow 2000). Robert Benford and David Snow (2000, 621) state that “hypothetically, the more central or salient the espoused beliefs, ideas, and values of a movement to the targets of mobilization, the greater the probability of their mobilization.” The promotion of doubt of mainstream scientific theories such as evolution and climate change via the promotion of academic freedom and critical thinking, which are popular

ideas in current education reform as well as long-standing educational values, allows for the movement to appeal to Americans outside of just the groups who maintain standpoints of science denial.

The four primary strategic processes employed in framing and frame alignment are frame transformation, frame bridging, frame extension, and frame amplification (R. D. Benford and Snow 2000; Snow et al. 1986). All four of these strategic processes are utilized by anti-science movements and all are evident in the promotion of academic freedom bills in general and in the statements of legislators regarding the passage of the Tennessee Teacher Protection and Academic Freedom Act.

The Evolution of Creationism: Frame Transformation in Anti-Science Movements

Frame transformation entails the pragmatic modification of frames in order to increase support and participation in a social movement. These modifications may be necessary when social movement causes or values do not resonate or align with conventional life and values (R. D. Benford and Snow 2000; Goffman 1974; Snow et al. 1986). Frame transformation has been ongoing in the anti-evolution movement, as the movement started with advocacy for “creationism” in the 1920s which then became “scientific creationism,” “creation science,” and finally “intelligent design” (See Appendix F for Figure F-1, an illustration of frame transformation in the anti-evolution movement, and Figure F-2, a timeline of anti-evolution framing). The legislative frames for these permutations of anti-evolution politics began as laws that made teaching evolution illegal, such as the Butler Act of 1925 in Tennessee (see Appendix F for a list of Key events that impacted frame transformation in the anti-evolution movement). After these laws were declared unconstitutional in *Epperson v. Arkansas* (1968), the anti-evolution movement began promoting “equal time” or “balanced treatment” laws that mandated the inclusion of creationist alternatives to evolution. These laws were declared unconstitutional in the 1982 case of *McLean v. Arkansas* and in the 1987 Supreme Court Case of *Edwards vs. Aguillard*. The next permutation of the mandated inclusion of anti-evolution in public school science classes manifested in the promotion of “disclaimers” such as the one that led to the

Kitzmiller v. Dover Area School District trial in 2005 and textbook stickers promoting doubt of evolution such as those that led to the *Selman v. Cobb County* case in 2005 as well. In the most recent transformation, the Academic Freedom law, the anti-evolution movement has stopped formally naming its alternative to evolution and instead promotes assessment of “strengths and weaknesses” of scientific theories (Tennessee General Assembly 2012a, 2012b). These transformations were a necessity due to judicial outcomes through the twentieth century, and they have been carefully crafted in recent years to appeal not only to evangelical and fundamentalist Christians but to others with anti-science inclinations. With Academic Freedom legislation there is not only an appeal for those with religious anti-evolution sentiments, but for those with religious, economic, or other objections to socially controversial theories such as climate change as well.

Claiming the Educative Benefits of Anti-Science Viewpoints: Frame Bridging and Frame Extension Via Academic Freedom Legislation

Frame bridging refers to the “linkage of two or more ideologically congruent but structurally unconnected frames regarding a particular issue or problem” (Snow et al. 1986, 467). In the case of academic freedom bills, common anti-science sentiments, including skepticism or rejection of theories such as evolution and climate change, are linked to ongoing education reform movements, specifically recent reforms that target student performance in STEM (science, technology, engineering, and mathematics) content areas. These Academic Freedom bills are framed not as mechanisms for the inclusion of anti-science alternatives to the named “controversial” scientific theories, but as laws that will contribute to student acquisition of valuable skill sets in science and in education in general. Academic Freedom bills are also illustrative of a frame extension effort. Frame extension refers to the elaboration of goals and activities in order to enlarge the adherent base by incorporating supplemental interests (R. D. Benford and Snow 2000; Snow et al. 1986). These Academic Freedom bills invoke the educational ideals of academic freedom and critical thinking which are appealing to most educators and citizens, though they are not directly related to the scientific theories named in

these bills or to the anti-science movement's skepticism or rejection of theories such as evolution or climate change. The Tennessee Teacher Protection and Academic Freedom Act (Tennessee General Assembly 2012a, 2012b) states,

The state board of education, public elementary and secondary school governing authorities, directors of schools, school system administrators, and public elementary and secondary school principals and administrators shall endeavor to create an environment within public elementary and secondary schools that encourages students to explore scientific questions, learn about scientific evidence, develop critical thinking skills, and respond appropriately and respectfully to differences of opinion about controversial issues.

The law also states that “teachers shall be permitted to help students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught” (Tennessee General Assembly 2012a, 2012b). These statements frame the issue not as one of simply allowing skepticism or denial of socially controversial theories in science. In addition to normalizing anti-science standpoints, the rhetoric and framing in Academic Freedom legislation implies that controversies surrounding the named topics are scientific rather than social or cultural. Additionally, these statements imply that exploring these anti-science viewpoints presents important educational opportunities for students both in academic and social development through the development of critical thinking skills as well as communicative skills and inclusivity of diverse opinions.

Experts are Bullies: Belief Amplification and Negotiations of Power in Anti-Science Politics

The two types of frame amplification in social movement political framing are belief amplification and value amplification (R. Benford 1997; Snow et al. 1986). Five kinds of beliefs have been identified in the social movement literature, including beliefs about the gravity of the issue, beliefs about the cause of the issue, beliefs about the perpetrators or targets of influence of

the issue, beliefs about the likelihood of change resulting from action, and beliefs about the necessity of a social movement's action (Snow et al. 1986). Belief amplification is seen in relation to all five of these beliefs in the statements made by legislators in interviews and legislative meetings.

In advocating passage of the Tennessee Teacher Protection and Academic Freedom Act, legislators in support of HB0368/SB0893 indicated that mainstream science is a problem in public education, with claims that problematic theories are mandated to be taught as fact without any alternatives. Representative Joey Hensley indicated this when he stated, "And we have heard from a lot of people that seem to imply that certain theories are just fact when they're not facts. There's so many things that need to be questioned about theories." Legislators in support of HB0368/SB0893 asserted that teachers' jobs were at stake as well as the respectful treatment of students in science classes, and that ultimately the future of science was at stake. Bill Dunn illustrated this when he stated, "We are teaching some science as just cold hard facts and really the beauty of science is to gather a whole lot of facts to get a better understanding of the world and seeing it. And that's, that's where discoveries come from." Representative Sheila Butt gave detailed examples of how scientific consensus changes and as a result should not be trusted. She illustrated this idea by describing her experience as a high school student, when previous science suggested that people sacrifice Aqua Net (aerosol) hairspray and chocolate in order to protect the environment and their bodily health, only to discover later that the atmosphere benefitted from Aqua Net hairspray because it "absorbs the earth's rays" and bodies benefit from "good dark chocolate" because it contains antioxidants.

The blame for problems in science education throughout the discussion and passage of HB0368/SB0893 was placed squarely on academic scientists, who were characterized as "bullies" who dishonestly force the teaching of troubled or uncertain theories as "fact" in public education. While academic scientists do not design public education curriculum, their influence was clearly interpreted as the cause for the teaching of theories such as evolution and climate change in public schools in spite of the fact that so many people reject these theories. HB0368/SB0893 was framed as a legislation that would liberate teachers and public school students from the oppression perpetrated by academic science and scientists. Though the bill states that "teachers shall be permitted to help students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific

theories covered in the course being taught” (Tennessee General Assembly 2012a, 2012b), in legislative meeting discussions this broad idea was reduced to skepticism or rejection of the theories of evolution and climate change. The urgency of this issue was clear in the statements of many legislators, such as the statement by Representative Richard Floyd that public education had been “hijacked” by “intellectual bullies” since the 1950s or 1960s and that public education had been problematic ever since, with more and more money spent and lower achievement attained by students.

The ways that legislators in support of HB0368/SB0893 framed socially controversial issues in science, the nature of science, and the role of science in education and society indicate that they feel academic scientists are in an unjust position of power. Legislators frequently mentioned receiving emails from scientific experts that were hateful or “bullying.” The victims of this bullying were not only the legislators who received this correspondence, but also the teachers who feared for their jobs if they introduced facts that scientists “don’t like” in science classes and the students who are “made to feel stupid” if they don’t accept theories such as evolution. Socially controversial issues, particularly evolution and climate change, were framed as “unproven” or even as scientists’ personal “opinions.” Representative John DeBerry even accused Dr. Molly Miller of misleading the legislature by comparing the “exact science” of atomic theory to the “theory” of evolution, and he stated that in spite of the “prefixes and suffixes” on her name that his opinion was just as “good” as hers. Science in general was framed as problematic as consensus and recommendations based on scientific understandings change over time, and examples of changes in scientific understandings of topics and instances of fraud in the history of science, such as Representative Bill Dunn’s explanation of Piltdown Man, were highlighted as reasons that science and scientific experts cannot be trusted. In the interview Representative Dunn stated that science experts in opposition to the passage of HB0368/SB0893 were emotionally motivated in their political action and possibly in their work in science as well, stating, “And they can beat their chest all they want and say, ‘We only look at data, we only look at facts.’ This is a perfect situation where they let their own personal views affect what they’re actually seeing and understanding.” This constructionist critique of science is commonly used by anti-evolution and anti-science movements to suggest that scientific work is biased or the validity of science is jeopardized by the emotions and worldviews of scientists (Kuhn 2012; Latour 2004).

In addition to the framing of scientists as bullies who cannot be trusted, legislators in favor of HB0368/SB0893 framed science in ways that do not align with the nature of science but that are appealing in American culture. For example, legislators characterized changes in scientific consensus as indicators of flaws or weaknesses in science. The repetitive, incremental, and self-correcting nature of work in science and changes in scientific consensus was not acknowledged by legislators such as Representative Sheila Butt, who stated that she had sacrificed the height of her hair in high school for the good of the environment only to discover later that her Aqua Net was actually good for the planet. Legislators focused on “facts” throughout the discussion and debate of the bill in legislative meetings, and “facts” were characterized as the “truth” in science while theories were labeled as “unproven.” According to Representative Joey Hensley, bill opponents were dishonestly promoting theories as “facts” when he felt that they should not hold that status. In the interview Representative Jeremy Faison discussed his perceived uncertainty of evolution, stating, “It’s not a true scientific fact, because facts don’t change, remember, facts are eternal. The truth is eternal.” This is in direct contrast to the way that “facts” are defined in science, as in science facts are tentatively accepted and can be changed or discarded as necessary (National Center for Science Education n.d.; National Research Council 2007). Legislators equated these socially controversial scientific theories to “guesses” and to “opinions,” while “facts” were clearly held in the highest regard and seen as the only “truth” in science.

In contrast to the legislators’ focus on facts, all of the teachers interviewed discussed “evidence” for scientific theories. These teachers did not refer to the information they teach as “facts” or “truth” and they rarely used the word “theory.” The primary focus of these teachers was “evidence,”—whether it be the evidence they presented in teaching or the evidence that students were required to provide when asserting alternative viewpoints. Meanwhile, most scientific experts who participate in educational policy advocacy tend to discuss “theories” and maintain a “big picture” focus with little mention of facts or evidence when explaining their opposition to bills such as HB0368/SB0893. For example, at one point during his questioning by Representative Joey Hensley, Dr. Gary McCracken stated, “Now, when I say ‘theory,’ what I’m talking about is ‘thinking.’” This definition of “theory” is far removed from any characterization of scientific theory offered by legislators or teachers in this study. This difference in rhetoric regarding the validity of science and what constitutes “information” or “knowledge” in science

implies that legislators and teachers conceptualize science in fundamentally different ways. It is well known that the term “theory” in science has a very different meaning from its colloquial usage and that this frequently presents a problem for the public in understanding the nature of science and particularly for educators and experts in communicating the validity of established scientific theories, especially those that are socially controversial and prone to skepticism or disbelief. The “fact vs. evidence” trend seen in the legislative meetings and interviews of legislators and teachers complicates this problem further, as legislators and teachers ultimately discussed entirely different things when asked the same questions about science education.

Anti-science movements have identified science as worthy of doubt and scientific experts as unjustly powerful and oppressive. These ideas, coupled with Foucault’s assertion that knowledge is inextricably linked to power and that power is conferred to a person or group by virtue of possessing a culture’s valued knowledge—in the case of the United States and other Western societies, scientific knowledge—places teachers in a precarious position. Teachers are tasked with conveying the mainstream knowledge of their content area to students, and in a climate of power struggle between mainstream science and the variously motivated anti-science movements and beliefs, the teaching of science becomes inherently political. It also places on teachers an overwhelming responsibility, because the ways in which students learn and understand science may ultimately impact the values and laws that govern scientific activity, science research funding, and science education in the future.

Public school teachers in general reported being in a position of subjection rather than power in their careers as educators. Their work is constrained by the curriculum content that is determined at the state level without their input and, in the case of some teachers, by the guidelines for order of content delivery and pacing mandated by districts. Additionally, other educational policies such as those that dictate intervention schedules or mandate the inclusion of additional activities, such as reading or physical activity, limit teachers’ options in the classroom. In fact, the two private school teachers who participated in this study cited their autonomy in determining course content and delivery of content as significant factors in their decision to work in private rather than in public education. All of the teachers indicated that in spite of these constraints on their work, they are aware that they can be very influential in the lives of their students. Maria Merian stated that high school students in particular have a tendency to be open-minded and receptive to learning about and accepting ideas that may be different or contrary to

what they have previously learned, perhaps more than other children or adults would be. Given this consideration, all of the public school teachers were careful to specify that they do not reveal their religious or political beliefs and affiliations to their students, nor will they engage in religious or political discussions with students. As members of the community it is impossible for teachers to completely hide these affiliations, as some teachers sponsor school clubs that imply religious or political affiliations and many teachers attend churches in their communities that students also attend. Nonetheless these teachers make explicit effort to maintain an environment of neutrality in their classrooms.

In assessing the power held by teachers, it is clear that Academic Freedom laws convey a vaguely-defined power for teachers as it provides some autonomy in the inclusion of supplemental content in science classes. Teachers such as Esther Lederberg assert that they do not need this latitude as they are “on board with the science” and do not wish to present anti-science objections or alternatives to theories such as evolution or climate change. Others mentioned that the curriculum standards do not include these supposed “weaknesses” in these theories, so to present such material would be an inappropriate deviation from the mandated course content, which is a concern that some legislators expressed in legislative meetings as well, as the law does not specify what, if any, deviations from the state curriculum standards are appropriate under the law. Although none of the public school teachers expressed an interest in teaching alternatives to mainstream science, some teachers had experience working with science teachers who object to evolution, and they feared that laws like the Tennessee Teacher Protection and Academic Freedom Act may embolden these teachers and result in the presentation of creationism, intelligent design, or other anti-evolution ideas in public school science classes. The Tennessee Teacher Protection and Academic Freedom Act implies an autonomy that is inconsistent with the rest of the daily responsibilities and expectations of a public school teacher. Several teachers mentioned that they largely disregard educational policies unless they mandate specific changes to daily classroom operations or otherwise have a tangible impact on their jobs, and the data indicate that since so few teachers were even familiar with the Tennessee Teacher Protection and Academic Freedom Act, it has not had a significant impact on the ways that the public school teachers who participated in this study do their jobs. While this common habit of dismissing policies deemed irrelevant or unimportant may be seen as a subversive assertion of power by teachers, it also indicates that this law is not an isolated case of the “principal-agent

problem” between legislators and “street-level bureaucrats,” teachers (Berkman and Plutzer 2010).

While respect for science is seen a fundamental to American culture, the nature of science is contrary to many American beliefs and values. Furthermore, certain scientific theories such as evolution and climate change are at odds with some religious, economic, and political viewpoints. Since the Enlightenment, scientific knowledge has been regarded as the knowledge of highest status and merit in Western cultures. However, people are troubled by the tentative and dynamic nature of scientific knowledge, and scientific practice and explanations do not always align with or support beliefs, social values, or economic activities that are important to American people. As a result, while scientific and technological advancement remains a priority in American culture, the reconciliation of Christian and American values with the nature of science and scientific practice remains a problem—and this problem is most evident in political power struggles involving public education.

Science as Anti-American: Value Amplification in Anti-Science Movements

Value amplification in social movements refers to the “identification, idealization, and elevation of one or more values presumed basic to prospective constituents but which have not inspired collective action for any number of reasons. They may have atrophied, fallen into disuse, or have been suppressed because of a repressive authority structure or the absence of an organizational outlet; they may have become taken for granted or cliched; they may not have been sufficiently challenged or threatened; or their relevance to a particular event or issue may be ambiguous” (Snow et al. 1986, 469). The framing of issues and positions in accordance with cultural norms and popular cultural values can help elicit support and participation in social movements (Oliver and Johnston 2000). Ideologies are learned through socialization and education and reinforced by membership in social groups and networks in which others share the same meanings and ideologies (Oliver and Johnston 2000). In the context of anti-science and in particular the century-long history of the anti-evolution movement’s involvement in public education, the stakes have always been high because the majority of children in the United States

attend public schools. This was true even during the years that fundamentalist “separatism” was popular. In the 1980s Jerry Falwell and others began encouraging their followers to participate more in mainstream American culture in any facet of work and social life and in education and politics, as it was evident that the messages of fundamentalism at home and church were not sufficient to expand the movement and enact change in popular culture (Harding 2000; Howell 2015). Given the integral role of schools in the generational maintenance and reproduction of ideologies and values, it is no wonder that anti-science and other social movements engage in ongoing power struggles with “intellectuals” and “experts” to control what children learn in public schools. It is understandable that the anti-science movements continue to target public education in spite of their long history of defeat in this arena, and since the anti-science objections to theories such as evolution have not enjoyed any elevated status or recognition in science in spite of their revision, renaming, and repackaging, an appeal to values is a logical strategy for maintaining relevance and influence. The statements of legislators in interviews and legislative meetings indicate that several typical American values that are unrelated to science serve as compelling justifications for the passage of Academic Freedom Legislation. These values include democracy and the rights of voters to determine policy, freedom of religion, freedom of speech, and common sense and individualism.

Democracy and the Rights of Voters to Determine Policy

The values of democracy and the rights of voters to determine policy are longstanding talking points in the anti-evolution movement, and they are widely popular in American culture at large. In the interviews legislators indicated that they generally feel their choices in education policy are in line with the desires and values of their constituents, while teachers indicated that they find policymakers to be clueless and tone deaf to the realities of public education. In the legislative meetings legislators described teachers as at odds with science experts in the delivery of content in public school science classes, and experts were characterized as bullies who prevent teachers from presenting valuable facts and knowledge to students. Academic Freedom bills rely on the assumption that teachers are going to behave in ways that are accommodating to and

reflective of the values of the communities in which they teach, and statistically teachers tend to be socially, politically, and religiously in alignment with the populations of the areas in which they work (Berkman and Plutzer 2010). Academic scientists and other experts, however, though they may be long-standing residents and members of communities in Tennessee, were not characterized as such by legislators. As a result this Academic Freedom legislation was framed as democratically giving autonomy to teachers to address topics according to their own values or according to the values of their communities. Under these circumstances in areas with large anti-science contingencies, Academic Freedom bills could result in the teaching of significant doubt of mainstream science theories such as evolution or climate change. Throughout the legislative meetings it was frequently stated that students could benefit from learning “both sides” of scientific theories. According to poll data this approach remains popular among the public as well (Gallup n.d.), and even some teachers stated that there was value in students learning about “both sides” of these topics. While these teachers stated that the evidence supports mainstream science rather than religious or other alternatives and that they do not teach any alternatives to accepted scientific theories, they still felt that it was proper to make room in their classes for students to maintain and assert anti-science viewpoints if they wished to do so.

A democratic approach to dealing with socially controversial topics in science education has been popular since the late 1960s when “equal time” and “balanced treatment” laws were introduced, and according to poll data this approach is still popular among the public (Gallup n.d.). Though it has been declared unconstitutional for students to learn Biblical creationism alongside evolution in public school science classes, the notion of allowing “both sides” of issues to be heard is still popular and common in discourses of legislators and teachers. In one legislative meeting, Representative Bill Dunn described HB0368/SB0893 as “a microcosm” of legislators’ work in the Tennessee House of Representatives—the representatives hear arguments “for and against” bills and then they make up their minds and vote. Similarly, Representative Dunn characterized HB0368/SB0893 as a law that would allow teachers to present “facts” for and against the named scientific theories so that students can decide for themselves whether to accept or reject the theories. This democratic approach is appealing to the public and puts opponents to academic freedom legislation at a disadvantage. It is democratic to give a voice to all sides of an issue and when an opponent of academic freedom legislation asserts that the other sides should not be presented in science classes, this opens the door for criticisms such as the

“bullying” allegation, censorship, or “fear.” In the interview Representative Jeremy Faison asked, “That’s what just intrigues me about these professors who get so worked up about it. Why are you so worked up about allowing a child to study something that’s different? Are you afraid the influence might impact a child’s mind? We don’t protect our children from anything else at UT, they’ll teach all types of humanism, they’ll teach all types of other things. What are they so scared of if [creationism] came to the classroom?” While science and education experts argue that in addition to being in violation of the Establishment Clause, religious alternatives to creationism have no place in science classes because they are not based on scientific inquiry, the vast amount of scientific-looking work produced by organizations such as Answers in Genesis, the Institute for Creation Research, and the Discovery Institute make this difficult to convey to a lay audience. The pseudo-science surrounding climate change may be even more challenging, as it rarely has an explicitly religious motivation or conclusion. Science and education experts would argue that within evolution the “controversies” and “unknowns” are already covered in the state curriculum standards. However, the purpose of Academic Freedom legislation according to the legislators who supported it in Tennessee is not to investigate these details but to discuss arguments in favor of and in opposition to theories such as evolution and climate change. While this is not seen as valuable in the field of education, it is appealing to the lay public. In fact, even some teachers who participated in this study stated that it is good for students to learn “both sides” of controversial issues like evolution and climate change. While none of these teachers reported seeing any academic or scientific merit in creationism, intelligent design, or climate change denial, they did feel like it was appropriate for “both sides” of these issues to be heard in public education so that students could “make up their own minds.”

In the interviews, Representative Jeremy Faison and Representative Bill Dunn both indicated their support for the rights of voters to determine educational policy. For example, although Representative Faison openly supported and voted for passage of HB0368/SB0893, in the interview he stated that “too much government control” was a weakness in Tennessee public education and that teachers would likely be able to do their jobs better if the state government interfered less. Representative Faison stated that he feels that local control is best for public education, and that larger governmental entities should relinquish some power and grant more autonomy to local school boards. When discussing his constituents’ involvement in his legislative work he stated, “When people come up to Nashville from my district, you know what

I tell them? ‘You walk around this place like you own it. You know why? Because you do.’” Representative Faison interprets his role as one of direct representation of the citizens of his district.

Representative Dunn also perceived himself as an advocate for voter rights in education. Representative Dunn stated that he has been an advocate for parental choice since the beginning of his career in the Tennessee House of Representatives in 1994. Representative Dunn advocates for vouchers and charter schools and stated that children become trapped in failing schools and have no political clout to combat the “teachers’ unions and the local schools who see children as dollar signs.” He stated that when he has carried voucher legislation, “In all that time I’ve never had somebody in the public school system say, ‘Please don’t take our kids.’ It was always, ‘Please don’t take our money.’” Like his portrayal of academic scientists as bullies from which teachers need protection, Representative Dunn also portrays children and families as in need of protection from the educational entities that are more concerned with economic benefit than the welfare of students. With his Academic Freedom bill and other legislative work, Representative Dunn aims to allow parents and families as much freedom as possible in determining the type of public education their children receive. While his standpoints on education in these two contexts may seem contradictory, in both cases individual freedoms are a primary concern in legislative action.

Freedom of Religion and Freedom of Speech

Freedom of religion and freedom of speech are often invoked in the evolution-creationism debate in education. In the era of Academic Freedom legislation, these freedoms seem to have been subsumed under the umbrella of “academic freedom.” In the interviews, teachers did not discuss the concept of academic freedom in depth. Most were dismissive of the concept. In discussing the Tennessee Teacher Protection and Academic Freedom Act Esther Lederberg stated,

I went to a dinner one time and there was this guy and he was a speaker and he said, “Elementary school teachers love the kids, and middle school teachers love the drama, and high school teachers love their subject, and college professors love themselves.” And he was joking, but you know part of that is true. I chose to be a science teacher because I love science, you know? And I think if I had a problem with evolution and climate change and human cloning I don’t know that I would be a science teacher, you know? And so I feel like that law is not necessary for me, because I think it’s giving teachers leeway in how they want to approach these controversial topics. And I don’t need any leeway, you know, I’m 100% on board with evolution.

Other teachers expressed similar standpoints, that they do not expect “academic freedom” in carrying out their responsibilities as teachers and that they would feel no need to deviate from the science outlined in the curriculum standards in order to adequately teach the subjects included in their high school biology courses. Mary Anning even stated that the idea of teaching alternatives to evolution such as intelligent design would be “absurd,” and that she certainly does not know any teachers who would want to do this. She stated, “If I did, I mean the whole thing is, it wouldn’t be people that I talked to about teaching. Because I think that would be ridiculous.” Nettie Stevens, Grace Hopper, and private school teacher Barbara McClintock stated that none of their current colleagues had ever expressed interest in teaching anti-science alternatives to evolution or climate change, but they had previously known teachers who rejected evolutionary theory and they suspected that many teachers in the state of Tennessee would teach creationism if it were allowed. In general the teachers did not conceive of their jobs as entailing academic freedom—though some of these teachers felt that the curriculum needs to be modified and improved, none of the teachers reported feeling that they should have the academic freedom to teach content outside what is outlined in the state curriculum standards.

Although the teachers interviewed in this study seemed to have a general disinterest in the concept of academic freedom, legislators who advocated for passage of HB0368/SB0893 asserted that this freedom was of vital importance for both students and teachers. Representatives Bill Dunn, Joey Hensley, and others stated that teachers fear for their jobs without the freedoms and protection granted by the law. Other legislators stated that academic freedom was important for students as it would allow them to ask questions and raise objections to scientific theories, usually evolution in particular, without being dismissed or potentially ridiculed. Many legislators brought up the concept of creationism or the Bible, making it clear

that this academic freedom was not just interpreted as an intellectual platform, but it was a way in which religious ideas could begin to re-enter public school science classes. Representative Dunn attempted to steer discussion in legislative meetings away from the inclusion of religious alternatives to evolution, and in one meeting he had the following exchange with Representative Mike Turner in response to Representative Turner's question about whether various forms of creationism could be taught under the law:

Bill Dunn: You're bringing up a question that a lot of people ask, and obviously there was a Supreme Court decision in the 1960s thanks to Madalyn Murray O'Hair that effectively removed God from the classroom. There's been court decisions since then dealing with the Establishment Clause that have said things such as creationism and more recently intelligent design cannot be taught, that it's considered to be religion and so this does not change the course of what can be taught. In fact, I said in my opening remarks that, I mentioned Darwinian evolution, it does not change, that's in our books. But it does, so I guess the answer to your question is, is court decisions would keep that from happening and obviously you couldn't have a bill telling someone to do something that the court says you cannot do.

Mike Turner: So you can't teach creationism under this bill?

Bill Dunn: You cannot teach the whole creationism A-Z, no.

This implies that while a teacher does not have the liberty to teach Biblical creationism as an alternative to evolution, some amount of creationism may be allowed if it can be construed as presentation of a "weakness" of the theory of evolution. Craig Fitzhugh also sensed that HB0368/SB0893 had to do with religious objections to evolutionary theory, stating,

I must say I appreciate the argument, I've just not still been convinced of the need for this legislation. As I said in the education committee I am certainly not a scientist or a theologian and I'm grounded in my faith. I remember the movie *Inherit the Wind*, where Spencer Tracy, at the end he had that book called *Origin of Species* and looked at it in one hand and he had the Holy Bible in the other hand and he glanced back and forth and he put them both together and walked out of the room. This has never been a problem for me, so I guess I'm having a little bit of a problem wondering why we're doing this.

Few legislators doubted the need for the legislation, and many vocally supported it, with many legislators speaking on the benefits of the law for public school students as well as for teachers. Given the assumption that teachers and students are oppressed and bullied by academic

scientists, HB0368/SB0893 was framed as returning free speech liberties that had been unjustly taken. Furthermore, the bill was framed as allowing teachers and students the religious freedom to reject theories such as evolution that may be perceived as contradictory to their religious beliefs, as under this law teachers cannot be prohibited from “helping students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught” (Tennessee General Assembly 2012a, 2012b). The implication that following critique of these theories students would be free to then “make up their own minds” regarding their merits was explicitly stated by many of the bill’s supporters as a desirable predicted outcome of the legislation. While asserting freedom of speech and freedom of religion may seem out of place in public school science education, the frame of academic freedom broadly encompasses these two freedoms and seems more appropriately situated in the discourse surrounding public education.

Common Sense and Individualism

Most of the public school teachers who participated in this study explained that they tell students that though they are not mandated to believe the science of socially controversial issues, they must nevertheless learn about these topics in order to be successful on the state-mandated End of Course examinations. Most teachers described their belief disclaimers as a way to deter resistance to learning about evolution and climate change when many students have been taught by their families, churches, and social networks that these theories are contrary to their beliefs and values and are not to be accepted. However, this statement by teachers, who are regarded as experts by students and communities, does contribute to the notion that the science of topics such as evolution and climate change is uncertain and that students’ “common sense” assessments of these theories are valid even if they are in disagreement with mainstream science. Teachers do not offer belief disclaimers prior to teaching about other topics which are held in no higher regard in the scientific community than evolution or climate change but that are not socially controversial, such as cell theory or photosynthesis. This action by teachers is in some ways pragmatic, as it avoids conflict with students and communities and it helps to prevent the

involvement of school or district administrators in daily classroom operation. As Joan Procter noted, current laws regarding teacher evaluation and tenure put many early-career teachers in an uncertain or unstable position regarding the security of their employment. She stated,

If you, let's just be blunt, if you cause trouble for administration they're going to get rid of you. So I think teachers, they have to be careful, it's not that they're doing anything illegal. It's just that if you cause problems in any, for anything, you're going to be not asked back or you're going to be asked to leave. So I mean, I think it's just something you have to be aware of. It's just like women walking to their cars at night. Should I have to be careful and look around to make sure it's safe for me to walk in the parking lot? No, but I do because I know what could happen. It's the same thing with teaching evolution. Now I know I shouldn't have to do it but I have to make sure everything's okay.

In addition to the practical benefit of offering this disclaimer for the benefit of teacher-student relationships, classroom atmosphere, or job security, these belief disclaimers are in keeping with some fundamental American values. The values of individualism and individual freedom are evident in this explicit allowance for students to ultimately make their own determinations regarding the validity of what they learn in school. As Maria Merian stated, "Despite what the evidence says we are still a free country, we can still believe what we want. So there has got to be a place in the classroom to allow for that to happen." The values of individualism and common sense are largely inextricable in the study of anti-science in public education. The individual freedom that students have to "make up their own minds," which many teachers and advocates for the Tennessee Teacher Protection and Academic Freedom Act prioritize, relies on the assumption that students' common sense assessments of what they learn are just as valid as the mainstream scientific information that they are taught. Furthermore, the high value of these common sense conclusions can serve to maintain the popular American mistrust of experts in spite of the amount of evidence that undergirds theories such as evolution and climate change, when ultimately even teachers are implying that if students dismiss or disregard this science that these decisions are legitimate. In this climate the End of Course examinations become just another example of the unjust power held by science, as students are expected to learn concepts that they do not believe in order to successfully complete their high school education.

The data suggest that legislators and teachers conceptualize critical thinking differently. Teachers discussed critical thinking in terms of a variety of skills such as problem solving, assessing evidence and drawing conclusions, identifying bias in information sources, supporting ideas and claims with reputable sources, and applying prior knowledge to new inquiries. Rachel Carson stated, “We teach them *how* to think, not *what* to think.” In contrast, most legislators discussed critical thinking in terms of disbelief of prevailing scientific theories. In a legislative meeting Representative Jeremy Faison stated, “And I’d just like to submit to the crowd today that evolution between one species to another species has never been proven. So how could we teach it as a fact and deny any other thought of what could be possible to a child or to anybody who wants to be a critical thinker?...Our whole state will be better when we teach our children to be critical thinking about how they got here and not just accept something that’s never been proven.” Frank Niceley suggested in a legislative meeting that if he were a teacher he would teach both creationism and evolution, stating, “If I was a teacher I would teach them both as theories and let the child as he grows up make up his own mind.” Critical thinking for most legislative supporters of HB0368/SB0893 was reduced to the activity of learning about scientific theories such as evolution and climate change, learning about alternatives to these theories, and then choosing which one to believe. This perception of critical thinking puts the concept more in line with the value of “common sense” than with critical thinking as it is understood by educators.

The value of individualism as seen in the context of Academic Freedom legislation is an extension of the value of democracy and the desire to grant a voice to “both sides” of issues, as then individuals who have been presented with “both sides” are allowed to “make up their own minds.” Several legislators and teachers who participated in this study expressed respect for the intellectual autonomy of students and stated that students should know “both sides” of issues and then “make up their own minds.” Some even referred to this as “the beauty of science.” This individualism is actually in direct contrast to the nature of science, as science is not a democratic enterprise that awards legitimacy to all opinions. The suggestion that any individual can assess the merit of scientific theories and then determine whether to accept or reject them highlights the value of common sense in American culture. The values of individualism, common sense, and egalitarianism are essential in anti-science movements, and this remains true in terms of Academic Freedom legislation. Statements by legislators indicate that the focus on “critical

thinking” in the language of HB0368/SB0893 was interpreted by bill supporters as “common sense,” and common sense was referenced by legislators in meeting and by study participants in other contexts as well. For example, in a legislative meeting Richard Floyd stated, “Common sense is something that we’ve all got, I don’t think we have a scientist in this body. I’ve met most of you, and most of you have common sense. So this is a common sense bill. Thank you for bringing this bill to protect our teachers from the other intellectual bullies.” In this statement Representative Floyd asserted not only the importance of common sense and the assumption that all members of the Tennessee House of Representatives possess it, but he also specified that no one in the legislature is a scientist. In addition, his joking implication that scientists lack common sense highlights the disdain for scientists and experts in American culture and the idea that common sense is more valuable than formal education or expertise (Robertson 1980). This disdain for experts also appeals to the values of democracy and egalitarianism and complements the myth of the frontier, as “beauty” and “discoveries” in science are seen as in direct opposition to mainstream scientific consensus.

Chapter 6:

Project Validity and Limitations

Methodology Limitations

The data collection methods present some limitation to the study. This study relied solely on interview data and no classroom observations were conducted. As a result the research relies on teachers' self-reported data regarding the methods used in teaching socially controversial topics, the level of coverage of these topics, student conduct and responses to learning about science that is perceived as controversial, and other factors that contribute to classroom experiences. The topics named in the Tennessee Teacher Protection and Academic Freedom Act are not covered extensively according to the state curriculum (Tennessee Department of Education 2009, 2017, n.d.). The Advanced Placement Biology curriculum has a framework of evolutionary theory, but in all other courses the topics have little or no curriculum coverage (College Board 2015; Tennessee Department of Education n.d.). The local school district from which most participants were recruited sets the order and pacing of topics in science classes, so all teachers and all schools in the area typically cover topics at about the same time in the semester. It would have been a practical impossibility for the sole researcher in this study to observe the coverage of these particular topics in multiple classrooms at multiple schools given the district-mandated pacing alignment. In addition to this practical consideration, the purpose of this study is not to investigate student perspectives or pedagogy, necessarily. The primary focus in the study of teachers is to understand the teachers' perspectives, and the interview method of data collection allowed for this.

In the process of conducting interviews it became evident that many of the teachers who participated in the study have never heard of the Tennessee Teacher Protection and Academic Freedom Act. This was initially perceived as a problem and a limitation for the research, but this can also be interpreted as useful data in itself when the context of teacher awareness is acknowledged and understood.

Analysis of the data indicate that participants did not all define the concepts of academic freedom and critical thinking in the same way. Though interview questions explored these topics, the interview protocols did not include explicit questions regarding participants' definitions of these concepts. The addition of this question to the interview protocols could have provided a clearer grounding of other data regarding these concepts in the analysis of legislator and teacher perspectives on these topics.

Participation

It is possible that participation bias was present in the teacher population that participated in this study. All of the teachers who participated in the study expressed an interest in teaching the topics named in the Tennessee Teacher Protection and Academic Freedom Act, particularly evolution and climate change. All of the teachers also expressed concern regarding educational policy and legislator understandings of public education. Subjective interest is likely the strongest factor that influenced the decision to participate, though the gift card may have served as an economic incentive as well (though the value of the gift card given to each teacher was ten dollars, and given that all participants are teachers who are employed full-time, the gift card is unlikely to have served as a very strong incentive) (Clark 2010; Head 2009). In addition to subjective interest, the subject position of the researcher may have influenced teachers' decision to participate. For example, the researcher disclosed in the recruitment letter that she is a graduate student in the field of anthropology. Two of the research participants disclosed in their interviews that they majored in anthropology in their undergraduate studies. One participant has a spouse who studied anthropology. Two participants have children who are pursuing graduate degrees and one has a spouse pursuing a graduate degree. Two teacher participants stated that they had learned about and practiced qualitative research in their graduate studies and indicated that their participation in this project, in addition to their interest in the subject of the research, was partially "sympathetic" and an effort to "give back," as they understood the challenges of participant recruitment in qualitative research. All of the participants mentioned these facts during their interviews, indicating that these facets of their personal lives may have affected the decision to positively respond to the invitation to participate.

In addition to the personal connections participants made to the researcher, during the interviews all of the participants were made aware that the researcher is a former teacher. This may have been influential in the level of familiarity and rapport established during the interviews, particularly in teacher interviews. In addition to the potential participation bias that may have been influenced by the subject position of the researcher, the position of the researcher as a student of anthropology may have implicitly indicated that the researcher maintains a pro-

science stance or, more specifically, that the researcher accepts the theory of evolution. Although the researcher never stated that she accepts evolution or climate change, participants familiar with the field of anthropology may have assumed this to be true and this may have influenced some individuals' decisions to participate or not to participate.

Response Rate and Sample Size

In data collection, response rate and sample size are the primary limitations of this study. The response rate for legislators to the invitation to participate in the study is low. Of the thirty-three that were invited to participate, ultimately four legislators were interviewed, which is approximately a 12% participation rate. All legislators who did not respond initially were invited up to three times via both email and phone. The legislator interviews relied on video calling and traditional phone calls, as all of the legislators interviewed were either in Nashville, TN during the legislative session or in their home districts at the time of the interviews. However, the use of the archived videos of legislative meetings does provide rich data regarding the perspectives of legislators on this policy and educational policy in general. The legislative meetings included discussion among legislators as well as testimonies of non-legislators both in support of and in opposition to passage of the Tennessee Teacher Protection and Academic Freedom Act. In support of the bill there was testimony by teachers, parents, and other concerned citizens including a doctor as well as a private-sector scientist. In opposition to the bill there was testimony by the American Civil Liberties Union, university professors from the University of Tennessee and Vanderbilt University, and teachers. Though the meetings cannot provide data regarding how legislators perceive the outcome or impacts of the law since its passage, the interviews ultimately did not generate much data about this topic either. Some legislators were able to speculate but none had explicitly examined the impacts of the law, so more interviews would not necessarily have guaranteed the generation of this data.

The low response rate limitation applies to the teacher populations as well as the legislator population. 122 public school teachers were invited to participate in addition to the unknown number that were invited following their participation in Darwin Day workshops, and twelve were interviewed. Given that the Darwin Day workshop was held at the University of Tennessee and all the teachers invited to participate in the project are current teachers in eastern Tennessee, it can be assumed that some teachers were invited using both means of recruitment. In spite of the participation rate of less than 10%, about half of the schools in a local school district were represented as well as one school in a neighboring, more rural district. Teachers

from the remaining unrepresented schools (a total of forty-eight teachers) were sent an additional invitation to participate via email, though none responded to the invitation. The purposive sample of private school teachers was quite small initially, as only four teachers were invited and two were ultimately interviewed. This small number of invitations is due to the confidentiality protections in place in the study. The researcher chose to contact teachers directly rather than contacting schools to invite teachers to participate in order to allow teachers to choose whether to disclose their participation to their colleagues and administrators. Few private schools in the research area post teacher contact information on their websites which limited the researcher's access to potential participants from private schools. Since this study did not include classroom observations in the data collection process, contacting school districts and administrators was not necessary. This allowed the researcher to better guarantee confidentiality to the participants, which was a primary concern of the researcher given the potentially controversial nature of some of the topics discussed in the interviews. In spite of the small sample size in this study, the process of data coding, analysis, and interpretation indicated that saturation had been reached (Fusch and Ness 2015).

Defining and Achieving Saturation

Yvonna S. Lincoln and Egon G. Guba describe naturalistic inquiry as occurring in natural settings and employing qualitative methods, purposive sampling, inductive analysis, and grounded theory methodology (Bowen 2008; Lincoln and Guba 1985). In order to ensure rigor in naturalistic research, detailed explanations of data collection methods and data analysis should be provided, and this paper has sought to give as much of this information as possible while still ensuring participant confidentiality. As generalizability is not seen as a goal of most qualitative research, Guba (Guba 1981; Morse 2015; Shenton 2004) has offered that a goal of “trustworthiness” is more appropriate for qualitative research, and trustworthiness can be achieved through credibility, transferability, dependability, and confirmability. Sarah J. Tracy (2010) has offered a model for ensuring quality in qualitative research that consists of eight criteria—a worthy topic, rich rigor, sincerity, credibility, resonance, significant contribution, ethics, and meaningful coherence.

In spite of these criteria, scholarship tends to support a degree of mystery regarding saturation and how to determine that saturation has been achieved in qualitative research (Bowen 2008; Guest, Bunce, and Johnson 2006; Mason 2010; O’Reilly and Parker 2012). In a study that employs grounded theory methodology, saturation is met when no new codes, categories, or themes emerge with the addition and analysis of more data (Bowen 2008; Fusch and Ness 2015; Guest, Bunce, and Johnson 2006; O’Reilly and Parker 2012). Some estimates have been given regarding the number of interviews that are appropriate for various types of studies, though many of these guidelines are not accompanied by any substantive arguments as to how the numbers were determined. These guidelines range from minimums of six or fifteen interviews to ranges of five to twenty-five, twenty to thirty, thirty to fifty, or thirty to sixty (Mason 2010). Mark Mason (2010) conducted an analysis of over five hundred Ph.D. dissertations that used qualitative interviews as the method of data collection and found that sample sizes ranged from one to ninety-five, the mean number of interviews was twenty-eight, and the median was 31. The most important finding of Mason’s (2010) analysis is that there was a high proportion of studies with sample sizes that are multiples of ten, with twenty and thirty being the most

common sample sizes. As there is no methodology or theory that mandates this and there is no indication that saturation is reached at a multiple of ten more often than at any other number, this finding indicates that the sample sizes in these studies are not chosen on the basis of saturation (Mason 2010). Mason (2010) suggests that this trend may be due to a lack of understanding of saturation, or that researchers are conducting the number of interviews predicted in their proposals in order to ensure validity, or that they may be opting for large sample sizes so that the data seem more defensible.

In contrast to the larger sample sizes suggested by many, some studies indicate that samples sizes as small as four or ranging from approximately six to twelve participants can be sufficient (Guest, Bunce, and Johnson 2006; Romney, Weller, and Batchelder 1986). Greg Guest, Arwen Bunce, and Laura Johnson (2006) suggest that studies that use purposive sampling assume a degree of homogeneity in the sample by virtue of the fact that participants are chosen based on a common criteria. The more similar participants are, the sooner saturation can be expected (Guest, Bunce, and Johnson 2006; Romney, Weller, and Batchelder 1986). Guest, Bunce, and Johnson (2006) determined that in a grounded theory methodology with a relatively homogenous population of study, a sample size of six to twelve can be sufficient. In a study of the coding process it was determined that saturation was reached with a relatively small sample, as 80% of codes were generated in the analysis of six interviews and 92% of codes were generated by the twelfth interview. Since grounded theory methodology mandates the constant comparative method and ongoing analysis during data collection rather than exclusively after data collection, researchers can assess the utility of continuing data collection with the ongoing analysis (Corbin and Strauss 2015; Robinson 2014; Strauss 1987; Strauss and Corbin 1990). When interviews no longer lead to generation of novel codes and themes in the analysis, the researcher can determine that saturation has been achieved and more interviews are not necessary.

The University of Tennessee Institutional Review Board, like most entities that oversee the ethical conduction of research, requires that researchers indicate the number of interviews that will be conducted in the review board proposal, before data collection begins. While this requirement is understandable, it is difficult to anticipate beforehand how many participants and how many interviews will be needed to achieve data saturation (Fusch and Ness 2015; Mason 2010). The proposed sample sizes were not achieved in this study. However, the use of the

legislative meeting data allowed for analysis in which saturation was achieved, and the addition of the legislator interview data did not result in the generation of more codes or themes. The legislator meetings involved the verbal participation of nearly fifty legislators as well as several citizens, advocates, and experts. While more legislator interviews were desired, the data available in the legislative meetings allowed for the analysis of legislator perspectives in spite of the unwillingness of most legislators to acknowledge or participate in the project. In the analysis of teacher interview data, saturation occurred after about nine interviews. The subsequent interviews did not yield any new major themes, though these interviews did reinforce and verify the codes and themes that had already been defined and led to some refinement of codes and themes. More private school teacher participants were desired as the researcher hoped to investigate how these teachers' experiences and perspectives compare with those of public school teachers. However, the larger goal of the research was to investigate perspectives on the Tennessee Teacher Protection and Academic Freedom Act and on educational policy in general, and private school teachers do not have to experience and abide by the same policies that govern public schools.

Conclusions and Recommendations for Future Research

This project sought to investigate how religious, political, and educational ideologies and rhetoric regarding American identity and values inform understandings of the definitions and roles of scientific inquiry and knowledge, and how these understandings influence science education policy, curriculum, and pedagogy. The data in this study are composed of interviews of legislators involved in the passage of the Tennessee Teacher Protection and Academic Freedom Act, the content of legislative meetings in which the bill was discussed and debated prior to passage, and interviews of public and private high school teachers in eastern Tennessee.

The data in this study indicate that the passage of the Tennessee Teacher Protection and Academic Freedom Act was an ideological victory for anti-science movements. Only one teacher who participated in the study has been impacted by the law, and she did not regard her experience as significant. For the teachers who participated in this study, the law has not had any significant impact on educational content or pedagogy and, in fact, most teachers were unaware of the law entirely. In part the lack of reported impact of the law may be attributable to the fact that human evolution is not included in the science curriculum in Tennessee. While some creationists reject all forms of evolution, many anti-evolution ideologies such as intelligent design and other forms of old earth creationism accept what is understood as “microevolution,” or evolutionary changes within species and lineages, and reject “macroevolution,” which refers to common ancestry, speciation, and changes of larger scale and time frame (Luskin 2012; Petto 2005). As yet there have been no legal challenges to the Tennessee Teacher Protection and Academic Freedom Act and given that the law does not include a specific directive for teachers to include non-science alternatives to accepted scientific theories, this newest manifestation of anti-science legislation in the form of Academic Freedom laws may be more impervious to legal scrutiny and constitutional challenge than its predecessors.

An analysis of the frames utilized by legislative supporters of the Tennessee Teacher Protection and Academic Freedom Act allows for a distinction between the issues of the anti-

science movement and the political frames employed to advance the movement and promote Academic Freedom legislature. The data in this study indicate that many of the ideologies that serve to maintain the momentum and salience of anti-science movements are only tangentially related to the scientific theories that anti-science movements reject. Rather, these ideologies embody important American values and therefore serve to broaden the appeal of anti-science to a larger proportion of the population. These values include democracy and the rights of voters to determine policy, freedom of religion, freedom of speech, and common sense and individualism.

Legislators in support of the Tennessee Teacher Protection and Academic Freedom Act framed the law as democratic in that it allows viewpoints outside of mainstream science to be expressed in public school science classes, thus allowing communities, families, and students to feel that their standpoints on the merit of socially controversial scientific theories are acknowledged and validated. Legislators' statements in support of the law indicate that "academic freedom" is a frame that encompasses freedom of speech and freedom of religion, and the values of common sense and individualism are framed within the popular educational concept of "critical thinking." Legislators framed the need for this legislation as a protection against the unjust power wielded by academic scientists—who were described as using their powerful credentials and expertise to "bully" teachers into teaching troubled and "unproven" science. These academic scientists were portrayed as emotionally or even religiously driven to dishonestly promote the "dogmas" of evolution and climate change at the cost of teachers' and students' rights to "free thought." Furthermore, with the framing of teachers, students, and the public as marginalized by the power of the scientific community, Academic Freedom legislation is propelled by the myths of science and progress and the frontier as these bills are framed as helping to ensure that teachers and students are not simply subsumed into the oppressive status quo of science.

In contrast to legislators' understandings of the teaching of socially controversial topics in public school science education, the teachers interviewed in this study do not employ the concepts of "academic freedom" and "critical thinking" as frames for these values. As a result they interpreted the meaning of the law differently, and most found it irrelevant to their work as science teachers. Those that saw relevance in the law felt that it would protect them in the event of complaints from students or parents who objected to the teaching of topics such as evolution or climate change, not that it would grant them freedom to introduce anti-science viewpoints.

None of the public school teachers who participated in this study had any desire to teach anti-science objections to these topics, though some of them were concerned that other teachers in the state may take the opportunity presented by this law and that it would ultimately be detrimental to students' learning and scientific literacy and perpetuate the popularity of anti-science.

Social constructionism and framing theory allow for the analysis of anti-science politics in terms of Foucault's power/knowledge, to deconstruct the power struggle between the regimes of truth of scientific and lay knowledge. In the past anti-science laws have ultimately been declared unconstitutional, though that has not deterred their ongoing popularity in American culture. The regime of truth that has been constructed by anti-science movements is an effective one as it validates and includes the knowledge of all people regardless of education or expertise, and it squarely places fundamental American values and components of American identity on the side of anti-science.

Assessing anti-science as a social movement that is tied to broad ideological values rather than as a religious reconciliation problem or an education problem of scientific literacy could be helpful to science education advocates in improving their approach to opposing anti-science activity in public education. It is clear that the rhetoric employed by science advocates often does not resonate with the lay public or with the legislators, school board members, and others who make decisions regarding educational policy and content and who ultimately are held accountable by their constituents. When the talking points are issues such as bullying, facts and proof, dogma, and free thought, no amount of clarification of the nature of science or correction of misconceptions about scientific theories will be effective without equally compelling frames that will resonate with people who do not conceptualize science as part of their everyday lives and who may not fully understand the theories with which they disagree. Everyone understands what it means to be an American and to enjoy and assert the individual importance and freedoms that come with that identity. In order to be more effective, science education advocates will have to make science—the reality of science and not just the "discoveries" and technological prowess of science—resonate with who we are as Americans.

Berkman and Plutzer's (2010) survey of teachers concluded that about 14-21% of public school science teachers teach creationism, which is not part of the science curriculum in any state and has been declared unconstitutional and in violation of the Establishment Clause. In this small-scale ethnographic study, none of the public school teachers reported teaching religious or

other alternatives to evolution or other socially controversial scientific theories. This may be due to participation bias—it is possible that only teachers with viewpoints that align with mainstream science volunteered to participate in the study. A larger scale ethnographic study or a survey of teachers could shed more light on trends in the teaching of anti-science in Tennessee. The benefit of ethnographic interviews rather than survey methodologies is that interviews can generate data that will allow for more in-depth investigation of why teachers choose to accept or not accept science and how they perceive the intersections of educational content, student and community standpoints on content, and their responsibilities as teachers. Given that few teachers knew about or felt impacted by the Tennessee Teacher Protection and Academic Freedom Act, a larger scale study may be appropriate to determine if this is a widespread phenomenon and to inform the methodology of future study of the impacts of Academic Freedom legislation. In addition, an ethnographic study of other stakeholders such as parents, scientists, and science education advocates may be of use to science advocacy groups in understanding what changes need to be made to how political advocacy is enacted in order to be more effective in influencing science education policy. In the context of a larger scale study it may be beneficial to also collect demographic data in order to determine if age, gender, race, or other factors are correlated with perspectives or behaviors of teachers or other stakeholders. In the field of cultural studies of science education, a study of science classes and students to investigate the relationship between frames utilized by teachers when teaching socially controversial subjects and educational outcomes in proficiency and/or in perspectives of students could help inform curriculum development or pedagogy as well.

This study indicates that rhetorical and political discourse and frame analysis can render visible the values and ideologies that serve to maintain this social and political controversy that is often reduced to a question of scientific literacy and education. In the anthropology of politics frame analysis can be a useful tool in deconstructing and understanding power relations and power struggles regarding contentious social issues, particularly in the context of governing bodies, the public, and institutions of cultural reproduction such as public schools. Finally, the characterization of scientific experts by anti-science movements makes it clear that conspiracy theory is a prominent and effective component of anti-science political advocacy. The scientific community should perhaps reconsider the pejorative nature of how it conceptualizes conspiracy theories, as academics tend to dismiss conspiracy theories as “silly” and lacking intellectual

credibility, but it is evident that they are popular and influential in politics and public discourse. Through research such as this project and future studies of the relationship between science and American culture and the political efficacy of science and anti-science advocacy, a better understanding of the role of science in American culture can be attained and ultimately lead to more positive outcomes in science education policy, student achievement in science, and public understanding and use of science.

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Appendices

Appendix A

Tennessee Teacher Protection and Academic Freedom Act

SENATE BILL 893 By Watson

HOUSE BILL 368 By Dunn

AN ACT to amend Tennessee Code Annotated, Title 49, Chapter 6, Part 10, relative to teaching scientific subjects in elementary schools.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF TENNESSEE:

SECTION 1. Tennessee Code Annotated, Title 49, Chapter 6, Part 10, is amended by adding the following as a new, appropriately designated section:

(a) The general assembly finds that:

(1) An important purpose of science education is to inform students about scientific evidence and to help students develop critical thinking skills necessary to becoming intelligent, productive, and scientifically informed citizens;

(2) The teaching of some scientific subjects, including, but not limited to, biological evolution, the chemical origins of life, global warming, and human cloning, can cause controversy; and

(3) Some teachers may be unsure of the expectations concerning how they should present information on such subjects.

(b) The state board of education, public elementary and secondary school governing authorities, directors of schools, school system administrators, and public elementary and secondary school principals and administrators shall endeavor to create an environment within public elementary and secondary schools that encourages students to explore scientific questions, learn about scientific evidence, develop critical thinking skills, and respond appropriately and respectfully to differences of opinion about controversial issues.

(c) The state board of education, public elementary and secondary school governing authorities, directors of schools, school system administrators, and public elementary and secondary school principals and administrators shall endeavor to assist teachers to find effective ways to present the science curriculum as it addresses scientific controversies. Toward this end, teachers shall be permitted to help students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught.

(d) Neither the state board of education, nor any public elementary or secondary school governing authority, director of schools, school system administrator, or any public elementary

or secondary school principal or administrator shall prohibit any teacher in a public school system of this state from helping students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught.

(e) This section only protects the teaching of scientific information, and shall not be construed to promote any religious or non-religious doctrine, promote discrimination for or against a particular set of religious beliefs or non-beliefs, or promote discrimination for or against religion or non-religion.

SECTION 2. By no later than the start of the 2011-2012 school term, the department of education shall notify all directors of schools of the provisions of this act. Each director shall notify all employees within the director's school system of the provisions of this act.

SECTION 3. This act shall take effect upon becoming a law, the public welfare requiring it.

Louisiana Science Education Act

SLS 08RS-1629 REENGROSSED

Regular Session, 2008

SENATE BILL NO. 733 (Substitute of Senate Bill No. 561 by Senator Nevers)

BY SENATORS NEVERS, CROWE, RISER AND THOMPSON

CURRICULA. Provides for the La. Science Education Act (gov sig)

AN ACT

To enact R.S. 17:285.1, relative to curriculum and instruction; to provide relative to the teaching of scientific subjects in public elementary and secondary schools; to promote students' critical thinking skills and open discussion of scientific theories; to provide relative to support and guidance for teachers; to provide relative to textbooks and instructional materials; to provide for rules and regulations; to provide for effectiveness; and to provide for related matters.

Be it enacted by the Legislature of Louisiana:

Section 1. R.S. 17:285.1 is hereby enacted to read as follows:

§285.1. Science education; development of critical thinking skills

A. This Section shall be known and may be cited as the "Louisiana Science Education Act."

B. (1) The State Board of Elementary and Secondary Education, upon request of a city, parish, or other local public school board, shall allow and assist teachers, principals, and other school administrators to create and foster an environment within public elementary and secondary schools that promotes critical thinking skills, logical analysis, and open and objective discussion of scientific theories being studied including, but not limited to, evolution, the origins of life, global warming, and human cloning.

(2) Such assistance shall include support and guidance for teachers regarding effective ways to help students understand, analyze, critique, and objectively review scientific theories being studied, including those enumerated in Paragraph (1) of this Subsection.

C. A teacher shall teach the material presented in the standard textbook supplied by the school system and thereafter may use supplemental textbooks and other instructional materials to help students understand, analyze, critique, and review scientific theories in an objective manner, as permitted by the city, parish, or other local public school board.

D. This Section shall not be construed to promote any religious doctrine, promote discrimination for or against a particular set of religious beliefs, or promote discrimination for or against religion or nonreligion.

E. The State Board of Elementary and Secondary Education and each city, parish, or other local public school board shall adopt and promulgate the rules and regulations necessary to implement the provisions of this Section prior to the beginning of the 2008-2009 school year.

Section 2. This Act shall become effective upon signature by the governor or, if not signed by the governor, upon expiration of the time for bills to become law without signature by the governor, as provided by Article III, Section 18 of the Constitution of Louisiana. If vetoed by the governor and subsequently approved by the legislature, this Act shall become effective on the day following such approval.

Alabama House Joint Resolution

HJR78

181658-2

By Representatives Butler, Mooney, Farley, Standridge, Moore (B), Rich, Ledbetter, Brown, Wingo, Drake, Clouse, Greer, Gaston, Faust, Ainsworth, Whorton (I), Wood, Wilcox, Patterson, Pettus, Ball, Williams (P), Fridy, South, Treadaway, Sessions, Weaver, Blackshear and Shedd

RFD: Rules

First Read: 23-FEB-17

ENROLLED, House Joint Resolution,

URGING TEACHER ACADEMIC FREEDOM REGARDING SCIENTIFIC EVIDENCE SUBJECTS.

WHEREAS, an important purpose of science education is to inform students about scientific evidence and to help students develop critical thinking skills necessary to become intelligent, productive, and scientifically informed citizens; and

WHEREAS, the teaching of some scientific subjects required to be taught under the curriculum framework developed by the State Board of Education may cause controversy including, but not limited to, biological evolution, the chemical origins of life, global warming, and human cloning; and

WHEREAS, some teachers may be unsure of the expectation concerning how they should present information when controversy occurs on such subjects; now therefore,

BE IT RESOLVED BY THE LEGISLATURE OF ALABAMA, BOTH HOUSES THEREOF CONCURRING, that we strongly urge:

(a) The State Board of Education, public elementary and secondary school governing authorities, directors of schools, school system administrators, and public elementary

and secondary school principals and administrators and teachers should endeavor to create an environment within public elementary and secondary schools that encourages students to explore scientific questions, develop critical thinking skills, analyze the scientific strengths and weaknesses of scientific explanations, and respond appropriately and respectfully to differences of opinion about scientific subjects required to be taught under the curriculum framework developed by the State Board of Education.

(b) The State Board of Education, public elementary or secondary school governing authorities, directors of schools, school system administrators, and public elementary or secondary school principals and administrators should refrain from prohibiting any teacher in a public school system of this state from helping students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught within the curriculum framework developed by the State Board of Education.

BE IT FURTHER RESOLVED, that this resolution is intended to support the teaching of scientific information and shall not be construed to promote any religious or nonreligious doctrine, promote discrimination for or against a particular set of religious beliefs or non-beliefs, or promote discrimination for or against religion or non-religion.

Speaker of the House of Representatives

President and Presiding Officer of the Senate

House of Representatives

I hereby certify that the within Act originated in and was adopted by the House 06-APR-17.

Jeff Woodard
Clerk

Senate 02-MAY-17 Adopted

Model Academic Freedom Bill

AN ACT PROTECTING TEACHER ACADEMIC FREEDOM TO TEACH SCIENTIFIC EVIDENCE REGARDING CONTROVERSIAL SCIENTIFIC SUBJECTS

A. The _____ State Legislature understands that an important purpose of science education is to inform students about scientific evidence and to help students develop critical thinking skills they need in order to become intelligent, productive, and scientifically informed citizens. The Legislature further understands that the teaching of some scientific subjects, such as biological evolution, the chemical origins of life, global warming, and human cloning, can cause controversy, and that some teachers may be unsure of the expectations concerning how they should present information on such subjects.

B. The _____ Board of Education, public elementary and secondary school governing authorities, superintendents of schools, school system administrators, and public elementary and secondary school principals and administrators shall endeavor to create an environment within public elementary and secondary schools that encourages students to explore scientific questions, learn about scientific evidence, develop critical thinking skills, and respond appropriately and respectfully to differences of opinion about controversial issues. Such educational authorities in _____ shall also endeavor to assist teachers to find more effective ways to present the science curriculum where it addresses scientific controversies. Toward this end, teachers shall be permitted to help students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught.

C. Neither the _____ Board of Education, nor any public elementary or secondary school governing authority, superintendent of schools, or school system administrator, nor any public elementary or secondary school principal or administrator shall prohibit any teacher in a public school system of this state from helping students understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught.

D. This Act only protects the teaching of scientific information, and this Act shall not be construed to promote any religious or non-religious doctrine, promote discrimination for or against a particular set of religious beliefs or non-beliefs, or promote discrimination for or against religion or non-religion.

E. This Act only protects discussion of the scientific strengths and weaknesses of topics that are already part of the required science curriculum and is not intended to authorize a teacher to discuss the strengths and weaknesses of new topics that are not already part of the required science curriculum.

F. By no later than the start of the 2015-2016 school term, the _____ Department of Education shall notify all public school system superintendents of the provisions of this Act. Each superintendent shall then disseminate to all employees within his or her school system a copy of the provisions of this Act.

Appendix B

Recruitment Letter for Legislative Participant

(Salutation)

I am a graduate student in the Department of Anthropology at the University of Tennessee-Knoxville, and I am conducting a study that investigates the Tennessee Teacher Protection and Academic Freedom Act of 2012. The purpose of this research is to address the question of how religious, political, and educational ideologies and rhetoric regarding American identity and values inform understandings of the definitions and roles of scientific inquiry and knowledge. This research will also explore how these understandings influence science education policy, curriculum, and pedagogy. In this study I will be interviewing both legislators and science teachers in order to gain the perspectives of two of the most important groups in the passage and enactment of educational policy.

I would like to invite you to participate in this study. Your participation would consist of one interview (about an hour in length) to be conducted via phone or video call at your convenience.

If you would like to participate or if you have any questions about the study or the researcher, please contact me via email at kstephe8@vols.utk.edu or via phone at (865)xxx-xxxx.

Thank you,

Karmen M. Stephenson

Recruitment Letter for Public School Teacher Participant

Dear science teacher,

I am a graduate student in the Department of Anthropology at the University of Tennessee-Knoxville, and I am conducting a study that investigates the Tennessee Teacher Protection and Academic Freedom Act of 2012. The purpose of this research is to address the question of how religious, political, and educational ideologies and rhetoric regarding American identity and values inform understandings of the definitions and roles of scientific inquiry and knowledge. This research will also explore how these understandings influence science education policy, curriculum, and pedagogy. In this study I will be interviewing both legislators and science teachers in order to gain the perspectives of two of the most important groups in the passage and enactment of educational policy.

I would like to invite you to participate in this study. Your participation would consist of one interview (about an hour in length) to be conducted at your convenience. If you choose to participate, confidentiality will be granted and your identity will not be revealed in any resulting publications of the study. To show my appreciation for your contribution to this research, you will receive a ten dollar gift card for your participation.

If you would like to participate or if you have any questions about the study or the researcher, please contact me via email at kstephe8@vols.utk.edu or via phone at (865)xxx-xxxx. Please feel free to distribute this letter and/or my contact information to any friends or colleagues in science education who may also be interested in participating in this study.

Thank you,

Karmen M. Stephenson

Recruitment Letter for Private School Teachers

(Salutation)

I am a graduate student in the Department of Anthropology at the University of Tennessee-Knoxville, and I am conducting a study that investigates the Tennessee Teacher Protection and Academic Freedom Act of 2012. The purpose of this research is to address the question of how religious, political, and educational ideologies and rhetoric regarding American identity and values inform understandings of the definitions and roles of scientific inquiry and knowledge. This research will also explore how these understandings influence science education policy, curriculum, and pedagogy. In this study I will be interviewing both legislators and science teachers in order to gain the perspectives of two of the most important groups in the passage and enactment of educational policy.

I would like to invite you to participate in this study. Your participation would consist of one interview (about an hour in length) to be conducted at your convenience. If you choose to participate, confidentiality will be granted and your identity will not be revealed in any resulting publications of the study. To show my appreciation for your contribution to this research, you will receive a ten dollar gift card for your participation.

If you would like to participate or if you have any questions about the study or the researcher, please contact me via email at kstephe8@vols.utk.edu or via phone at (865)xxx-xxxx.

Thank you,

Karmen M. Stephenson

Appendix C

Informed Consent Statement (Legislative Participant)

INFORMED CONSENT STATEMENT (Legislative Participant)

Project: Academic Freedom, Critical Thinking, and the Culture of American Science Education

INTRODUCTION

You are invited to participate in a study about the Tennessee Teacher Protection and Academic Freedom Act of 2012. The purpose of this research is to address the question of how religious, political, and educational ideologies and rhetoric regarding American identity and values inform understandings of the definitions and roles of scientific inquiry and knowledge. This research will also explore how these understandings influence science education policy, curriculum, and pedagogy.

INFORMATION ABOUT PARTICIPANT'S INVOLVEMENT IN THE STUDY

Your participation in this study will consist of an interview (about an hour in length) to be conducted at your convenience. The interview will be audio recorded with your consent.

RISKS AND CONFIDENTIALITY

There are no foreseeable risks in this study. All notes and recordings will be password protected and stored in Karmen M. Stephenson's personal computer until the conclusion of the project. You may choose whether to have your identity revealed in the written results of the study. As any participation you may have had in the passage of the Tennessee Teacher Protection and Academic Freedom Act is publicly available on the website of the Tennessee General Assembly, the provision of confidentiality in the publication of the results of the study may not be possible.

BENEFITS

Participation in this study is voluntary, and no remuneration will be given for participation. This study will provide the researcher information about how legislators and teachers perceive, interpret, and participate in the passage and implementation of educational policy regarding the teaching of controversial topics. This information may reveal reasons for the persistence of these debates in public education, and it may offer useful insight for legislators, teachers and teacher educators, education advocates, and the public in pursuing a resolution to ongoing, divisive conflicts in our schools. As a law similar to the Tennessee Teacher Protection and Academic Freedom Act passed previously in Louisiana and several comparable bills are proposed in other states each year, the potential impact of these laws is widespread for children who attend public schools in the United States.

CONTACT

If you have questions at any time about the study, you may contact the researcher, Karmen M. Stephenson, at the Department of Anthropology at the University of Tennessee, at 250 South Stadium Hall, Knoxville TN 37996, via email at kstephe8@vols.utk.edu, or via phone at (865)974-4408. If you have questions about your rights as a participant, contact the Office of Research and Engagement IRB Compliance Officer at (865)974-7697.

PARTICIPATION

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed your data will be returned to you or destroyed.

CONSENT

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Participant’s Signature _____ Date _____

Choose one of the following:

I agree for my participation to be made public. Participant’s initials _____

I wish for my participation to be confidential. Participant’s initials _____

I consent to audio recording of my interview.

Participant’s Signature _____ Date _____

Informed Consent Statement (Teacher Participant)

INFORMED CONSENT STATEMENT (Teacher Participant)

Project: Academic Freedom, Critical Thinking, and the Culture of American Science Education

INTRODUCTION

You are invited to participate in a study about the Tennessee Teacher Protection and Academic Freedom Act of 2012. The purpose of this research is to address the question of how religious, political, and educational ideologies and rhetoric regarding American identity and values inform understandings of the definitions and roles of scientific inquiry and knowledge. This research will also explore how these understandings influence science education policy, curriculum, and pedagogy.

INFORMATION ABOUT PARTICIPANT'S INVOLVEMENT IN THE STUDY

Your participation in this study will consist of an interview (about an hour in length) to be conducted at your convenience. The interview will be audio recorded with your consent.

RISKS AND CONFIDENTIALITY

There are no foreseeable risks in this study. All notes and recordings will be password protected and stored in Karmen M. Stephenson's personal computer until the conclusion of the project. Your identity will not be revealed in any resulting publications of this study.

BENEFITS

Participation in this study is voluntary. You will receive a ten dollar gift card as remuneration for your participation in the study. This study will provide the researcher information about how legislators and teachers perceive, interpret, and participate in the passage and implementation of educational policy regarding the teaching of controversial topics. This information may reveal reasons for the persistence of these debates in public education, and it may offer useful insight for legislators, teachers and teacher educators, education advocates, and the public in pursuing a resolution to ongoing, divisive conflicts in our schools. As a law similar to the Tennessee Teacher Protection and Academic Freedom Act passed previously in Louisiana and several comparable bills are proposed in other states each year, the potential impact of these laws is widespread for children who attend public schools in the United States.

CONTACT

If you have questions at any time about the study, you may contact the researcher, Karmen M. Stephenson, at the Department of Anthropology at the University of Tennessee, at 250 South Stadium Hall, Knoxville TN 37996, via email at kstephe8@vols.utk.edu, or via phone at (865)974-4408. If you have questions about your rights as a participant, contact the Office of Research and Engagement IRB Compliance Officer at (865)974-7697.

PARTICIPATION

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed your data will be returned to you or destroyed.

CONSENT

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Participant's Signature _____ Date _____

I consent to audio recording of my interview.

Participant's Signature _____ Date _____

Appendix D

Interview Guide: Legislator

- Explain your history in the Tennessee General Assembly.
 - What is your political party affiliation?
 - How long and in what roles have you served as a member of the Tennessee General Assembly?
 - What are your primary goals as a member of the Tennessee House of Representatives/Senate?
 - What other education bills did you sponsor in 2011 and 2012, and what education bills have you sponsored since 2012?
- Why did you decide to sponsor/co-sponsor the Tennessee Teacher Protection and Academic Freedom Act?
- Can you explain the meaning of the Tennessee Teacher Protection and Academic Freedom Act?
 - What is the purpose of the law? What problem does the law solve?
 - What impact did you think the law would have in science classes?
 - What do you know about the impact of the law since it was passed?
 - How do you think teachers feel about the law?
 - How do you think students and parents feel about the law?
 - What is your familiarity with similar laws in other states?
- What are your thoughts on the legislative meetings prior to the passage of the law?
 - What were the most informative components of the meetings?
 - What are your thoughts on the statements made by supporters and opponents of the law?
 - Why do you think the American Civil Liberties Union of Tennessee and many college professors opposed the bill?
 - Critics of the bill asserted that the bill would allow for the inclusion of non-scientific content in public school science classes, such as religious theories or “fringe”/”pseudo-science” theories. What are your thoughts on these criticisms?
- Why do you think the bill was so widely supported in the legislature?
- What do you think is the role of the Tennessee General Assembly in science education? What is the role of scientific experts? What is the role of voters and communities?
- What are your thoughts on the topics named in the law? (Biological evolution, chemical origins of life, global warming, and human cloning)
 - In what way(s) is biological evolution controversial? The chemical origins of life? Global warming? Human cloning?
 - How do you think these topics have previously been addressed in Tennessee public schools?
 - How do you think these topics should be addressed in public education?
 - What changes in curriculum need to be made?

- What weaknesses of the theories or alternative theories should be included?
- What do you think are the strengths and weaknesses of science education in Tennessee?
- What is your background in science? What is your background in education?
- Why do you think that teaching evolution remains controversial nearly one hundred years after the Scopes trial?
- What is your religious affiliation, if any? What relation does this have to your work in the Tennessee General Assembly? What relation does this have to your involvement in the Tennessee Teacher Protection and Academic Freedom Act?

Interview Guide: Public School Teacher

- What were your thoughts on the Tennessee Teacher Protection and Academic Freedom Act before it was passed?
 - When/how did you initially become aware of the bill?
 - What were your thoughts on whether the bill should be passed?
 - What impact did you expect the law to have on science education in Tennessee?
 - What impact did you expect the law to have on your job?
 - What impact did you expect the law to have on your students?
 - Why do you think this bill was so popular in the state legislature?
- What impact has the law had so far?
- What is your background in science and education?
 - Describe your science education, both K-12 and post-secondary.
 - Describe your career history. Describe your experience in science education.
- The topics named in the Tennessee Teacher Protection and Academic Freedom Act are biological evolution, the chemical origins of life, global warming, and human cloning. What are your thoughts on teaching each of these topics?
 - In what ways is each topic controversial?
 - How much do you have to teach about each of the topics?
 - How much coverage do these topics have in the state curriculum?
 - How do you feel about teaching these topics?
 - How do your students react to learning about these topics?
 - How do you address student objections to the topics?
 - How do you address parental or community concerns about the topics?
 - How frequently do you encounter objections to teaching these topics? What types of objections do you typically encounter?
 - What was your experience teaching these topics before the new law passed? How have your experiences teaching these topics changed since the law passed?
 - How do you teach each of the topics? What materials and methods do you use?
 - What supplemental materials do you use?
- How well do you think state legislators understand public education in Tennessee?
Science education in Tennessee?
 - How well informed do you think our state's educational policy decisions are?
 - What are the strengths and weaknesses of science education in Tennessee?
 - In what ways could these be addressed by the makers of educational policy?
- Supporters of the Tennessee Teacher Protection and Academic Freedom Act have stated that the law promotes critical thinking and protects teachers who present scientific weaknesses of scientific theories. What are your thoughts on these assertions?

- Opponents of the Tennessee Teacher Protection and Academic Freedom Act have stated that the law promotes the inclusion of non-scientific alternatives, including religious or fringe theories, in public school classrooms. What are your thoughts on these assertions?
- Why do you think that teaching evolution in public schools remains controversial nearly one hundred years after the Scopes trial?
- What is your religious affiliation, if any? What is your political affiliation? How do these relate to your job?

Interview Guide: Private School Teacher

- Describe your awareness of the Tennessee Teacher Protection and Academic Freedom Act.
 - When/how did you initially become aware of the bill?
 - What were your thoughts on whether the bill should be passed?
 - What impact did you expect the law to have on science education in Tennessee?
 - Why do you think this bill was so popular in the state legislature?
- What is your background in science and education?
 - Describe your science education, both K-12 and post-secondary.
 - Describe your career history. Describe your experience in science education.
 - Why did you choose to teach in a private school setting?
- In what ways is the curriculum you teach similar to public school science curriculum? In what ways does your school's curriculum differ from that of public schools?
 - What textbooks and other teaching materials do you use?
 - In what ways is your job similar to that of a public high school teacher? In what ways does it differ?
 - In what ways do you think your science classes are similar to those in public schools? In what ways are your classes different?
 - What do you see as the benefits of teaching in a private school? What are the drawbacks, if any?
- The topics named in the Tennessee Teacher Protection and Academic Freedom Act include biological evolution, the chemical origins of life, global warming, and human cloning. What are your thoughts on teaching each of these topics?
 - In what ways is each topic controversial?
 - How much do you teach about each of the topics?
 - How much coverage do these topics have in the state curriculum?
 - How do you feel about teaching these topics?
 - How do your students react to learning about these topics?
 - How do you address student objections to the topics?
 - How do you address parental or community concerns about the topics?
 - How frequently do you encounter objections to teaching these topics? What types of objections do you typically encounter?
 - How do you teach each of the topics? What materials and methods do you use?
 - What supplemental materials do you use?
- How well do you think state legislators understand public education in Tennessee? Science education in Tennessee?
 - How well informed do you think our state's educational policy decisions are?
 - What are the strengths and weaknesses of science education in Tennessee?
 - In what ways could these be addressed by the makers of educational policy?

- Supporters of the Tennessee Teacher Protection and Academic Freedom Act have stated that the law promotes critical thinking and protects teachers who present scientific weaknesses of scientific theories. What are your thoughts on these assertions?
- Opponents of the Tennessee Teacher Protection and Academic Freedom Act have stated that the law promotes the inclusion of non-scientific alternatives, including religious or fringe theories, in public school classrooms. What are your thoughts on these assertions?
- Why do you think that teaching evolution in public schools remains controversial nearly one hundred years after the Scopes trial?
- What is your religious affiliation, if any? What is your political affiliation? How do these relate to your job?

Appendix E

Data Analysis Codes

- Attribute codes
 - Advocacy group spokesperson
 - Expert
 - Academic expert
 - Private Sector expert
 - Citizen/Parent
 - Legislator
 - Teacher
 - Private school teacher
 - Public School Teacher
- Descriptive codes
 - Political Party
 - Democrat
 - Republican
 - Other
 - Religious Affiliation
 - Christian
 - Baptist
 - Catholic
 - Evangelical
 - Lutheran
 - Mennonite
 - Methodist
 - Non-denominational
 - Presbyterian
 - Not religious
- Teachers
 - Familiarity with Tennessee Teacher Protection and Academic Freedom Act
 - Familiar
 - Unfamiliar
 - Education
 - Education majors/minors
 - Provisional Licensure
 - Other entry to profession
 - Careers
 - Teaching as only career
 - Other careers prior to teaching

- New teacher (<5 years experience)
- Veteran teacher (>5 years experience)

- Provisional Codes
 - Academic freedom
 - Christian nation
 - Common sense
 - Equality
 - Fact
 - Fairness
 - Freedom of religion
 - Human exceptionalism
 - Philosophical naturalism
 - Religious persecution
 - Scientific naturalism
 - Social Darwinism
 - Taxpayer/voter rights
 - Theory
 - Truth

- Second Cycle Codes: Values Codes, Evaluation Codes, Simultaneous Codes, and In Vivo Codes (In Vivo Codes are denoted with *)
 - Adaptation*
 - Answers
 - Anxiety
 - Balance*
 - Basic skills*
 - Beauty of science*
 - Belief*
 - Both sides (two sides, etc.)*
 - Bully*
 - Certainty*
 - Change (change over time; evolution)
 - Change (change in scientific consensus)
 - Christian
 - Common sense
 - Correct/incorrect; Right/wrong
 - Consensus/Agreement
 - Controversy
 - Critical thinking
 - Curiosity *
 - Curriculum problems
 - Debate*
 - Disclaimer

- Dogma*
- Economy (as impacted by educational policy)
- Economy (as impetus for anti-science viewpoint)
- Ethics*
- Evidence*
- Fact
- Faith*
- Fear
- Free Thought
- Gentle; Sensitive*
- Guess*
- Ignorance*
- Indoctrination*
- Information Sources
- Inquiry
- Micromanagement
- Myth*
- Nature of Science
- No clue*
- No textbook
- Opinion*
- Own (their own conclusions; make up their own minds, etc.)*
- Question
- Relationship
- State test
- Support
- Theory
- Time
- Too much content
- Truth
- Unknown
- Worldview
- Third cycle Codes: Axial Codes
 - Nature of Science
 - Understandings of the process of scientific inquiry and of the field of science
 - Anti-science viewpoints
 - Issue frames
 - Frames used by legislators
 - Frames used by educators
 - Perceptions regarding educational policy and practice
 - Perceptions of legislators
 - Perceptions of teachers

Appendix F

Framing in the Anti-Evolution Movement

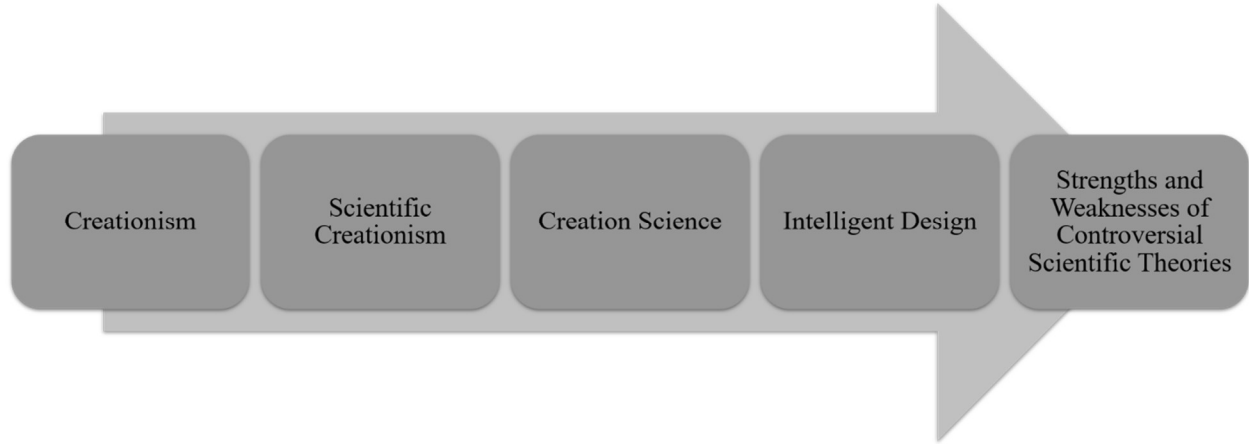


Figure F-1: Frames Employed in the Anti-Evolution Movement, 20th Century to Present

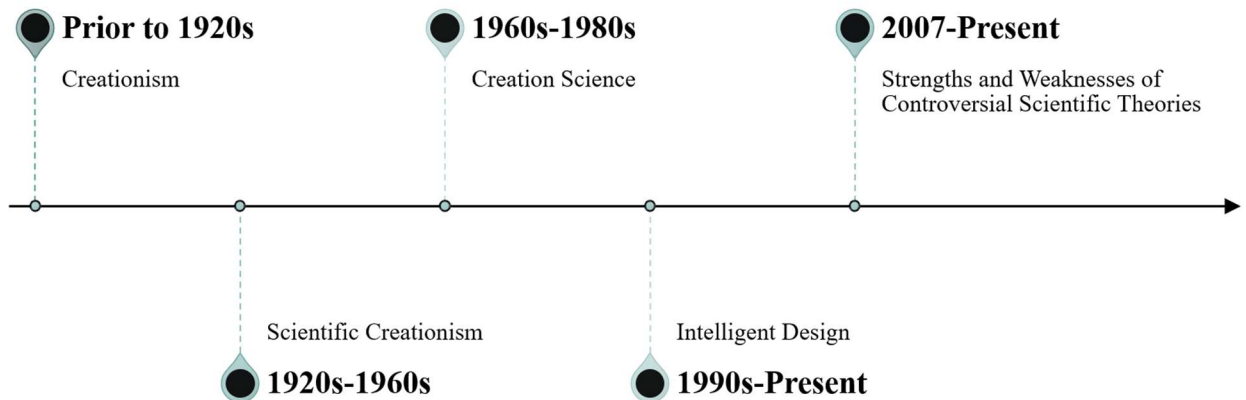


Figure F-2: Timeline of Anti-Evolution Frames, 20th Century to Present

Key Events that Impacted Anti-Evolution Framing

- 1925: Butler Act passed in Tennessee
- 1925: *The State of Tennessee v. John Thomas Scopes*
- 1961: Publication of *The Genesis Flood* by John C. Whitcomb and Henry M. Morris
- 1968: *Epperson v. Arkansas*
- 1973: Genesis Law passed in Tennessee
- 1982: *McLean v. Arkansas*
- 1987: *Edwards v. Aguillard*
- 1991: Discovery Institute founded
- 1996: “The Wedge” produced
- 2005: *Selman v. Cobb County*
- 2005: *Kitzmiller v. Dover Area School District*
- 2007: “Model Academic Freedom Bill” published
- 2008: Louisiana Science Education Act passed
- 2012: Tennessee Teacher Protection and Academic Freedom Act passed
- 2017: Academic Freedom Resolution passed in Alabama

Vita

Karmen Melissa Stephenson grew up in South Carolina, North Carolina, and Florida. She graduated from the North Carolina School of Science and Mathematics in 1999. She attended the University of North Carolina at Chapel Hill and graduated in 2003 with a Bachelor of Arts in Anthropology with a second major in Romance Languages (Spanish). Karmen pursued graduate studies at the University of Tennessee at Knoxville and completed a Master of Arts in Anthropology in 2010 and a Doctor of Philosophy in Anthropology in 2018. She has two premium children, Kathryn Matilda and Lillian Harper.