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Dare We Speak Of It: The Teaching Of Evolution In Private Schools Of An Urban Middle Georgia Setting

Eric J. Thompson

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DARE WE SPEAK OF IT:
THE TEACHING OF EVOLUTION IN PRIVATE SCHOOLS OF AN URBAN MIDDLE
GEORGIA SETTING

by

ERIC JOSEPH THOMPSON

(Under the direction of John Weaver)

ABSTRACT

The purpose of this study was to explore the perceptions, experience, and thinking of teachers at three private schools in Middle Georgia to determine how different private schools approach the teaching of evolution. For this project three private schools were included representing a secular, non-religiously affiliated private school, a Catholic affiliated private school, and an independent, Christian private school. The research was designed to answer one research question and three sub-questions. The primary research question was: How do private schools of the Middle Georgia area teach the theory of evolution? The three sub-questions were (2) Does the type of private school affect the teaching of evolution in private schools of Middle Georgia? (3) Does teacher religiosity affect the teaching of evolution in private schools of Middle Georgia? (4) Does student religiosity affect the teaching of evolution in private schools of Middle Georgia? The project was organized in an embedded, multiple case study format. Each of the three private schools was examined independently before being compared to the other schools. In-person interviews were conducted with a total of twelve individuals from the three participating schools. Most of the interviews were conducted with high school science teachers, but school administrators and theology teachers were included where appropriate. The transcripts were coded and analyzed, looking for themes that were common among representatives of the school

and then themes that presented across all three schools. The theoretical framework that guided this work was that of Worldview, and drew heavily upon the work of Cobern (1991 and 1996), Keaney (1989), and Hansson (2104). Examination of the worldview framework focused on participant religiosity and how the religiosity of the participants impacted their personal worldview. Additionally, the framework examined how personal worldview impacts how the theory of evolution was approached at the participating schools. The results showed that the worldview of each participant did play a considerable role in how evolution was taught in that while evolution was being taught in all three private schools, the method differed considerably from classroom to classroom and school to school.

INDEX WORDS: Teaching, Evolution, Georgia, Private schools, Case study, Multiple case study, Embedded case study, Worldview, Religiosity, Nature of science

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GEORGIA SETTING

by

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B.S., University of North Alabama, 2006

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A Dissertation Submitted to the Graduate Faculty of Georgia Southern University
in Partial Fulfillment of the Requirements for the Degree

DOCTOR OF EDUCATION

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DEDICATION

This dissertation is dedicated first and foremost to my wife, Jessica. Your willingness to stand beside me during this process has been invaluable. I appreciate your patience with my long typing nights, your willingness to make those trips to the library with me, and most importantly, your willingness to help edit my writing. This doctorate would not have been possible without your assistance.

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CHAPTER 1

INTRODUCTION

Nearly 160 years since the 1859 publication of *On the Origin of the Species by Natural Selection*, understanding of evolution has most likely moved far beyond what Charles Darwin could have imagined. Evolution, once taboo even amongst many in the sciences, is now considered the unifying theory upon which much of our biological knowledge stands (Bland & Moore, 2011; Coleman et al., 2015; Holt et al., 2018; Rutledge & Warden, 1999; Sanders & Ngxola, 2009; Schilders et al., 2009; Vaughn & Robbins, 2017). Moore (2009), a biology professor at the University of Minnesota, even stated, “All biology teachers should be grateful to have jobs that involve helping students and others understand the power and beauty of Darwin’s great idea” (p. 72). However, not all teachers would agree with Moore’s sentiment.

Dissent to Moore’s statement is most likely to occur in U.S. schools associated with religion and/or not beholden to government mandate. This applies specifically to private schools, as they are frequently founded on religious charter and they free from most government oversight and funding. Finding private schools located in a more religious place, such as the American South, simply increases the chance these schools have individuals who object to Moore’s statement. For this reason, private schools in the Middle Georgia region were the focus of this project. Accordingly, the aim of this study was to increase understanding of the teaching methods surrounding the theory of evolution in three private schools in Middle Georgia.

Distinctions Between Private and Public Education Settings

In every state in the United States, there are certification requirements for teachers in public schools, and while the requirements differ from state to state, each has guidelines regarding content certification, methods to attain certifications, certification duration, and

professional development requirements for certification renewal. The state educational departments also provide vetted curriculum standards and curriculum guidelines to help ensure the following of mandated state curriculum. If a teacher steps outside of the curriculum requirements, he or she risks termination and potential loss of certification. As a school district, and sometimes as individual schools, there is also a requirement of maintaining at least one accreditation; otherwise, graduates' diplomas can be deemed worthless and college admissions revoked or denied. Examples of public school accrediting groups include AdvancED, the Council for Higher Education, and the Southern Association of Colleges and Schools.

However, private schools are able to operate quite differently. First, there is no universal requirement that teachers in private schools hold certification in any specific content area, much less the class that they are teaching. While many, and perhaps, most private school teachers possess teaching certificates, it is not a universal requirement, nor are teachers universally required to renew a certificate if it expires. Therefore, the maintaining of teaching certification becomes a decision of private school representatives, thus, varying from private school to private school.

Second, there is not a universal curriculum to which all private schools must adhere. The representatives of each private school have the opportunity to choose a curriculum to follow. As mentioned earlier, some undoubtedly choose to follow the state-provided curriculum, whereas others choose alternative, vetted curriculums. Many times, curriculum choices come down to school affiliations and/or the size of the school. More curriculum options and arguably more robust educational experiences usually exist in large schools, simply because the larger quantity of students typically makes for greater access to resources, both through teachers and materials.

However, as surely as some private schools provide extremely high-quality curriculum, there are also schools that provide low-quality or highly questionable curriculum.

Lastly, there is no universal requirement for private school institutions to maintain accreditation. There are many options of accreditation for private schools, including the National Association of Independent Schools, the Independent Schools Association, and the Independent Schools Council, at both the state and national level. However, even with the great variety of options available to them, not all private school representatives will take the time or expend the resources to attain, or maintain, accreditation.

The autonomy from government that private school representatives enjoy makes it easy to see why, in some instances, college personnel and individuals question the validity of private school education, as in the case of *A.C.S.I. v. Stearns* (2008). The concern is that, while many students gain a high-quality education in private schools, other students are hurt educationally in some private schools because of lack of adherence to high standards. Therefore, it is necessary to understand the methods and motivations by which teachers teach at private schools as a means to better understand what kind of education students are receiving.

Background of the Study

Georgia's Educational Standards and Evolution

Effective teaching of evolution in schools is a complex endeavor, and, consequently, does not just spontaneously happen. As with other subjects and topics, teachers begin preparation for teaching evolution by studying prepared educational standards and teaching frameworks. It is an expectation that teachers use these standards and frameworks to guide their planning as they compile activities, labs, and other acts of instruction. This is standard operating procedure within schools, especially public schools. So engrained is this planning process, and the launch point of

educational standards, that major shifts in educational standards often come with intense backlash, most frequently of the political kind.

The political backlash associated with new educational standards can be quite extensive, with the most recent example of major backlash coming from the nationwide discussion of the implementation of Common Core Standards, and its offshoot, the Next Generation Science Standards (NGSS). The merits of Common Core Standards and NGSS are surely a subject of debate, but those discussions are better left for others. However, political backlash quickly occurred with the introduction of Common Core Standards, and more specifically, the NGSS, in Georgia. The contention focused on the science discipline, specifically on the new vigor with which the NGSS called for a more detailed teaching of evolution. In fact, it was the creation of new standards for science, based largely upon the NGSS, in the state of Georgia, and the political storm the new standards created that led to this project. Although national opinion polls (Gallup, 2009, 2017) show a majority of Americans still believe that God had a hand in the creation of man, the position of the scientific community, and thus the formal science standards, is to focus only on that which meets the definition of scientific. From a scientific literacy and nature of science perspective, this approach is the correct method. However, not all teachers, or even science standard writers (many of whom were teachers), agree with the scientific community, which has at times influenced the writing of science standards.

Consider the following:

In the 1980s, dissertations from two doctoral candidates were published (Buckner, 1983; Eglin, 1983) that evaluated how teachers in Georgia approached the teaching of evolution. Lawrence Lerner (2000) examined the findings of these two dissertations, and Randy Moore (2002) subsequently evaluated Lerner's findings. Moore (2002) determined the available data

demonstrated that the science standards for Georgia should receive a grade of F for their treatment of evolution, a dubious distinction that Georgia and 12 other states shared. That same work noted that 29% of teachers indicated they experienced pressure to reduce their teaching of evolution, increase their teaching of creationism, or both. Additionally, about 30% of teachers wanted creationism taught, and approximately 27% of teachers were teaching creationism in spite of the laws (R. Moore, 2002).

Subsequently, the teaching standards for the State of Georgia changed to the Quality Core Curriculum (QCC), which improved the setting the teaching standards for evolution, but still were very rudimentary. Furthermore, while the QCC standards' treatment of evolution received no grade assignment, the assumption was that these standards were little better than their predecessors. Then, just as the Georgia Department of Education (GaDOE) was beginning to move towards a rewrite of the science standards (the upcoming Georgia Performance Standards), Georgia Superintendent of Education Cathy Cox exacerbated the problem of teaching evolution. Moore (2004) summed up Cathy Cox's words as "evolution is a 'buzzword' that should be removed from Georgia's science-education standards so that science teachers can teach 'all legitimate theories,' especially 'intelligent design' to 'ensure that our kids are getting a quality science education'" (p. 860). Thankfully, no one heeded Cox's desires related to evolution education, and the introduction of a new set of science standards, the Georgia Performance Standards (GPS), occurred in 2006, with evolution as one of the five themes to teach in biology classes.

In 2017, the Georgia Standards of Excellence (GSE), constructed in 2015 and implemented for the 2017-2018 school year, replaced the GPS. These new standards drew very heavily from the Next Generation Science Standards (NGSS), which the National Research

Council constructed with the idea of making a common set of science standards to use across the United States. While much within the NGSS was remarkably similar to previous Georgia science standards, there was a complete rewrite to the evolution standards, creating considerably more depth in what educators should teach. This change in the science standards created a political controversy in many portions of Georgia. From many corners of Georgia, politicians mobilized to oppose the new standards, and while the anger might have been as much about perceived government overreach in education as it was about evolution, it focused on the inclusion of evolution within the rewritten teaching guidelines. Some politicians against the concept of evolution in the new GSE advertised, held rallies, and attempted to convince the writers of the standards and the individuals who would vote to accept the standards that the inclusion of evolution was wrong. In the end, the new GSE received approval, but it further proved the schism of opinions related to evolution.

With the implementation of the GSE, public schools all over the state of Georgia were subject to the new expectations. However, implementation of the GSE into public schools fails to tell the entire story of Georgia's educational landscape.

Private Schools in the United States

While Georgia serves as a good example of the existence of private schools, private schools are, of course, not limited only to Georgia. In the biannual *Digest of Educational Statistics* 2013, the U.S. Department of Education National Center for Education Statistics (NCES, 2015) provides the most comprehensive look at private school student population in the United States. Within this digest is a report called the *Private School Universe Survey* (PSS). The July 2013 NCES release of the 2011-2012 PSS officially identified private schools as:

all schools in the 50 states and the District of Columbia that are not supported primarily by public funds, provide classroom instruction for one or more of grades kindergarten through 12 (or comparable ungraded levels), and have one or more teachers.

Organizations or institutions that provide support for home schooling, but do not provide classroom instruction, are not included. (p. 1)

The June 2018 release of the 2015-2016 PSS gave a similar definition of private schools.

Researchers of the 2018 PSS calculated the number of private schools in the United States to be 34,576 and private school enrollments within the United States at 4.903 million students during the 2015-2016 school year. This is approximately 10% of all students in the United States (NCES, 2018). The NCES (2018) also stated that the percentage of students in private schools across the country has remained steady at approximately 10% of students for since the institution of PSS in 1988.

Of the students who attend private schools, the PSS calculations indicated that, in 2015-2016, 23,272 (67.3%) of private schools were religiously affiliated, and 3.834 million (78.2%) of private school students attended religiously affiliated private schools (NCES, 2018). The PSS also determined that 11,328 (32.8%) of private schools were in the American South, making the South home to more private schools than any other region. Following the Southern region were the Midwest (26.0% of schools), the Northeast (22.5% of schools), and the West (18.8% of schools). Furthermore, the PSS showed that the American South accounted for 1.654 million (33.7%) of private school students. Again, the Midwest followed the Southern region at 24.8% of students, succeeded by the Northeast (23.2% of students) and the West (18.3% of students) (NCES, 2018).

Specifically, within the State of Georgia, the GaDOE (2019) recognized a total of approximately 1.6 million public school students for the FY2019 school year. For the FY 2019 year, the Private School Review (2018) showed that Georgia had 867 private schools that serve approximately 155,000 students. Based on these data points, Georgia had a private school population equal to approximately 8.8% of its total student population, a number that is slightly below the average consistently found by the PSS.

Additionally, the PSS (2018) identified 65% of private schools in Georgia as religiously affiliated, compared with the 67.3% of private schools identified as religiously affiliated on a national level (NCES, 2018). Again, Georgia was slightly below the national average for the number of religiously affiliated private schools.

Private Schools in Georgia

Upon implementation of the GSE, private schools across the State of Georgia were immediately exempt from the requirement to teach GSE content. This exemption, which is completely legal, occurs because private school institutions are not subject to the same regulations as public schools, a situation that exists largely due to the difference in funding sources. While public schools receive funding by the government—and thus are subject to their rules—private schools, by definition, do not receive their primary funding from the government (PSS, 2013). Although some private school representatives opted to follow the GSE or a comparable version, others elected to wholly ignore the GSE in favor of some other curriculum that the schools' advisory boards deemed as more appropriate for their students.

The question of how much the curriculum autonomy of private schools matters frequently depends on an individual point of view, as there are many people who argue both for and against the right of private schools to determine the curriculum they will use. Consequently, it is

necessary to focus on the number of students possibly impacted by the curriculum decisions that private schools can make and the processes and structures that private school teachers use when teaching.

To examine the potential impact of private school instruction upon the student population, it is necessary to understand the presence private schools occupy within the education populace. Per the Private School Review (2018), 155,424 students attended 868 private schools within the state of Georgia for the 2018-2019 school year. As previously mentioned, the GaDOE could not directly compel any of those 868 schools to adopt or teach the new GSE, and while some undoubtedly did adopt the GSE, there are assuredly others that did not.

Private Schools in the Falls County Area

Moving closer to the study area, the Private School Review (2018) also provided statistics that 4,735 students attended 1 of 20 private schools in Falls County¹, and 60% of the private schools had religious affiliations. This number is important because it shows that Falls County fell behind only Fulton (152), Dekalb (91), Cobb (85), Gwinnett (63), and Chatham (32) in the number of private schools operating within the county. The fact that Falls County ranks sixth in the state of Georgia for the number of private schools is also important because the U.S. Census Bureau (Georgia Demographics, 2018) estimated that, as of July 2017, Falls County was the 15th most populous county in Georgia. Based on Falls County's population, the expectation would typically be that Falls County would be lower on the list of number of private schools, especially when considering how many counties are of larger population than Falls County.

¹ The name of the county has been changed to protect confidentiality.

The Private School Review (2018) data also demonstrate that the private schools in Falls County are slightly less religiously affiliated than the state average, with the state of Georgia showing that 65% of schools are religiously affiliated and Falls County showing 60% of schools are religiously affiliated. However, 3,313 of the 4,735 (69.9%) students in Falls County attended a religiously affiliated private school, meaning that more than two-thirds of Falls County private school students were getting an education at least partially rooted in religion.

One more important statistic regarding education processes in Falls County is that in the 2017-2018 school year, the public school system served 26,436 students (GaDOE, 2018). Based on the Private School Review (2018) statistic that 4,735 students attended private schools in Falls County, 31,171 was the number of the total student population in Georgia. Accordingly, the private school enrollment of Falls County equaled 15.1% of the total student body.

The Application of Curriculum Studies to This Work

To understand how curriculum studies impact not only the teaching of evolution but also the interaction of religion with science requires an examination of what curriculum studies involve. It is helpful to consider the questions posited by Ayers et al. (2008):

Is the curriculum a mandate or is it learning as it is engaged on the ground? Is the curriculum immutable, or is it a dynamic and a living thing? Is it a course of study, a body of knowledge, a scope and sequence, a set of settled objectives or directives from those who know best? Is the curriculum a political or pedagogical thing? (p. 305)

These curriculum questions are thought provoking, especially in consideration of their implication on interactions between science and religion, for they only serve to begin a discussion of what curriculum studies actually are. Curriculum studies continue beyond these questions by examining a host of interdisciplinary observations and ideas (Ayers et al. 2008,

Connelly et al. 2008; Crotty, 2003; Schubert, 2009), including those observations and ideas that assist in understanding how science and religion engage within the educational space.

Curriculum studies are unique in that they not only investigate historical and current curriculum theories and educational practices, but they also examine how society and culture influence schools, including examining the conflicting and contradictory information, both in and out of the classroom, that students must possess during their educational progression. Ayers et al. (2008) explained, “Education is conflicted—it can be controlling, enslaving, oppressive; it can, as well, be awakening, propulsive, liberating. It depends on what people believe is worthwhile and valuable and on how they act to bring education to life” (p. 313). Stanley and Wise (1990) issued a similar sentiment when they questioned “who can be a ‘knower’, what can be known, what constitutes and validates knowledge, and what is or should be between knowing and being” (p. 26).

Additionally, Ayers et al. (2008) wrote,

School is always contested space, always a site of struggle over what constitutes the truth, the good life, the valuable, and the reasonable, as well as conflict over who is entitled to be counted as worthy of access to it. (p. 307)

These observations beg asking: What knowledge is worthwhile and therefore should be taught? Who gets to decide if a piece of knowledge is worthy of being taught? Why should a particular bit of knowledge be taught and who is worthy of learning the knowledge? Schubert (2009) summarized these questions as “What knowledge is worth knowing, needing, experiencing, doing, being, becoming, overcoming, sharing, and contributing?” (p. 15).

Unfortunately, it is arguable that education has moved away from the goals of understanding knowledge. Weaver (2010) suggested that schools previously strove to create

opportunities for individuals to learn, but that schools are now little more than training sites, seeking to create humans capable of taking assessments that can be used to compare one set of students with another and hold teachers accountable. Weaver (2010) proposed this occurs because education has become a series of steps that teachers are to follow, with the end goal being a specific learning outcome. Further, Ingold and Hallam (2007) postulated that education can become so bound to the execution of a predefined script that it is incapable of responding to the slightest deviation in method. In science education, this “predefined script” is frequently a list of *facts* that students need to *know*, but Weaver et al. (2001) advocated that what science education should do is expose students to how scientists create models, which in turn produce evidence that allows scientists to understand some part of the world in which we live. Weaver et al. (2001) proposed this avenue for science education because teachers and students often live in the illusion that knowledge is static, when they should be attempting to understand and model natural phenomena, which would illustrate that humans cannot *know* all that there is to know in the universe.

Ethics in Religion and Science

Evolution is often a contentious topic between theologians and scientists. While everyone does not perceive the need for this conflict, many who do base their conflict on morality issues. Baker (1999) stated that the intellectual disagreement between religion, especially Protestant Fundamentalism, and Darwinian evolution that existed during the late 1800s and early 1900s was over morality implications. Specifically, many suggested that Darwinism found chance and lack of providence unproblematic morally, while Protestant Fundamentalism feared that the notion of Darwinian evolution might cause humanity to revert to less socially advanced forms or allow individuals to validate “shameful” behavior.

Two philosophers, both beginning their writing careers before Darwin (1859) published *On the Origin of the Species*, advocated for using evolutionary principles to examine human cultures. The first, scientific anthropologist, Lewis Henry Morgan (1818-1881), argued for an inevitability of racism and imperialism as culture evolved from savagery into formal civilization (Fracchia & Lewontin, 1999). The second philosopher, Herbert Spencer (1820-1903) suggested that evolutionary descent led to a cultural hierarchy (Shaw, 1999). Although later declared morally suspect, the works of these philosophers also shaped how individuals examine human culture and how those cultures evolve. While Morgan and Spencer's ideas of Social Darwinism and the racism and colonialism they inspired have now been discredited, anthropologist Franz Boas initially argued against their work (Fracchia & Lewontin, 1999). Boas's efforts succeeded in largely removing Social Darwinist ideas from anthropology during the 1890s and again in the 1970s and 1980s when some anthropologists sought to revive Social Darwinism (Fracchia & Lewontin, 1999). Franz Boas is also an important figure for this work because of his insights on worldview, discussed in Chapter 2.

Despite pointed disagreements over whether Social Darwinism was valid, anthropologists also quarreled over the possibility that human culture could evolve at all (Fracchia & Lewontin, 1999). From these quarrels emerged an entire field of sociobiology, whose members seek to examine if human behavior and the manner in which individuals form our societies are in fact evolutionarily based (Berry, 1999). While some critics maintain that sociobiology is flawed because culture may not evolve along a similar path to biological evolution (Shaw, 1999), the truth is that culture does help to guide what individuals find ethical, especially scientifically ethical (Blades, 2006). Emmanuel Levinas (1906-1995) initially debated this point with his philosophy of ethics, which offered a method to develop an ethical science education (Blades,

2006). Levinas also suggested that education is fundamentally invested in ethics, stating that students are not objects to mold into copies of adults. Instead, adults should teach students to think (Blades, 2006). Gough and Sharpley (2005) further recommended expanding science education in schools because of its ability to shape thinking and ethical considerations. However, Gough and Kesson (1992) suggested remaining wary of allowing science to capitalize on cultural fears, for even science can be corrupted as individuals seek to support the social and economic order that best suits them.

Struggle for Power Between Religion and Science

Power has the ability to manifest in many ways, but Weaver et al. (2001) described two types of power that affect all human knowledge: monetary power and normative power. Monetary power addresses the vast sums of money that has found its way into education, buying influence with curriculum and science professionals, and thus blurring the lines concerning the desired autonomy of scientists (Weaver et al., 2001). Normative power represents a power of legitimacy, scientifically speaking, focusing on who gets credit for discoveries and who is allowed to speak about discoveries (Weaver et al., 2001). These two types of power have exhibited profound influence not just on science but also on religion.

On their own, religion and science are both extremely powerful entities, exerting influence of some capacity on every person in the world. Billions of dollars taken in every year influence both. Furthermore, representatives of both entities claim power—power that resonates through respective *truths*. However, each entity demonstrates a different version of *truth*, with religious *truth* typically based in sacred texts and traditions and scientific *truth* typically based upon study and reasoning. Despite the existence of these *truths*, there is no power if representatives of science and religion cannot teach their viewpoints to others, and when

teaching occurs, a curriculum generally ensues. Additionally, these institutionalized versions of *truth* emit a sense of power that is social in nature, capable of influencing the creation of knowledge, and circular in behavior (Baker, 1999).

Science curriculum is usually easily identifiable because state or national governing bodies typically decree it and subsequently pass it to local educational boards for implementation. However, Weaver (2010) pointed out that religion also has a curriculum, which is expressed both through churches and within schools. It is the potential, and frequent, collision of scientific and religious curriculums that can cause flashpoints. Most religions, including non-Christian ones, advocate for the superiority of “man” above other animals. Snaza and Weaver (2015) suggested that religion often views “man” as the measure of all things, with the implication that “man” is more valuable than any other living organism, complete with a hierarchy that often dismisses viewpoints that do not represent human superiority. This viewpoint, and the teaching of it, is where religion draws most of its power.

Science, specifically evolutionary science, frequently offers a viewpoint that differs from religious viewpoints in its treatment of the role of “man.” Within biological and evolutionary science, humans, simply put, are animals. However, humans are animals with high opinions of themselves that have set themselves apart from other animals. Lemm (2009) explained this separation: “What distinguishes the human animal from other animals is its culture” (p. 1). Weaver (2015) suggested that human culture results from its animal nature to forget, rather than the desire or tendency to remember. Weaver (2015) posited that, like most other creatures of the animal kingdom, human culture is a mixture of partially remembering the past but willing to forget those portions of history that do not have bearing in modernity. The suggestion here is that human culture develops much the same way that other animals establish culture, customs, and

preferences. Therefore, humans are distinctly more animalistic than individuals often claim to be. Weaver's ideas are similar to statements by Snaza (2015) that suggest that until humanity rejects the idea that humans are separate from all other organisms on the planet, humans will not be able to alter their futures. This viewpoint, and the teaching of it, is where much of evolutionary science draws its power. This is also where representatives of religion and science can find themselves engaged in a power struggle as each seeks to influence the knowledge offered to the world at large. Within the public schools, science has a legally enforced upper hand, but in private schools the balance between science and religion can be far more contested, especially with a concept such as evolution.

Positioning of This Work

I position this work to explore the role that curriculum, both religious and scientific, plays in understanding the functioning of select private schools in the Middle Georgia area. Additionally, I intended this work to explore the concept of power over knowledge. At each participating institution, classroom and administrative representatives played an active role in determining what is and is not taught, providing those individuals with an immense amount of power to influence students toward religion or science. Understanding this dynamic can lead to better understanding of the interaction of science and religion in general, thus expanding the knowledge of interrelated curriculums.

Statement of the Problem

Research has demonstrated that many fundamental differences exist between public schools and private schools in relation to educational practices. As demonstrated by the work of Glaze and Goldston (2015), extensive research explores how educators teach evolution in U.S. public schools. However, the methods by which evolution educators in U.S. private schools

teach evolution has gone largely unexplored. Accordingly, the problem examined by this project is the lack of knowledge and understanding in academia as to the methods by which U.S. private school representatives address the teaching of the theory of evolution. Within the larger research problem, this project sought to answer specific questions about the methods of teaching evolution in a secular private school, a Catholic-backed private school, and an independent Christian private school, all located within the Middle Georgia area.

Searches of academic literature repositories for terms related to evolution, creation, and the teaching of each within the classroom yielded vast numbers of articles, reviews, books, and journals. A search for the phrase “teaching evolution in public schools” within academic repositories such as ERIC, Wiley, and JSTOR, returned nearly 160,000 possible matches. Examining the first few pages of the possible match list revealed dozens of unique articles from numerous countries and written in a myriad of languages, all dealing with instructional practices for teaching the theory of evolution in public schools. More specifically, the previously mentioned article review published by Glaze and Goldston (2015) included 213 academic studies, published between the year 2000 and 2014, that met their criteria of “the approach to teaching, attitudes and perceptions, religiosity, and proposed teaching methods, with particular emphasis on evolution teaching and learning” (p. 1). Their research further highlights the incredible interest in studying how educators teach evolution in public schools by illustrating that an average of nearly 15 studies conducted and published every year—a staggering number considering many studies take multiple years to fully complete.

However, the previously cited literature searches turned up only four published articles related to the teaching of evolution in private schools. First was a survey-based study in which the researcher sent surveys to Lutheran secondary school teachers across the country and then

formulated the results from returned surveys (Schulteis, 2010). In another study, Reichard (2016) examined the effect of a “secular” textbook on students attending a religious private school and found that the book had far less effect on the student than the teacher did. A third article included teacher perspectives, acquired through a survey and a small number of face-to-face interviews, from a small number of teachers working in Christian schools in California and Hawaii (Mangahas, 2017). The most recent article, published in early 2019, depicted a government longitudinal study conducted by Cheng to examine how the educational emphasis of science teachers in evangelical Protestant high schools impacted student outcomes. All of these studies were narrow in their scope, and only one presented the participants with the opportunity to interact with the researcher in a personal manner.

The preceding academic article discussion illustrates that little is known about the actual teaching of evolution in U.S. private schools. Therefore, by examining multiple schools and allowing the representatives of those schools to tell their story, this project will help to establish an early foundation for understanding the stance of private schools related to evolution.

Purpose of the Study and Research Questions

The purpose of this study was to explore the perceptions, experience, and thinking of teachers at three private schools in Middle Georgia to determine the approach to evolution teaching and learning in private schools of different backgrounds. The researcher designed the research questions to examine the following concepts: the personal and professional backgrounds of the participants; how they address evolution in the classrooms; and what, if any, controversy the participants have experienced for their methods of teaching related to evolution. The primary research question was:

1. How is the teaching of evolution approached in private schools in one county in Middle Georgia?

To help answer the primary research question, a series of secondary research questions were explored:

2. Does the type of private school impact the teaching of evolution?
3. Does teacher religiosity impact teaching of evolution in private schools of Middle Georgia?
4. Do perceptions of student religiosity impact the teaching of evolution in private schools of Middle Georgia?

Context of the Study

Acceptance of the theory of evolution within the regular, nonscientific populace of the United States is not as universal as one might expect in the modern, Western-ideology society (Alters & Nelson, 2002; Goldston & Kyzer, 2009; Griffith & Brem, 2004; Hermann, 2012; Moore & Cotner, 2009; Moore et al., 2009; Nehm et al., 2009). Some researchers have suggested that the United States stands in contrast to other developed countries during discussions of the acceptance of evolution (Coyne, 2012; Gervais, 2015; Hermann, 2012; Infanti & Wiles, 2014; Levesque & Guillaume, 2010; Manwaring et al., 2015; Mazure, 2005; Miller et al., 2006). This is also evident in that fact that secondary and postsecondary age students in the United States are accustomed to examining topics like evolution that present religious or scientific controversy for some (Borgerding et al., 2017; Glaze et al., 2015; Longest & Smith, 2011; Winslow et al., 2011).

One specific example of the perceived controversy toward evolution that exists between religion and science in the West is a survey of 2,000 adults in the United Kingdom conducted by the British Broadcasting Corporation (BBC, 2006). Participants identified what they believed to

be the best description of the origin of life on Earth. Survey results revealed that 17% of participants chose intelligent design, 22% chose creationism, and 48% chose evolution. The same survey found that 69% of participants agreed with teaching evolution in the science curriculum, but 40% also supported teaching creationism.

Similarly, a long-running Gallup poll, last updated in May 2017, has sought to identify American views on the origins of human beings by asking participants to pick between the same three phrases: (a) *Human evolved with God guiding*, (b) *Humans evolved, but God had no part* (c) *God created humans in present form*, or (d) *no opinion*. The first stage of this poll, taken in 1982, revealed that 38% of participants chose option *a*, 9% chose option *b*, and 44% chose option *c*, and the remaining participants had no opinion. The most recent poll data, again from May 2017, showed that 38% chose option *a*, 19% chose option *b*, and 38% chose option *c* (Gallup, 2017). The percentages have fluctuated within a fairly tight range over the years, with the only category to make a consistent rise being the option that humans have evolved, but God had no part. The Gallop poll is important because it illustrates that, as late as 2017, nearly 80% of Americans believe that God has played a part, or the whole, in the development of humans. The data demonstrate that if individuals seek to make evolution entirely about human evolution, or even to begin discussion of evolution from the mindset of human evolution, the risk of alienating many Americans is quite high. If educators approach teaching evolution with an initial emphasis on human evolution, then understanding of evolution in general, including its many nonspecific human evolution parts, is at a disadvantage with many Americans.

A separate Gallup poll (2009) examined belief in evolution based on education level and age. Results supported the work of Mazur (2005), which indicated that the higher a person's education level the more likely the person was to accept evolution. The poll data showed that

only 40% of Americans believed in evolution, but the more education a person had, especially in the sciences, the more likely the person was to accept evolution. From an age standpoint, data revealed that individuals between 18 and 34 years old were more likely to believe in evolution (49%), while those over the age of 55 were the least likely to believe in evolution (31%). The poll data also indicated that the more an individual attended church, the less likely that person was to believe in evolution (Gallup, 2009).

Still another poll, this one conducted by Zogby International in 2006 for Discovery Institute, found that 77% of Americans “agree that when Darwin’s theory of evolution is taught in school, students should also be able to learn about scientific evidence that points to an intelligent design of life (Crowther, 2006, para. 5). Even though a group that championed intelligent design commissioned the Zogby poll, the results were similar to those found by Gallup and Pew Research. The finding from these polls are significant for the understanding of evolution acceptance because they illustrate how many different aspects of American culture, both non-manipulatable (age) and manipulatable (education level, church attendance), impact how individuals approach evolution and their views on how it should be taught to students.

The researcher conducted this project in Middle Georgia, which is not only in the American South, a geographic area known for its strong religious leanings (Glaze et al., 2015; Goldston & Kyzer, 2009; Johnson et al., 2016), but the schools were also located near a city with one of the highest number of churches per capita of anywhere in the United States (New Georgia Encyclopedia, 2017). Stoet and Geary (2017) found that, on average, a country with a populace possessing a high level of religiosity evidenced lower achievement scores in science and mathematics when compared to other countries. Stoet and Geary (2017) analyzed poll data that measured religiosity, science literacy, and mathematics from over 70 countries. The data for the

United States showed that, while achievement in mathematics and science did not regress, it did progress at a slower rate than most countries. Stoet and Geary (2017) concluded, “National levels of religiosity are strongly related to national levels of educational performance” (p. 77), and they cautioned against trying to read too much into their work, they firmly believed that time spent on religious activities could affect the secular education of that country.

The research literature also illustrates that some teachers question the methods and validity of teaching evolution. One example was a survey of science teachers in Florida by Fowler and Meisels (2010), who found that 74% of teachers were comfortable with the inclusion of evolution in Florida’s new science standards, but 20% were uncomfortable with evolution’s inclusion. Additionally, 72% of teachers believed evolution to be a unifying principle, while 17% of teachers believed that a person could understand biology without learning about evolution at all. Lastly, survey results showed that 66% of teachers disagreed that a belief in God means rejecting evolution (Fowler & Meisels, 2010).

Levesque and Guillaume (2010) discovered possible connections between acceptance or nonacceptance of evolution and religiosity, gender, and opinions of evolution. More specifically, Deniz et al. (2011) found that religiosity and acceptance of evolution were related in pre-service teachers. Projects by Hermann (2016) demonstrated that some teachers are hesitant to accept evolution regardless of individual religiosity.

Overview of Methods

This project drew upon multiple forms of data. Initially, the researcher gathered historical information on each school. Next, the researcher gathered data about the types of science texts used at each school and each school’s average pass rate on the AP (advanced placement) biology

exam. However, most of the data for this project generated from face-to-face interviews and researcher field notes.

At each of the participating institutions, the researcher sought an interview with the principal/head of school and life science teachers who were currently teaching biology or had taught biology in the last three years. At religious private schools, the researcher sought an interview with a theology teacher. Each of the interviewed individuals participated in an informed consent interview and received confidentiality for their responses. In order to ensure confidentiality, each interviewee picked a pseudonym from a list of approved pseudonyms. The researcher then referenced interviewees only by the chosen pseudonyms.

The researcher recorded all interviews using a digital audio recorder. At no point was a device capable of recording video used for the interviews. Finally, the researcher asked all interviewees the same set of questions, then follow-up questions based upon the answers and thus, specific to each interviewee.

A third-party, professional transcriptionist transcribed the interviews. By not allowing the transcriptionist to know any information about the interviewees except their chosen pseudonym, the researcher was able to maintain participants' confidentiality throughout the transcription process.

After transcription, the researcher coded the interview responses and then examined the codes utilizing two methods. The first method of examination was to look for commonalities and differences between the participants of each school. By initially examining in isolation the commonalities and differences found amongst the participants at each school, it was possible to acquire an understanding of that school's overall stance toward evolution. The second method of examination was to look for commonalities and differences that existed amongst all three private

schools. The second method allowed for examination of the larger picture, allowing for the beginning of comparison to other private schools and a loose contrasting with public schools.

Significance of the Study

Studies of the teaching of evolution in public schools are quite plentiful (Glaze, 2015), but less so in private secondary and postsecondary schools. The types of educational institutions that serve as sites of the studies matter because private institution representatives, often operating outside the bounds of government curriculum oversight, typically are able to determine for themselves what is and is not taught. This option gives them wide latitude to avoid those topics that school overseers, administrators, and, potentially, teachers deem to be controversial. One such topic that some private schools choose to not teach or diminish is the teaching of evolution.

Given the importance of evolution to biological understanding, it is reasonable that a large body of literature would exist examining the degree and fidelity of evolution instruction. However, the distribution of literature is skewed overwhelmingly toward public schools, with scant few publications addressing how private schools address evolution. The lack of research concerning private schools and their teaching of evolution is distressing, especially when considering the statistics provided by Schulteis (2010) and supported by the NCES (2018) indicating 5 million students across the United States attend private schools.

The lack of research concerning private schools is likely based on two phenomena. First, even though there are approximately 5 million private school students, their number represents only 10% of total students (NCES, 2013), perhaps leading researchers to allocate resources to other areas. Additionally, because leaders and teachers at private schools can decide their own curriculum, there is significantly less standardization, potentially making it more difficult for

researchers to observe teaching phenomena that can be discussed in broad terms within the literature. Since the data demonstrate no decrease in the number of students in private schools, it is necessary to inquire if there is knowledge of how private school administrators and instructors address evolution with these students. While it was impossible for this project to fully address every facet of the private school and evolution debate, by gathering information from three different types of private schools, it is possible to confirm expansion of the base knowledge.

The Coming Chapters

The second chapter of this work explores the relevant literature. The chapter begins with an examination of worldview as the theoretical framework for this project. Next the chapter explores the effects of religiosity, both teacher and student, on the teaching of evolution, followed by examining the acceptance versus understanding of evolution and the compatibility of science and religion. The chapter then moves to Lipsky's (1980) concept of street-level bureaucrats and how teachers exhibit the characteristics of said bureaucrats. Next is an examination of the positions on evolution held by some Christian groups and Christian religious denominations. The discussion focuses on young Earth creationists, progressive creationists, theistic evolutionists, and intelligent designers, as well on the official positions of the Catholic Church and the Presbyterian Church. The discussion then turns to an examination of the previous research related to private schools and evolution. Despite the limited amount of existing research, it is still possible to glean some important insight into private school protocols for teaching evolution to their students. The chapter then concludes with an examination of three court cases that directly impacted the teaching of evolution and creation in private schools.

Chapter 3 provides a discussion of the research methodology utilized in this work. Included here is an explanation of the reasons for using interviews to collect data and the

rationale of selecting an embedded case study format for the research methodology. Also included is a discussion of the data analysis techniques employed, which involved analysis of interviewed participants in each school as a separate and independent case study before examining the collective information as a larger case study.

Chapter 4 houses the case studies from each of the three private schools. In each case study, the researcher combined historical information and curriculum information with the participant interviews to create an overall understanding of the approaches for teaching evolution in each school. The researcher compared information from the schools only after participants in all three schools had independently explained their methods and rationale for how they deal with teaching evolution.

Chapter 5 presents the conclusions of this work. Additionally, the researcher addresses the limitations of the work, as well as the implications for the teaching of evolution in private schools. The chapter concludes with suggestions for future research pertaining to this topic.

CHAPTER 2

REVIEW OF LITERATURE

Research into the teaching of evolution is not a new concept. Research conducted by Glaze and Goldston (2015) cited 213 works related to the teaching of evolution published in the years 2000-2014. Since their work, the publication of more articles, research papers, and the occasional dissertation has continued to expand the vast knowledge of information related to the topic of teaching evolution. However, the number of research projects relating directly to the teaching of evolution in private schools is sparse. Even so, the lack of research that directly examines the teaching of evolution in private schools does not mean that research relevant to the topic does not exist. On the contrary, information that matters to this project abounds, and it is essential to gaining any understanding of this complex issue.

Most important to understanding how teaching evolution in private schools occurs is understanding the role of worldview (also the theoretical framework for this project) and the role of the Nature of Science (NOS), and how it impacts the understanding and examination of evolution and creationism. A second critically important aspect is how religiosity affects the teaching and understanding of evolution. Third, among the most important aspects is the role that location, known as *significance of place*, plays in how teaching and learning of curriculum occurs. Following these three aspects is a need to understand four other topics: (a) how teachers, even in private schools, act as street-level bureaucrats, (b) how major religions and denominations view evolution, (c) what court cases have been adjudicated that directly relate to the teaching of evolution and/or creationism in private schools, and (d) what the previous research related to private schools and the teaching of evolution revealed.

Theoretical Framework

History of Worldview

Worldview comes from the German word *Weltanschauung*, used first by Immanuel Kant (1724-1804) in 1790 to reference a person's sense perception—how one sees the world (Cobern, 1991). Johann Fichte (1762-1814), a student of Kant's, and Fredrick von Schelling (1775-1834), a colleague of Fichte, adopted the word and began to adjust its meaning to be less sense perception and more intellectual perception—how one understands the world (Cobern, 1991). In the early 19th Century, the meaning of *Weltanschauung* became the overall concept of human experience and reality rooted in our life experiences (Wolters, 1989). By the 20th Century, Wilhem Dilthey (1833-1911) suggested that everyone has a *Welbild*, a pre-theoretical, implicit world based upon the world in which a person lives (Holmes, 1983). Further, one's *Welbild* provides the foundation upon which to construct a *Weltanschauung*, allowing a person to explain the mysteries of life. The work of Dilthey inspired Franz Boas (1858-1942), who possessed a love of natural sciences and interest in studying processes of inquiry. The work of Boas began the examination of the impact of science on the sociocultural environment (Kearney, 1984).

As the use of *Welbild* and *Weltanschauung* continued to evolve, Kok (1988) coined the phrases *lived worldview* and *articulated worldview*. Lived worldview describes the communally shared, epistemological macro-framework of daily life, or *Welbild*. Articulated worldview describes a process that is more akin to philosophy, religion, and ideology, or *Weltanschauung*. Understanding lived worldview and articulated worldview is important, especially for educators, because, although ideally the two worldview ideologies would be separate, more and more frequently the two are becoming blurred in many cultural settings (Cobern, 1991).

Worldview as Individual Reality

Worldview represents how an individual perceives the world that he or she lives in, shaping his or her thoughts, habits, beliefs, actions, and numerous other behaviors (Kearney, 1984). Anthropologically, worldview refers to the organization of the mind, and it is composed of the assumptions that predispose individuals to how they feel, think, and act. Worldview underpins rationality, affecting the explanations and justifications used to explain actions, inclining individuals to a particular way of thinking (Cobern, 1991). Additionally, as individuals continue to interact and act upon the cultural influences that exist in their lives, their worldview becomes further reinforced and, over time, becomes the normative value to judge everything they encounter (Cobern, 1991).

Worldview is not something individuals are born with; rather they develop their worldview over time. Worldview, born out of people's need to relate to the world around them, forms from physical and social interactions (Cobern, 1991). As children, individuals imitate and often believe that which their parents believe, approaching things in the same way they do. However, as they grow older, their worldview continues to evolve, adjusting to accommodate all the things they learn. Nevertheless, comprehensive change of their worldview from that of their childhood is exceedingly difficult because it may require a full shift of their mindset and potential abandonment of everything previously held dear (Cobern, 1996).

Both religion and formative education contribute to worldview. Religion is unique in that it both shapes worldview and is shaped by worldview (Cobern, 1991). This occurs because religion, and the morals, values, and expectations it teaches, can profoundly influence those who adhere to the religion. However, religious doctrines do not solely determine worldview; it is how a person interacts with and practices said doctrine (Cobern, 1991).

Additionally, the community at large is also able to impact what religion teaches by influencing the collective doctrines that individuals carry within them into the religious institution (Cobern, 1991). Formative education influences worldview by exposing individuals to new experiences and ideas that may cause those individuals to augment their own worldviews. It is important to note that the concept of formative education does not typically focus on trying to prove or disprove religion or an individual worldview. However, by systematically exposing individuals to new ideas, the chance that worldview shifts, at least partially, is substantial (Cobern, 1991).

Some suggest that science itself has a worldview; however, the more accurate statement might be people can have a scientifically compatible worldview (Cobern, 1996; Hansson, 2014). Science is purported to be based upon testable results, not presuppositions. As such, although science and worldviews can both develop, evolve, and change, the two do not represent synonymous entities. Remembering that worldview is a human epistemological macrostructure furthers this separation, and it has been argued that humanity likely does not want science functioning as a lens through which individuals view all of their experiences (Cobern, 1991). Rather, by having a scientifically compatible worldview instead of a scientific worldview, individuals are capable of effectively interacting and understanding scientific concepts without having to deal with science as the premise for all we do (Hansson, 2014).

The Rise of Intelligent Design

Over the decades since Darwin's (1859) introduction of evolution, there have been countless attempts to continue teaching creationism in science classrooms. Court case judgments have repeatedly struck down any law that formally brought creation into the science classroom, but a newer and better organized attempt at teaching an alternative to evolution has attempted to

enter science classrooms. This version is known as intelligent design (ID), often billed as *creation science*.

Arising in the mid-1990s, ID was the brainchild of a group called the Discovery Institute. Located in the state of Washington, the Discovery Institute still operates and advocates nationally for their ideas on ID. Campbell (2003) asserted that advocates of ID declare it to be a science, philosophy, and vehicle of education reform. Advocates of ID also argue that “by keeping students ignorant not just of creationism and conservative religion but of liberal ways of integrating science and religion, science education nurtures a secular mentality and profoundly biases the thinking of students” (Nord, 2003, p. 54). The view that students in science classrooms need to be taught alternatives to evolution, namely viewpoints based around a religious deity as a creator, are at the heart of the movement for ID. Thus, the question is, what supposedly makes ID different from regular creationism? Furthermore, what supposedly makes it capable of being taught in science classes?

In developing the concepts of ID, the Discovery Institute made a few key changes to the presentation of creationism with the hopes of the acceptance of ID into the traditional science curriculum. One of the first changes made was to drop any reference to a specific deity, focusing instead on an anonymous designer being the individual behind creation (Ravitch, 2011). The second change, was to relabel the ideas as creation science and propose consideration of the ideas alongside evolution, arguing that creation science could fill the gaps left behind by evolution (Ravitch, 2011). The problem with treating ID as a scientific theory is that ID does not meet the standards of NOS any more than traditional creationism does. Bear in mind that ID still advocates for a supernatural explanation to species change. Also, remember what Ravitch (2011) stated: “Scientists try to prove or falsify an underlying hypothesis as well as the question it

raises. Frequently new data begets new questions. The key is that scientists generally try to prove or falsify a hypothesis, not just prove it” (p. 24). When considering creation, it is necessary to remember that although everything has a beginning, rarely is anyone there to document that beginning, and even more rarely does said observer understand what is occurring and document the event. Accordingly, it is virtually impossible to test creation by scientific standards, and therefore, individuals must resist the temptation to equate creation as a science.

Evolution, on the other hand, has been able to withstand the scrutiny of scientific protocols. Perhaps the most frequently tested evolutionary concepts are forms of Lamarckian evolution and a manipulated version of natural selection, with regular experiments to test how camouflage, behavior, and other physical or intellectual attributes impact an organism’s ability to survive. However, in the conducting of each of these experiments, the researchers employed the nature of science to determine the methodology and evaluate the results.

There are also examples of the nature of science found in approaches used to test the accuracy of existing phylogenetic trees. One such example was a discovery made by University of California, Berkeley ornithologist Rauri Bowie and several other researchers. Announcing their findings in 2008, the researchers had examined the DNA from 169 species of non-songbirds. The results were said to nearly rewrite the known evolutionary history of birds (Sanders, 2008). The researchers made some key discoveries and discussed their work in such a way that one can easily see the use of the nature of science as the team worked. As a part of their work, the team acknowledged that previous bird ancestry was typically based upon morphology. However, the new genetic testing allowed the researchers to determine which birds were related to each other on a genetic basis instead of appearance, causing the researchers to proclaim that “much of bird classification and conventional wisdom on the evolutionary relationships of birds

is wrong” (Sanders, 2008, para. 13). Additionally, the researchers noted, “These are just simple examples of how people are going to have to rethink the behavioral characteristics that have evolved” (Sanders, 2008, para. 11) and “the study has raised as many questions as it has helped to solve” (Sanders, 2008, para. 11).

The University of California, Berkeley research project is a good example of how the nature of science can be found in evolutionary science that is not natural-selection based. By simply looking back at the five tenets mentioned earlier it is possible to identify three that directly correlate to the Berkeley project. Those three tenets are (a) experiments have a role in science, (b) science cannot answer all questions (and therefore limited in its scope), and (c) scientific knowledge is tentative but durable. The researchers obviously felt the need to conduct a new experiment, this time genetically based, in order to answer their questions about bird ancestry, and by doing so, they validated the first tenet. The scientists also acknowledged that their research created as many new questions as it answered, thereby validating the second tenet. Lastly, the classification system for birds prior to the genetics experiment made sense and stood up to scrutiny until the researchers completed the genetic testing. Then, with the new evidence in hand, the accepted thought on birds needed to change. The process of change followed the third tenet of knowledge being tentative but durable.

To conclude the examination of the teaching evolution and creation in the science classroom, it is important to remember the role the nature of science plays in determining what science is. In order to consider a concept as valid for the science classroom, the concept must be able to meet some of the tenets of the nature of science. When considering the concept of creation, it is necessary to realize that, while everything has a moment of creation, it is impossible to test when that moment of creation was or to otherwise conduct examinations

meeting nature of science specifications. When considering the concept of evolution, the literature reveals there are research projects related to broad evolutionary concepts and specific questions with evolutionary impacts that do meet the nature of science specifications.

Accordingly, while evolution and creation both have their supporters, educators should only teach evolution in the science classroom.

The Effects of Religiosity

When trying to determine why there is a perceived conflict between the scientific theory of evolution and religious understandings of creation, it is necessary to understand why some individuals are so adamantly against evolution. Few religious individuals would argue that some degree of biological change has occurred in our world, but many of those individuals do question how much evolution has occurred and by what mechanism (Strobel, 2004). Strobel (2004) discussed an interview with Dr. Jonathan Wells, an ID advocate, in which Dr. Wells described evolution as a theory that claims all living creatures come from a common ancestor and that Darwinism claims every new species can be described by descent with modification.

This statement illustrates the obstacle many religious individuals experience: rationalizing their faith and an acceptance of evolution. While many scientists can give extensive discussions on the validity of evolution, the truth for a large portion of the American populace is the degree to which a person accepts evolution seems to have a high correlation to where the individual grew up; if the individual was religious, specifically Christian; what type of school the individual attended; and what his or her teachers believed. These influencing factors, collectively representing a person's religiosity, greatly shape the thoughts and understandings that many individuals have towards scientific concepts, especially evolution.

To better understand what religiosity is, Nadelson and Sinatra (2009) defined religiosity as “an individual's level of religious commitment” (p. 493). Additionally, Nadelson and Sinatra (2009) identified numerous variables that significantly affect an individual's acceptance of evolution, including academic experience, level of education, number of college level biology courses taken, and the individual's religiosity. Individual religiosity typically focuses on whether or not the individual is religious, what religion or religious denomination the individual belongs to, and how devout the individual is to that religion. It is also important to remember that religiosity is typically socially constructed and observable in a geographic area (Glaze et al., 2015; New Georgia Encyclopedia, 2017; “South Has Most Churches Per Capita, But Fewer Choices,” 2002), with teachers (Berkman et al., 2008; Bland & Moore, 2011; Deniz & Donnelly, 2011; Holt et al., 2018; Moore, 2004; Schulteis, 2010), and with students (Bland & Moore, 2011; Campbell, 2003; Holt et al., 2018; Schilders et al., 2009).

Significance of Place and Religiosity

Individuals living in the United States tend to have a fairly high religiosity (Pew Research Center, 2020), but religiosity is not equally spread across the United States. Religious individuals all over the United States, but a higher than average concentration of religious individuals resides in the Southeastern United States (Numbers & Stephens, 2017). Many research projects suggest this concentration of religious individuals impacts educational outcomes. Glaze et al. (2015) pointed out that the Southeastern United States, which has a large percentage of the population identifying as biblical literalist, is a unique region that has consistently defied court rulings on the teaching of evolution and creation. Further, Numbers and Stephens (2017) stated, “No region in the world has won greater notoriety for its hostility to Darwinism than the American South” (p. 5). Glaze et al. (2015) also suggested that the high number of biblical literalists in the

Southeastern United States may have a dramatic impact on the science education that students receive, with the prevailing thought being that students receive less evolution education than comparable students in other portions of the United States. Accordingly, it is possible that where a person lives will have some impact on the religiosity of that individual.

After examining the literature regarding the effects of religiosity inside the classroom, two aspects clearly merit consideration. The first is the religiosity of the teachers. The second is the religiosity of the students.

Teachers and Religiosity

Teacher religiosity can have an enormous impact on student exposure to evolution. Examining how students are exposed to ideas on evolution and creation within their schooling experiences offers valuable insights. Teacher religiosity usually begins as it does with the students. Teachers attend church services, often from childhood, and develop their religious beliefs. The difference between teachers and students is that teachers have had the time to grapple with what their religious beliefs are. For some individuals, their religiousness will disappear gradually (Lovely & Kondrick, 2008). Others will find their religiousness has strengthened to the extent that they cannot entertain any outside ideas (Lovely & Kondrick, 2008; Moore et al., 2009; Taber, 2017). Another group of individuals will struggle with different religious and scientific concepts and reach a decision that lies in-between what the most ardent for or against religion believe (Lovely & Kondrick, 2008; Taber, 2017).

While individual religiousness is up to each individual, ideally teachers, as professionals, are capable of separating their personal feelings and perspectives from what occurs within the classroom. A 1991 lawsuit, *Pelozo v. Capistrano Unified School District*, sought to ensure the separation of personal feelings and perspectives from state-approved curriculum by decreeing

that public school teachers could not deny an education in evolution because it conflicted with the religious beliefs of the teacher, nor could the teacher share his or her beliefs with the class (Hermann, 2017). Given the adjudication of the lawsuit in 1991, the state department of education should have implemented the resulting policy changes within a few years. However, research since 1991 reveals teacher religiosity of the variety that *Peloza v. Capistrano Unified School District* sought to eliminate still, in fact, exists in schools.

Glaze and Goldston (2015) found teachers teach topics that align with their personal perceptions, and the primary reason for omission or undermining of evolution is due to teacher perceptions. Deniz and Donnelly (2011) found that teacher acceptance or nonacceptance of evolution most influences the way educators teach evolution. Moore (2004) found high percentages of teachers either teach creationism, do not teach evolution, or teach evolution poorly, and that the primary factor was the religious beliefs of the teacher.

Holt et al. (2018) cited secondary education in particular when they determined that teachers in the United States present evolution as lacking credibility as much as 40% of the time. Schulteis (2010) found teachers at Lutheran schools held many of the same opinions as teachers in nonprivate school settings. Some teachers believed evolution was a foundation of biology, while other teachers believed the concept too controversial to address in its entirety, instead focusing on pieces of the theory.

A few research projects have provided statistical information about the teaching of evolution and creation in science classrooms. Bland and Moore (2011) detailed a study in Arkansas public schools where 72% of surveyed teachers stated they taught only evolution, while 24% said they taught both evolution and creation, and 4% said they taught neither. Bland and Moore (2011) also found 27% of teachers felt teaching creationism does not inappropriately

bring religion into the classroom, whereas 38% said it would illegally bring religion into the classroom. Additionally, Berkman et al. (2008) found 59% of the teachers surveyed taught evolution for three or more hours a year, but only 17% of the teachers surveyed covered human evolution at all. Berkman et al. (2008) also showed that 25% of teachers taught creationism for at least one hour during the school year.

The evidence related to religiosity and teachers is quite clear. A sizable portion of the science teaching population appears hesitant to teach evolution with fidelity, seemingly content to omit or downplay evolution. This problem may explain why so many researchers focus on trying to make pre-service teachers more at ease with teaching evolution.

Students and Religiosity

A challenging aspect for teachers of life sciences and evolutionary theory is determining how to deal with a student's religiosity and still accomplish appropriate teaching of evolution. Many state educational standards require the teaching of evolution in public schools. However, Baker (2013) reported,

The influence of religious identity on educational trajectory and selective perception presents unique challenges for evolution. Addressing these topics in a manner perceived as an attack on creationism, and therefore religion, is likely to strengthen prior convictions of the faithful. (p. 226)

To reach students who begin with less accepting views of evolution, teachers need to understand their students and the students' worldviews. When discussing the perceived controversial nature of evolution, Schilders et al. (2009) stated, "Claiming that biology education should only deal with evolution and not with students' religious worldviews ignores these difficulties and will not contribute to their conceptual understanding of evolution" (p. 115).

Aflalo (2018) echoed this finding, suggesting that teachers will need to continue to work to understand the beliefs and positions of their students if the students are to be reached effectively. Campbell (2003) reiterated the findings of Schilders et al. (2009) in that students who do not believe in evolution are unlikely to gain a belief in it unless the teacher connects with the student and explains evolution based on the characteristics of the Nature of Science.

In attempting to identify the primary source of the religiosity that students have, Winslow et al. (2011) found students' primary exposure to non-evolutionary ideas were from their parents and their churches. The result is that an individual's belief system most strongly forms when the individual is young, and the beliefs are frequently a direct result of the culture in which the individual is raised. Therefore, if the individual forms a belief system that is accepting or hostile to the theory of evolution when young, the individual is less likely to change that belief later (Goldston & Kyzer, 2009). The implication is if parents possess a high religiosity and vocalize against the theory of evolution, then their children tend to be far less receptive to evolution. Consequently, when students' religiosity is high, their knowledge of evolution is generally lower than other students, and their acceptance of evolution is lower still (Moore et al., 2009).

Holt et al. (2018) arrived at the same conclusion, stating that students who perceived little conflict between evolution and their personal worldview were, typically, more knowledgeable about evolutionary science than their peers who did see a conflict. Further, the stronger an individual's religiosity, the less likely the individual is to accept evolution in any form. This is similar to Nadelson and Sinatra's (2009) statement that "the strong association between acceptance of evolution and belief systems makes individual attitudes toward evolution resistant to change" (p. 492). However, some evidence suggests students with high religiosity "are more positive toward the individual tenets of evolution than to the general statement of evolution. One

explanation for this finding is that students may hesitate to self-identify as evolutionists” (Ingram & Nelson, 2006, p. 17).

Given the importance of student religiosity to whether or not students are willing to learn about evolution, it is important to examine research into how students perceive evolution. After surveying students in Arkansas, Bland and Moore (2011) found that students perceived they received instruction in evolution at a far lower rate than the teachers felt it was being taught. Only 36% of students surveyed said they received instruction in evolution, while 42% of students said they received instruction in both evolution and creationism, 3% stated they received instruction in only creationism, and 20% felt they did not receive instruction in evolution or creation.

Moore et al. (2009) polled a different set of students and found that 62% received instruction in evolution only; 22% received instruction in evolution and creationism; 13% received instruction in neither one; and 3% received instruction in only creationism. Moore et al. (2011) published similar percentages. The key point from these survey results is that either students incorrectly perceive their teachers are teaching them creationism, or students are receiving substantially more instruction about non-evolution topics than teachers are willing to admit. It is also possible that student religiosity blinds some students to what teachers are teaching them in the classroom, causing the students to focus on the moments when the instruction satisfies their worldview, and leading to an overstatement of non-evolution teaching.

Acceptance versus Understanding of Evolution

Upon establishment of an individual’s worldview, augmentation of the worldview becomes extremely difficult. This is especially true if the new ideas derive from ideas not originally included with the worldview. For many individuals, evolution is such a situation,

leading many researchers to wonder if it is more important for individuals to *understand* evolution or *accept* evolution (Deniz & Donnelly, 2011; Glaze et al., 2015; Ingram & Nelson, 2006; Manwaring et al., 2015; Moore et al., 2011; Nehm & Schonfeld, 2007; Taber, 2017; Winslow et al., 2011). At its core, *understanding* evolution is about ensuring students know enough about evolution to accurately relay their knowledge for a desired period of time (Glaze et al., 2015) or recognizing “evolutionary theory to be the most powerful contemporary problem-solving tool at the disposal of the biologist” (Winslow et al., 2011, p. 1027). Correspondingly, *accepting* evolution, sometimes referred to as belief (Nehm & Schonfeld, 2007; Taber, 2017), is about recognition of the theory’s validity based on examination of evidence (Nehm et al., 2009; Winslow et al., 2011).

The distinction between accepting evolution and understanding evolution is important because of the role worldview can play in the learning of an individual. This can be especially true when considering religious beliefs. Compared to the rest of the world, resistance to evolution is unusually high in the United States (Coyne, 2009; Miller et al., 2006) and that resistance is often attributed to the religiosity of the individuals in the United States (Coyne, 2012; Ingram & Nelson, 2006; Manwaring et al., 2015; Moore et al., 2011). Their religious worldview prevents many individuals from being able to consider evolution at all. As such, Taber (2017) proposed that science teachers should aim to teach understanding of science topics rather than try to persuade students towards belief in scientific concepts. Taber (2017) argued that good science teachers should discourage belief in scientific ideas, pressing instead for students to be able to understand and communicate about scientific concepts.

Methods by Which Science and Religion Interact

Barbour's Interactions

In 1990, Barbour released *Religion in an Age of Science* in which he outlined four ways in which he saw religion and science interacting: *conflict*, *independence*, *dialogue*, and *integration*. The four methods derived from what he saw as the views of many that science was objective, rational, and based on solid observational evidence, while religion was emotional and based on traditions or authorities that often disagreed from one religion to another (Barbour, 1990).

Conflict. Barbour identified conflict as having to choose between science and religion because they make rival statements that cannot both be true. Thus, either science consumes religion or religion consumes science. Speaking on Barbour's statement, Reiss (2009) posited that it is customary to perceive the relationship between religion and science as in conflict, while Aflalo (2018) claimed the science and religion interaction of conflict manifests as one is superior to the other and only one side is correct.

Independence. When discussing independence, Barbour suggested science and religion address two separate endeavors, autonomous of each other, a scenario described by Reiss (2009) as science and religion using different methods and answering different questions, and therefore, being capable of existing independently of the other. Aflalo (2018) went a step further when he explained, "Science describes the reality and the search for its causes, while religion deals with the objective purpose of the world" (p. 240). Because of these vastly different ideologies, Aflalo (2018) argued for the consideration of science and religion as independent.

Dialogue. For Barbour (1990), dialogue between science and religion focused on methods and discussion of where the boundary of each existed. To better explain dialogue,

Barbour examined ways religious thinking led to scientific understandings and vice versa. From these examinations, he determined that there is enough overlap in thinking to warrant dialogue between the two. In concurrence, Reiss (2009) stated that scientific discoveries can give rise to religious questions, thus dialogue is necessary. Aflalo (2018) advanced this thinking by pointing out that dialogue recognizes that religion and science can be in conflict, but that neither side can confirm with certainty that the other is incorrect.

Integration. The final interaction of science and religion discussed by Barbour (1990) was that of integration. Barbour postulated the possibility of identifying at three versions of integration, each with its own specifics, but with the overall understanding that science and religion have existed concurrently for so long that portions of science are entrenched in religion and portions of religion are now entrenched in science. For example, in his statements on natural theology, Barbour suggested that studying nature helps individuals to see the existence of a creator god. Aflalo (2018) also discussed Barbour's thoughts on integration, identifying that integration "tries to bring religious belief closer to scientific theory" (p. 240).

Haught's Interactions

In addition to Barbour's work, Haught (1995) released a list of interactions. He indicated that he saw science and religion interactions of conflict (the two are fundamentally irreconcilable) and contrast (no conflict between the two because they are different). Haught (1995) also perceived contact (need dialogue between the two because of how science shapes religion), and confirmation (religion supports and nourishes the entire scientific enterprise).

Coping Strategies

The literature of the science and religion interactions outlined by Barbour and Haught indicate that conflict, and dealing with that conflict, is a major issue with a large number of

individuals (Aflalo, 2018; Calver & Bryant, 2017; Cobern, 1996; Francis & Greer, 1999; Glaze et al., 2015; Goldston & Kyzer, 2009; Griffith & Brem, 2004; Holt et al., 2018; Mazur, 2005; Miller et al., 2006; Nadelson & Sinatra, 2009; Nehm et al., 2009; Reiss, 2009, Schilder et al., 2009; Winslow et al., 2011). Because of perceived conflict, many teachers and students have developed ways of coping, in large part because “personal conflicts between religious belief and science have been shown to cause greater stress for science teachers compared with those who do not experience conflict” (Nehm et al., 2009, p. 1139). For many students and teachers experiencing conflict, there is a pattern of coping strategy approach across three areas: avoidance, advocacy, or accommodation (Calver & Bryant, 2017).

Avoidance. Calver and Bryant’s (2017) first coping mechanism of avoidance occurs when the instructor elects not to include evolution or other provocative topics within the curriculum, especially when the clientele is of the creationist viewpoint (Calver & Bryant, 2017). Avoidance is problematic because it can lead students to either question the veracity of scientific principles or to accept creationist ideas as fact, leading students to seek avoidance of similar topics (Calver & Bryant, 2017). Furthermore, research has found that avoiding teaching evolution decreases students’ overall understanding of scientific principles (Moore et al., 2011; Moore et al., 2009; Nehm et al., 2009).

Advocacy. Advocacy, Calver and Bryant’s (2017) second coping strategy, takes place when the instructor teaches evolution while ignoring creationist view (Calver & Bryant, 2017). Advocacy is the most scientifically correct approach, but it risks alienating religious students within a classroom, especially if those students possess a creationist worldview (Calver & Bryant, 2017). As such, the staunch use of advocacy risks deepening the divide and conflict between those that are scientific and those that are religious.

Accommodation. The third mechanism proposed by Calver and Bryant (2017) is accommodation. This happens when learners are confronted with ideas and evidence that conflicts with their original worldview, and the learner changes his or her worldview to incorporate the new learning and form some kind of equilibrium between the conflicting ideas (Winslow et al., 2011) This particular coping mechanism allows evolution-leaning learners to incorporate religious ideas and religious-leaning learners to incorporate scientific ideas, providing each with a more integrated approach to the learning. However, Winslow et al. (2011) warned that learners will only be able to accommodate evolution or religion if they find the information credible.

Facilitating Accommodation. Additionally, Calver and Bryant (2017) suggested three additional methods by which to facilitate accommodation of evolution and religion within a classroom. These are *affirmative neutrality*, *procedural neutrality*, and *acknowledging theological positions that accept evolution*. Affirmative neutrality involves presenting a wide range of thoughts on biodiversity while highlighting the difference between science and religion, and then positioning to only teach evolution in the science classroom. Procedural neutrality allows students to express their views, which are then briefly discussed as the primer to teaching evolution as the explanation for biodiversity (Griffith & Brem, 2004), causing the discussion to be less about religious beliefs and more about the differences between religious and scientific thought (Hermann, 2012). Lastly, by acknowledging the theological positions that accept evolution, students are able to see how many religious faiths do accept evolution, and many religious students may come to the understanding that evolution is not something that has to be controversial (Calver & Bryant, 2017).

Teacher Classifications

Given the myriad of coping strategies, Griffith and Brem (2004) identified three categories of teachers that can affect how students deal with instruction in evolution. These are *scientist teachers*, *selective teachers*, and *conflicted teachers*. The following sections offer descriptions of these teacher classifications.

Scientist Teachers. Scientist teachers are staunch adherents to teaching evolution only, providing no link to religious thought and at times, denigrating those who oppose their viewpoint. Griffith and Brem (2004) found scientist teachers experience stress in their concerns that they continue to be allowed to teach evolution, but they have little stress or conflict from teaching evolution itself and seek to have clear boundaries between what is science and what is religion. In summary, scientist teachers are frequently vocal activists for teaching evolution in school without any sort of religious interference, and most commonly fear an administrative or educational situation that would prevent them from being able to teach evolution.

Selective Teachers. Griffith and Brem (2004) described selective teachers as deliberately omitting controversial content, strategically scheduling lessons, and going to great lengths through questions and disclaimers to ensure students did not find conflict between science and religion. Selective teachers are also largely free of stressors because they develop means of coping with the controversial topics, frequently by selectively choosing what to teach and allow into the classroom (Griffith & Brem, 2004). Further, selective teachers often begin from a place of perceived conflict, hypothesizing that students will take issue with evolution and seeking to lessen the impact (Hermann, 2012). They may also allow their own religiosity to impact what they teach (Deniz et al., 2011). In summary, selective teachers are likely to avoid teaching evolution, and they deeply embed their own coping mechanisms to help deal with evolution.

Conflicted Teachers. The last grouping of teachers that Griffith and Brem (2004) identified was conflicted teachers. Conflicted teachers spend a great deal of time and effort learning how the evolution curriculum may affect students and then provide students with comfort and reassurance. Conflicted teachers rarely find stress in how their administrators, parents, and colleagues handle evolution instruction, nor are these teachers overly worried about outbursts within the classroom. What does cause them stress is the student distress that goes unseen or unshown—those students who may be in conflict but unable or unwilling to voice their thoughts (Griffith & Brem, 2004). In summary, conflicted teachers will teach evolution, but they are frequently concerned about how students are interacting with the topic. Table 1 lists researchers who have addressed the use of these strategies as coping mechanisms proffered by Calver and Bryant (2017), as well as the classification of teachers proposed by Griffith and Brem (2004).

Table 1

Research on Coping Strategies in Evolution Education

| Coping Mechanism (Calver & Bryant, 2017) | Focal Studies | Classification of Teachers (Griffith & Brem, 2004) |
|---|--|---|
| Avoidance | <ul style="list-style-type: none"> • Hermann, 2012 • Moore, Brooks, & Cotner, 2011 • Moore, Cotner, & Bates, 2009 • Nehm, Kim, & Sheppard, 2009 | Selected |
| Advocacy | <ul style="list-style-type: none"> • Coyne, 2012 • Ecklund, 2010 • Forest, 2000 • Aflalo, 2018 | Scientist |
| Accommodation | <ul style="list-style-type: none"> • Calver & Bryant, 2017 • Fowler & Meisels, 2010 • Nehm, Kim, & Sheppard, 2009 • Sanders & Ngxola, 2009 • Schilders, Sleop, Peled, & Boersma, 2009 • Winslow, Staver, & Scharmann, 2011 | Conflicted |

The Compatibility of Science and Religion

A key aspect of the interaction between evolution and religion is that the two are compatible. In fact, more than a few high-profile scientists and philosophers of science insist that science and faith are compatible (Longest & Smith, 2011). This is an especially important consideration for those individuals who are both religious and seeking a level of understanding or acceptance of evolution. However, research reveals multiple instances of support and refutation of the compatibility of evolution and religion. This compatibility frequently begins with the religious institutions. While individuals of Christian denominations vary considerably in how they view evolution, Catholics tend to be the most accepting of evolution.

However, this does not mean that all of the laypersons who practice a Christian religion accept that religion and science are compatible. Some evangelical Christian groups view religion and evolution to be in direct conflict (Manwaring et al., 2015; Martin, 2010). For example, surveys indicate that a majority of individuals belonging to Christian denominations reject evolution (Manwaring et al., 2015).

Conversely, there is evidence that emerging adults with high religiosity are more likely to believe in the possibility of integrating science and religion than do their peers who lacking high religiosity. Research conducted by Longest and Smith (2011) suggested that students who attended a Protestant high school were more likely to agree that science and religion were compatible, and science strengthened their faith. In another study, Borgerding et al. (2017) found that college students who took evolution and biodiversity classes were more likely to say that religion and science were compatible than were students who did not take those courses. Uecker and Longest (2017) described this circumstance as young adults failing to succumb to a mindset of religion in conflict with science. They contended that many religious commitments are

flexible, allowing scientific worldviews to be accommodated into religious worldviews (Uecker & Longest, 2017). This would suggest that emerging adults are currently more likely to find religion and science compatible than other portions of the population.

Many believe that science and faith are not compatible. Uecker and Longest (2017) found that some creationist organizations support the belief that the doctrines of religion and science are too different to ever reconcile. Aflalo (2018) suggested that students see a conflict between science and religion, and it causes them to reject accepted scientific perceptions. Longest and Smith (2011) posited that more devoted religious adherents may reject science to maintain their own deeply held religious doctrines and avoid cognitive discord. Additionally, Levesque and Guillaume (2010) found that 61% of strong believers are unable to harmonize evolution with their belief in God, and it is difficult for some with strong beliefs, even if not biblical literalists, to accept any evolutionary statement that does not have a theological component attached. Furthermore, Mangahas (2017) found that a person's interpretation of scripture played a notable role in his or her perception of whether or not religion and science were compatible. Lastly, Borgerding et al. (2017) discovered that conflicts between student's view of science and religion may impact the student's view of evolution.

There are also examples of science and religion incompatibility that emanate from academics. For instance, some scientists position their work as direct challenges to science (Uecker & Longest, 2017). Noted evolution advocate and atheist Coyne (2012) postulated that evolution contradicts many common religious beliefs, specifically stating "religion breeds resistance not only to evolution, but also to *science itself*. Yet, we often hear that these two spheres of thought are perfectly compatible" (p. 2656). Paz-y-Miño-C and Espinosa (2015) even

suggested that belief in supernatural causation stops or delays comprehension and acceptance of scientific evidence.

Teachers as Street-Level Bureaucrats

In 1980, Lipsky released *Street-Level Bureaucracy: Dilemmas of the Individuals in Public Services*. In the work, Lipsky (1980) identified street-level bureaucracies as “the schools, police, and welfare departments, lower courts, legal service offices, and other agencies whose workers interact with and have wide discretion over the dispensation of benefits or the allocation of public sanctions” (p. xi). Lipsky’s work fully situates public schools within the concept of street-level bureaucracy, but it is not difficult to see how this concept applies to private schools as well.

Lipsky (1980) stated, “The actions of most public service workers actually constitute the services ‘delivered’ by government. Moreover, when taken together the individual decisions of the workers become, or add up to, agency policy” (p. 3). An examination of the role of teachers reveals it can be stated that the curriculum teachers deliver amounts to their version of “agency policy”. This is one reason federal and state governments have sought to regulate instruction by instituting curriculum standards. However, “lower-level participants in organizations often do not share the perspectives and preferences of their superiors and, hence, in some respects cannot be thought to be working toward stated agency goals” (Lipsky, 1980, p. 16). The work of Moore (2008), Moore and Cotner (2009), Fowler and Meisels (2010), Hermann (2012), and Glaze and Goldston (2015) reinforces that not all teachers are intent on following government policy.

When trying to identify why teachers exhibit apathy or hostility to agency goals within curriculum and instruction, Lipsky (1980) surmised it was because “the policy-making roles of street-level bureaucrats are built upon two interrelated facets of their positions: relatively high

degrees of discretion and relative autonomy from organizational authority" (p. 13). This makes sense when considering a classroom, as there are limited methods by which to evaluate how a teacher is performing and to ensure the teacher is meeting the appropriate curriculum goals. Those methods include examining lesson plans, observing teachers in the classroom, and analyzing student test score results by administrators, whether at the school, district, state, or federal level. However, none of these methods are unbeatable, or particularly reliable, for ensuring teachers perform their jobs in the desired method. Berger and Luckman (1966) found that teachers are going to share with students what they deem valuable, and no two classes or cohorts of students will receive the exact same information. So long as teachers maintain some degree of classroom autonomy, teachers will have the opportunity to decide what they teach and do not teach to the students within their classrooms.

When examining how the concept of street-level bureaucracy applies to private schools, recall that by being outside of government oversight, the individuals teaching at the school have considerably more autonomy to determine what they teach and do not teach in their classrooms. However, autonomy does not mean private school teachers do not feel pressure to conform to certain standards (Schulteis, 2000). Consequently, even for private schools, the community's belief system and the array of stakeholders who can bring pressure upon the teacher influence the teaching of evolution, especially in the American South (Goldston & Kyzer, 2009). However, classroom autonomy does allow teachers to selectively choose parts of the curriculum to teach, with many teachers deciding to omit teaching evolution in an attempt to avoid classroom conflicts (Glaze & Goldston, 2015). In the end, the pressure to teach evolution a particular way may or may not influence the teacher to conform to the desired curriculum pathway for "teaching

it (evolution) comes down to the classroom biology teacher and personal decision-making” (Goldston & Kyzer, 2009, p. 764).

Positions of Some Major Religions and Denominations

In many ways, religion is the antithesis of process to science. Whereas science functions in the realm of things that are testable and observable, religion has its basis in faith, and faith is what individuals may rely upon to explain those things that they cannot fully explain or see. Science and religion, especially the Christian religion, seem to frequently be at odds because each provides its own explanation for some of the biggest events in Earth’s history, beginning with the most spectacular of all events: the beginning of life. Most, if not all, religions have a creation story, most well-known of which is arguably the biblical Genesis account, which accounts for the origin of the universe, the Earth, all the plants and animals, and the origin of humans—a belief process known as *creationism*.

One of the first things necessary to understand about creationism is that, like the theory of evolution, there are many different interpretations of what creationism really means. Typically, a creationist is a follower of the Christian religion and his or her beliefs fall into four classifications: (a) young Earth creationist, also known as biblical literalists, (b) progressive creationists, (c) theistic evolutionists, and (d) intelligent designers.

Young Earth Creationists

Young Earth creationists, also referred to as Christian fundamentalists or biblical literalists, are the most conservative of the creationism camps. They typically believe:

without questions that divine creation is the explanation for the diversity of life we see today—the many different species of plants, animals, fungi, and microorganisms, that flourish around the globe. Their position is based on their reading of Genesis, with its

familiar story of the creation week—six days during which God created all of nature. (J. Moore, 2002, p. 5)

Winslow et al. (2011) even went to the extent to contend that young Earth creationists “categorically reject evolution as descent with modification from a single common ancestor” (p. 1026). Given this information, few individuals would be surprised that young Earth creationists do not believe in evolution in any form.

Young Earth creationists also tend to believe that all scientific evidence demonstrating the Earth to be older than 6,000 years is flawed. Further, all fossils are examples of species discarded during creation. From the standpoint of teachers, these individuals are least likely to teach evolution, in large part because they feel so strongly that evolution is a falsehood.

Progressive Creationists

Progressive creationists find themselves positioned between the beliefs of the young Earth creationist and the theistic evolutionist. Tooley (2018) described progressive creationists as believing creation occurred over a much longer time than six 24-hour days, that God directed every stage of the creation of life with every new life form being deliberately made, and that each new living that was not created out of nothing. However, just like with young Earth creationists, Winslow et al. (2011) declared that Progressive creationists “categorically reject evolution as descent with modification from a single common ancestor” (p. 1026). Generally, Progressive creationists are more open to accepting some scientific principles, but they still hold quite firmly to a rejection of evolution and the uses of natural selection.

Theistic Evolutionists

Theistic evolutionists believe “that the scientific proof for evolution is so overwhelming that it would be ludicrous to ignore it, but that this in no way precludes a belief that God created

life” (Ravitch, 2011, p. 3). This viewpoint allows the individual to fully accept both science and religion. Ravitch (2011) stated, “Theistic evolutionists accept modern science and do not see it as inconsistent with faith—faith is faith, not science” (p. 3). Since these individuals accept evolution and religion, teaching evolution to their students is generally not an issue, although they may include religious references within the discussion.

Intelligent Designers

Intelligent designers are those individuals who believe that nature provides ample evidence to prove that there is a creator, although this group tends to replace a specific deity of creation with an ambiguous individual who created everything (Lentini, 2007; Marshall, 2015). Winslow et al. (2011) stated these individuals tend to be closer to young Earth creationists in their beliefs, not in how old the Earth is, but rather in the notion that the creator created in such a way that evolution was either unnecessary or incapable of producing the results that have been attributed to evolution. Teachers who ascribed to these beliefs typically argue in favor of teaching intelligent design within the classroom.

Also included is an understanding of the official position of the religious denominations that the participating institutions either affiliate with or split from, with the data generating from a Pew Research Center (2014) survey and analysis of major religious groups’ views on the teaching of evolution. While the survey examined all major religious denominations, of particular interest is what pollsters found with the Catholic Church and the Presbyterian Church. The Pew Research Center (2014) published the following results: The Catholic Church generally accepts evolutionary theory as the scientific explanation for the development of all life. Originally made acceptable to Catholics by the writings of Pope Pius XII, writings by Pope John Paul II and Pope Francis purport acceptance of evolution. However, this acceptance comes with

the understanding that natural selection is a God-directed mechanism of biological development, and man's soul is the divine creation of God. Additionally, a 2006 article in the Vatican Newspaper, *L'Osservatore Romano*, indicated that intelligent design was not science, and educators should not teach it in science classrooms alongside evolution (Martin, 2010).

20th-Century Official Position on Evolution

In 1969, the Presbyterian Church USA's governing body amended its previous position on evolution, originally drafted in the 19th century, to affirm that evolution and the Bible do not contradict each other. In 1998, 85% of Presbyterian pastors agreed with the statement: "Evolutionary theory is compatible with the idea of God as Creator" (Martin, 2010, p. 426). Still, church representatives have stated that it "should carefully refrain from either affirming or denying the theory of evolution", and church doctrine continues to hold that man is a unique creation of God, 'made in His own image'" (Pew Research Center, 2014, para. 10). It is noteworthy that the more conservative Presbyterian Church in America, which is strongest in the Southeast, particularly in Georgia, was unable to reach a consensus on whether or not they accepted evolution and creationism.

Based on these official positions, it was possible to determine if the Catholic private school surveyed was operating within the official decree of the Catholic Church, and if the independent Christian school was operating within the official decree of the Presbyterian Church from which it split. However, even if the Catholic private school or the independent private school was found to be operating outside of the official decree of their respective denominations, that does not guarantee that the school was recalcitrant or that the students were not receiving a valid education. At the time of this writing, a religious private school operating outside of the

official denominational decree simply meant the school was on a different path than what the denomination subscribed to as a whole.

Relevant Court Cases

The list of court cases that deal with the teaching of evolution is well established, so it will not be repeated here, save for three cases. The reason for including these cases is because each one has a specific relevance to the method of teaching evolution in private schools. The following paragraphs provide a discussion of *Lemon v. Kurtzman* (1971), *Kitzmiller et al. v. Dover Area School District* (2005), and *Association of Christian Schools International v. Stearns* (2008).

Of the three court cases with direct relation to teaching evolution in private schools, the first, and arguably most consequential, was *Lemon v. Kurtzman* (1971). The plaintiff objected to the 1969 Salary Supplement Act passed in Rhode Island. In this act, the State of Rhode Island agreed to pay a supplement to teachers in private religious schools as long as the teachers taught only courses taught in public schools and specifically agreed not to teach courses in religion (*Lemon v. Kurtzman*, 1971). The U.S. Supreme Court determined the Rhode Island pay supplement in exchange for control over what was taught was a violation of the First Amendment of the U.S. Constitution, specifically the Establishment Clause, which holds that “Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof”. In addition to striking down a government attempt to exert itself upon a religious private school, this case formed the basis for the “Lemon test”, the legal precedent still used to determine if government policy is unconstitutional when considering matters of religion.

The court ruled that under the “Lemon test”, government policy is unconstitutional if (1) it has a primarily religious purpose, (2) it has a primarily religious effect, or (3) it excessively entangles the government and religion (*Lemon v. Kurtzman*, 1971). Based on these three statements, everything considered to be a part of the government must be devoid of official or perceived religious affiliations. This means that government schools (i.e. public schools) may not officially promote or sanction anything that would be seen as promoting a religion. It also means, the government cannot dictate the teaching of subject content in a religious private school.

In 2005, the *Kitzmiller et al. v. Dover Area School District* decision provided another important perspective on the teaching of evolution and creationism. At the center of the lawsuit was a policy created by The Dover (Pennsylvania) Area School District that allowed the teaching of intelligent design in the science classroom, stating, “Students will be made aware of gaps/problems in Darwin’s theory and other theories of evolution, including, but not limited to, intelligent design” (*Kitzmiller et al. v. Dover Area School District*, 2005). Of secondary concern in the court case was a disclaimer that teachers were required to read before teaching evolution, which, among other things, stated “The reference book, *Of Pandas and People*, is available for students who might be interested in gaining an understanding of what intelligent design actually involves” (*Kitzmiller et al. v. Dover Area School District*, 2005). The U.S. Supreme Court decided that providing *Of Pandas and People* as an alternative text and specifically instructing students that the alternative text explained intelligent design was a violation of the Establishment Clause of the U.S. Constitution. Within the court case, the full impact of the text *Of Pandas and People* was not the book itself, but rather where the book originated. The text *Of Pandas and People*, created by the Discovery Institute, served as their method of explaining creation science. Because the lawsuit referenced a text from the Discovery Institute, a member from the Discovery

Institute had to testify. Michael Behe, a biochemist working for the Discovery Institute, served as an expert witness for the Discovery Institute. The testimony of Michael Behe was seen as critical to the Dover Area School District's defense case because he was able to explain how he and the other scientists at the Discovery Institute believed that recent advances in the field of biochemistry provided evidence of intelligent design.

When the case concluded, the court ruled against the Dover Area School District, determining the position to include intelligent design in the science classroom did in fact violate the Establishment Clause. In his ruling, , presiding Judge John E. Jones, III stated, "The overwhelming evidence at trial established that ID is a religious view, a mere re-labeling of creationism, and not a scientific theory" (*Kitzmiller et al. v. Dover Area School District*, 2005). Accordingly,

The courts have been quite clear that when one promotes supernatural causation as the alternative to science in science classes, one is promoting religion for establishment clause purposes. There is no need to connect it to a specific faith or deity for it to be religion. Therefore, the purpose of teaching the controversy is itself religiously grounded and therefore endorses and promotes religion. (Ravitch, 2011, p. 97)

The *Kitzmiller et al. v. Dover Area School District* case also has implications to *Lemon v. Kurtzman* (1971) because the determination of intelligent design as a method of teaching creationism in schools meant that "schools would have to have a secular purpose for teaching ID and/or disclaiming evolution" (Ravitch, 2011, p.70).

However, *Kitzmiller et al. v. Dover Area School District* (2005) did not change the narrative for private schools, particularly religious private schools. Considering, religious private schools were already free to choose whatever form of evolution or creation they wanted for their

science classes, naming the deity behind creation was already occurring. Therefore, it is unlikely private schools were rushing to hide behind the ambiguity that intelligent design utilizes.

However, the U.S. Supreme Court's designation of teaching intelligent design as religiously motivated, teaching it in nonprivate schools was all but forbidden. The secondary effect was that if a private school did elect to teach intelligent design, that school was once again seen as teaching creation instead of teaching actual science, thereby eliminating the entire reason for introducing intelligent design instruction in the first place.

Despite freedom from government curriculum oversight, some question what and how private schools teach. For example, Mangahas (2017) found that the perception of students graduating from religious private schools is that they have an inadequate and inaccurate understanding of science, especially evolution. Mangahas (2017) added that there is a concern about college readiness for many students matriculating through Christian schools when those students had biology teachers whose personal beliefs possibly interfered with instruction of evolution.

The University of California officials challenged that very notion in 2008 when it rejected five courses taught at a religiously affiliated private school in California. The resulting court case, *Association of Christian Schools International v. Stearns* (2008), alleged the education students that received was not the equivalent of what students received in the public schools, specifically, the textbook used in the Christian school. The Christian school representatives had chosen textbooks written from a religious standpoint, and they omitted, reduced the influence, or gave alternate explanations to some of the topics deemed contentious, including evolution. Officials at the University of California determined that the textbooks were not rigorous enough; therefore, the students in the classes had not received adequate preparation

for college. Although the Association of Christian Schools International (ACSI) argued that the Christian school was the object of discrimination, the court upheld the University of California's position, which was further upheld during the appeals process.

The inclusion of *A.C.S.I. v. Stearns* (2008) within this work is not designed to bring in a new component (i.e. textbooks), but rather to demonstrate that there is now precedent for college officials to question what private schools, especially religious private schools, teach. Even though the University of California representatives stated that textbooks served as the basis of their decision to disallow the private school courses, there is no way to completely authenticate their reasoning for disallowing the courses.

Previous Private School and Evolution Research

As repeatedly mentioned, there is sparse research conducted specifically with teachers in private schools and how they approach evolution. Undoubtedly, teachers in private schools have responded to questionnaires, surveys, and interviews conducted for a wide array of academic and scientific articles, but frequent delineation of which responses came from private school teachers is absent. Instead, the typical method of data reporting has been the aggregation of private school teacher responses received with all the other data gathered from teachers (Bland & Moore, 2011).

Of the four articles related to evolution in private schools, two of the articles related to surveys and interviews conducted with teachers at religiously affiliated private schools. These were Schulteis (2010) who worked with teachers at Lutheran schools across the United States, and Mangahas (2017) who worked with teachers at Catholic schools in California and Hawaii. In both cases, the overall findings were very similar. Mangahas (2017) found that teachers' beliefs related to evolution and Christian beliefs were extremely complex, with teachers most frequently

believing parts of evolution, while distancing themselves from the entire theory. Schulteis (2010) also saw this behavior occurring when he noted that all of his subjects were willing to teach evolution, but that they were most likely to minimize the topics of descent with modification and human evolution.

Schulteis (2010) found that nearly 75% of his participants did not believe in evolution, even though they were willing to teach it. Mangahas (2017) also found this phenomenon to be occurring within her subject group, stating that teachers supported teaching evolution because it better prepared students for critical thinking in college, but most felt that evolution was not a requirement for students to learn or understand science. The teachers Mangahas (2017) worked with also voiced support for teaching intelligent design and other counterexamples of evolution because it would promote critical thinking among the students. These studies demonstrate that within some private schools there is willingness to teach evolution, but that the topic of evolution may be augmented from its presentation in public schools. However, Mangahas (2017) also advocated for private schools, especially religious private schools, meeting state science standards and ensuring that students left the school with an accurate understanding of evolution, even if it was a basic understanding. Similarly, Schulteis (2010) felt that public and private schools were in accord with the need for proper education of students, and the issues private school teachers faced with teaching evolution were highly similar to those faced by public school teachers.

Reichard (2016), author of the third article related to evolution in private schools, focused on a change in textbook that occurred at a religious private school. Citing many of the textbook battles over disclaimers placed in science texts, Reichard (2016) sought to determine if a religious school changing over to a secular textbook from a religious textbook would have an

impact on student religiosity. After conducting before and after surveys of the student body, Reichard (2016) found that the switch to a secular textbook had virtually no effect on the religiosity of the students. Reichard (2016) speculated that this might have been partially because all of the teachers received training in faith-based teaching practices during the phase-in period of the textbook adoption.

The most recent article, authored by Cheng (2019), described his examination of the educational emphasis of science teachers in evangelical Protestant (EP) high schools. Using data from the *High School Longitudinal Study of 2009*, compiled for the National Center for Education Statistics, Cheng (2019) determined that teachers in EP schools were more likely to place strong emphasis on teaching scientific reasoning and analytical skills than were their public school counterparts. This may be due to Mangahas's (2017) findings that private school teachers sought to improve students' critical thinking skills through science instruction.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

Methodology

This project was designed to better understand how private schools of the Middle Georgia area addressed the teaching of evolution in science classrooms. In total, this project focused on three private schools and approximately four individuals per school. Because the sample size was small, 12 individuals, and the desire was for an in-depth look at each school, the researcher utilized a case study format.

The use of case study methodology allows the researcher to examine the meaningful parts of real-life events and situations (Yin, 2009). Yin described the rationale for using a case study:

The case study is preferred in examining contemporary events, but when the relevant behaviors cannot be manipulated. The case study relies on many of the same techniques as history, but it adds two sources of evidence not usually included in the historian's repertoire: direct observation of the events being studied and interviews of the persons involved in the events. (Yin, 2009, p. 11)

Because this project was designed to tell the story of the private schools and their methodology of teaching evolution, there was a need to find out the "hows" and "whys" of what the schools did and "'how' and 'why' questions are more explanatory and likely to lead to the use of case studies, histories, and experiments as the preferred research methods" (Yin, 2009, p. 9).

Dyer et al. (1981) identified two main categories of case studies: the singular case study and the multiple case study. Singular case studies focus intently on one entity and seek to fully understand that entity. Multiple case studies arise when the researcher simultaneously contemplates what would be considered as more than one singular case study. Some researchers

believe singular case studies provide better information because the researcher's time and focus are in one area (Dyer et al., 1991). However, other researchers argue that multiple case studies are superior because they allow for comparisons and contrasts (Vannoni, 2014), and they permit the researcher to analyze data both within each entity and across multiple entities (Yin, 2004).

In this project, the intent was to simultaneously analyze teaching methods regarding evolution at three different private schools, culminating in a multiple case study format. The literature would describe this project as being proper for a multiple case study format as detailed by Yin (2009) or as a collective work as delineated by Stake (1995) because, while the project was examining three different private schools, the project focused only on how each school dealt with teaching the theory of evolution, seeking to compare and contrast their methods independently and collectively. Yin (2004) championed the use of multiple case study format for projects such as this because the method provides a greater detail of collective analysis and reduces the chance critics will assume the findings are unique to any of the individual schools involved in the case study. Initially, the researcher presented each school as its own entity, with its own identity and procedures related to the teaching of evolution. After discussing the individual cases, the researcher discussed the commonalities and differences that existed between the three schools. This approach also meets Yin's (2004) expectations because the researcher used the interview data to build explanations, both confirming and rejecting the hypothesis, and other arguments that will continue to expand the knowledge base.

This project utilized an embedded case study methodology, which Yin (2009) described as one where "attention is also given to a subunit or subunits" (p. 50). This type of case study differs from a holistic case study in that holistic case studies look at an organization or similar entity in its entirety, while the embedded case study is only interested in a portion of the whole.

In this project the intent was to only examine how each type of school addressed teaching the theory of evolution. The “whole” entities in this study were the three private schools, while the subunits were the processes by which the theory of evolution was or was not taught in those schools, and the individuals who most directly influenced the teaching process. Since this project focused on the teaching methods pertaining to evolution, rather than the teaching methods of the private school in general, the project examined a subunit within the whole, rather than the “whole”. The biggest concern of a project that focuses on a subunit is that the subunit becomes the full extent of the project, failing to return the analysis to the original whole (Yin, 2004). The implication here is that even in studying the subunit of the teaching of the theory of evolution in each school, the researcher must ensure the project returns the embedded analysis to the original point of study: the comparison of teaching methodologies in the different types of private schools. Additionally, from a classification point of view, Yin would identify this project as being descriptive because it seeks to describe a phenomenon and the context in which it is occurring (Yazan, 2015). Also, this project meets the criteria of a descriptive case study because it focused on determining how evolution was taught in the included private schools and it is detailed in explaining the questions and explanations given by the participants (Mills et al., 2010).

Role of the Researcher

Within this work, I, the researcher, operated as an interpreter. Stake (1995) identified the case study interpreter as someone who “has recognized a problem, a puzzlement, and studies it, hoping to connect it better to known things. Finding new connections, the researcher finds ways to make them comprehensible to others” (p. 97). In this research situation, it was unknown how the three schools addressed the teaching of evolution. By examining the teaching methods

through a series of face-to-face interviews, I was able to see into the teaching operation of these private schools. I then interpreted the interviews as faithfully as possible to give the readers an understanding of how participants addressed evolution. The end result is that the gathered information can supplement the academic literature at large, allowing academia to have a clearer picture of how private schools deal with evolution.

Gathering Data

The data for this project generated from multiple venues. Initially, the researcher examined the website for each participating school, which provided information such as AP (Advanced Placement) courses offered and the presentation of curriculum. The researcher then conducted interviews with representatives at each of the schools and wrote field notes after each of the interviews. During the interviews, the researcher gathered information regarding the types of textbooks used within the classroom. After the conclusion of all interviews, the researcher asked follow-up questions of the AP Biology teacher at each school related to AP Biology test results and test administration procedures at each institution, with all school administrators agreeing to provide the data in some manner.

At each of the three private schools examined, the intent was to conduct face-to-face, audiotaped interviews with the principal/head of school and up to four science teachers. At the two schools with a religious charter, it was acceptable to substitute one science teacher for one Bible teacher. This allowance was included because at many religious private schools the theory of evolution is also examined within the Bible class, just from a quite different perspective. Since numerous researchers (Cleaves & Toplis, 2007; Deniz et al., 2011; Goldston & Kyzer, 2009; Levesque & Guilloume, 2010; Mangahas, 2017; Schilders et al., 2009; Schulteis, 2010) examined the impact that teaching both creation and evolution has upon students, it was prudent

to include some examination of how students were exposed to “evolution alternatives” within the religious private schools. One school was allowed to substitute an academic dean for the Bible teacher because the academic dean had operational knowledge of teaching methods and could make suggestions and corrections of teaching practices.

The researcher asked each interviewee the same series of questions. The researcher also included data from any clarification questions and resulting responses that arose based on the initial responses of the interviewee. The design of the interview questions was to learn about the educational and teaching background of the teachers, specifics of how the teachers deal with evolution in their classroom, and what, if any, pushback teachers have received for their chosen method of addressing evolution. The Appendix contains a full list of the questions used in interviews.

After conducting the interviews, a third party transcriptionist transcribed the audio files. The researcher then coded each transcript with categories created to facilitate comparison of the responses from within each school and with the other participating schools.

Data Examination

Examination of the interview data took place in multiple formats and used multiple types of analysis. First, the researcher examined each individual’s transcript via thematic analysis, searching for patterns within the data and the systematic processes with the school culture that could be causing those patterns. The second analysis technique was cross comparative examination, examining the patterns from all the interviewees to see if there were any patterns that were universal for everyone.

More specifically, because this project began as three separate embedded case studies, the researcher initially examined data from the interviews of each of the three private schools

exclusively for that private school. For example, all interviews conducted at the Catholic school were used as information for the case study of the Catholic school only. This initial comparison utilized thematic analysis for each individual and cross comparative examination of all interviews conducted at each school.

The purpose of utilizing these methods of data analysis was to ensure that each of the private schools under examination was allowed to tell its own story without interference from comparison to the other private schools. Each private school has its own reasons for why it teaches or does not teach the theory of evolution, and while the three private schools may have similarities in what they do and how they teach, each is its own entity, and needs to be addressed as such to best understand the reasons behind their teaching actions.

After conducting thematic analysis for each individual and cross comparison examination within the school, the researcher used cross comparison examination to compare all three schools, searching for common themes (or lack thereof) across all three private schools. By interviewing teachers and administrators in multiple, highly different, private schools, there was potential that the data would demonstrate thoughts, feelings, or procedures that bridged the structural differences of the schools and were found throughout. It was also possible that there would not be any common themes carried from one school to another.

Identification of Participants

At the time of the study, the Falls County, Georgia area had 20 private schools of various sizes that ranged from secular, non-religiously affiliated schools to schools affiliated with most of the major religious denominations. Due to the number of private schools that could have been examined, this project constrained its focus to three of the largest private schools, with those

three schools representing a secular, non-religiously affiliated private school, a Christian nondenominational private school, and a private school associated with the Catholic Church.

The researcher chose these three institutions because the communities viewed each with respect and considered them to educate students well. Further, each represented a different philosophy in the methods of educating student. In addition, each was of sufficient size to be capable of having the need for teachers and classes through which the theory of evolution would be taught. All three of the schools currently maintained accreditation by two or more private schools accrediting agencies.

The researcher sought to interview the principal/head of school of each school because that individual can, and often does, have the final say on what is taught within the school. Therefore, it was important to know the perspectives of the principal/head of school in relation to whether or not he or she believed in the teaching of the theory of evolution within the school. By understanding the position of the principal/head of school, a lot of understanding about the stance of the school could be determined.

The researcher also sought to interview the science teachers, and potentially a Bible or theology teacher, of the included private schools because these individuals are on the front line of education. What is and is not taught and to what degree it is taught is a direct result of the teachers and any bias that the teachers may have toward a given topic. Therefore, it was possible that the teachers might add or detract emphasis from a topic, and in the case of the theory of evolution, the teachers might teach or not teach the theory based on their own thoughts and views, rather than the official position of the private school. By being on the front line, the teacher has the ability to uphold the view of the principal/head of school or to subvert it in some way. Accordingly, the teachers were able to provide great insight into the specifics of how the

theory of evolution was treated at the classroom level. Additionally, teachers were most likely to be able to explain the views of evolution that the students possess. Each student likely enters the science classroom with some previous knowledge of evolution, and this knowledge can greatly affect how teachers approach evolution. Accordingly, the teachers, and administration, received the chance to explain how they perceived students dealing with evolution.

Ethical Considerations

Maintaining ethical considerations during research is of vital importance, especially when matters of a personal nature, in this case, religion, are the subject of an investigation.

Accordingly, the researcher submitted this project to the Georgia Southern University Institutional Review Board (IRB) before contacting any potential participants. Upon the granting of approval, the researcher also submitted an IRB application to each of the three participating private schools because approval from each school's administrator was necessary. Upon receipt of permission from each school, the researcher sought out participants, both administrators and teachers, in a voluntary, informed consent manner. Those individuals who agreed to participate received guarantees of confidentiality. Each participant chose a pseudonym to be known by during the interview process. Additionally, as mentioned before, the researcher assigned pseudonyms for the name of the county and the names of the participating schools as a measure of maintaining confidentiality.

The researcher recorded all interviews on the researcher's personal digital audio recorder, dedicated solely to the project and lacking the ability to gather video of the interviewees, then transferred the audio files to a professional transcriptionist for transcribing. The transcriptionist only knew the interviewees and participating schools by their pseudonyms. The researcher deleted the recordings upon completion of the transcriptions. Digital and print copies of the

interviews were kept for potential further study, but confidentiality of the interviewee is maintained through continued use of the pseudonyms even if the data were to be used again in the future.

Positionality

In any study, the experiences and biases of the researcher impact the lens through which data are viewed and impact the work. As the sole researcher for this project, cognizance of how predispositions impact interactions with the participants, the framing of interview questions, and interpretation of the data both allows awareness and intentional address of bias. Therefore, an exploration of positionality is meaningful in expressing the orientation of the researcher within the topic of study.

For the sake of transparency, I identify as a theological evolutionist, having long ago reconciled that evolution is undoubtedly viable, but still seeing considerable merit in there being a God of creation. However, having attended church regularly since my youth, I have no recollection of ever witnessing teaching by any of the pastors or laypersons related to evolution. Second, possessing formal training in the sciences, a Bachelor of Science in Marine Biology, and a minor in Chemistry, I took courses in evolution, natural history, cellular biology, microbiology, and genetics. As a result, my exposure to the concepts of evolution and consequent understanding of how life has changed over time exceeds that of a novice. Additionally, as a high school science teacher for over a decade, frequently teaching biology, and with it the theory of evolution, I never shied away from the topic, nor intentionally sought to censor what I taught, despite living and teaching in an area of high religiosity. Any intentional reduction in the teaching of evolution might have resulted from district-level positioning of the evolution unit in the curriculum pacing guide at the end of the year, right before state level testing.

As it relates to public and private education, I am a big proponent for public schooling; however, I acknowledge that private schools do have their place in the educational landscape. Concerns regarding private school education personally rest upon the nature of curriculum selection and exclusion, as well as the absence of standardization from setting to setting. While not the only indicator of success, a certain standard of education ensures that students are being held to performance and understandings that reasonably prepare them in comparison to their peers. Therefore, when considering the role of private schools in general, I am most impressed with private schools that hold their students to standards of achievement that rival or best their comparable public schools.

In reflection, understanding my own positionality led to some specific decisions about how I interacted with the participants and data. First, I refrained from discussing my own personal beliefs with the interviewees until the end of the interview when the participant was allowed to ask me questions, and even then, I only discussed my personal beliefs if specifically asked. If asked a question about my beliefs during the interview process, I redirected the participant back to my questions and promised to answer their question at the end of the interview. Second, during data analysis, I endeavored to remove my personal feelings from the process and focus instead on accurately portraying the information.

CHAPTER 4

THE CASE STUDIES

Primary and secondary research questions served to guide the design of this project, providing guidance for the participant interviews, data analysis, and data presentation. The primary research question was:

1. How is the teaching of evolution approached in private schools in one county in Middle Georgia?

To help answer the primary research question, a series of secondary research questions were explored:

2. Does the type of private school impact the teaching of evolution?
3. Does teacher religiosity impact teaching of evolution in private schools of Middle Georgia?
4. Do perceptions of student religiosity impact the teaching of evolution in private schools of Middle Georgia?

In total this project saw interviews conducted with 12 individuals from three different private schools in the Middle Georgia area. The researcher conducted face-to-face interviews in May, June, July, and August of 2019. Information from the interviews was disaggregated into three case studies, one for each of the private schools being studied. Within each case study, the researcher examined and answered the primary and secondary research questions.

Each of the three case studies included five components: (a) a history of the school, (b) a discussion of curriculum, including important or unique components or situational considerations, and discussion on how students at the school performed in the past five years on

AP Biology exams, (c) biographies of each of the individuals who agreed to be interviewed, (d) the role of freedom, and (e) discussion of the research questions.

Case Study 1: St. Arthur Academy

St. Arthur Academy (pseudonym), founded in the early 1870s by five members of the Catholic group Sisters of Mercy, represents the first formal educational entity for the Falls County area. The five founding members of St. Arthur Academy, originally based in St. Augustine, Florida, relocated to Columbus, Georgia during the Civil War. After the war, the five ladies relocated to Falls County where they began the school as Academy of the Sacred Heart Jesus.

The Sisters of Mercy website provides a statement that their primary focus was on education, health care, and charitable work for those who are underprivileged (Sisters of Mercy, 2019). Specifically, the educational aim of the Sisters of Mercy (2019) stated that most of its elementary and secondary schools

are sponsored by the Mercy Education System of the Americas (MESA) which ensures that education ministries are identified within the mission of the Catholic Church and are faithful to the charisma, mission and core values of the Sisters of Mercy. para. 3)

MESA oversaw and determined the overall curriculum for St. Arthur Academy, with stated intent of striving to provide a rigorous education. St. Arthur Academy's standard curriculum, which included matters of theology and encouraged critical thinking amongst students, and the 21 Advanced Placement courses offered at the school demonstrated this effort. Included in St. Arthur's Advanced Placement offerings were science courses AP Physics I, AP Physics II, AP Chemistry, AP Biology, and AP Environmental Science. Of importance here was the inclusion of AP Biology because the AP Biology course structure, and associated nationally standardized

exam, placed significant emphasis on evolution. St. Arthur also offered an elective course in Sociobiology.

The faculty and student body of St. Arthur Academy was diverse. Although the school had direct affiliations with the Catholic Church and adhered to Catholic doctrine in educational matters, the St. Arthur Academy protocol did not require a statement of faith from its employees, nor did it require its employees to be practicing Catholics. Individuals who taught theology courses were the only exceptions to this protocol. The protocol required teachers of theology courses to be practicing Catholics and specifically trained in Catholic beliefs.

Likewise, the students and families who enrolled at St. Arthur Academy did not have to be Catholics, nor did they have to sign a statement of faith or make a profession of faith. In fact, St. Arthur Academy policy accepted a wide variety of students, as demonstrated by the fact that less than 50% of the student population identified as Catholic, and some students identified as atheists at the time of this study. However, St. Arthur Academy policy did require all students to attend regularly scheduled observances of Mass.

The Catholic Church and Science

For many, the notion that the Catholic Church is not anti-science is hard to believe. The well-known case of Galileo placed on trial and convicted of heresy for believing and teaching the heliocentric model of the universe is a prime example of the issues the Catholic Church has formerly had with science. Still others find fictional works like Dan Brown's *Angels and Demons* and *The Davinci Code* to be proof enough that the Catholic Church is anti-science and hiding and suppressing information. Truth is, while Catholic Church representatives have made mistakes (see Galileo and the 300 years it took for the Catholic Church to admit their error),

members of the Catholic Church have made some enormous contributions to science, and the Catholic Church does formally accept evolution.

One example of the contributions to science made by a Catholic is the work of Father George Lemaître (Soter & Tyson, 2000). Although his name is not famous, the work he accomplished is. Father Lemaître was the first to apply Einstein's ideas of space and time to conceptualize the idea of the Big Bang Theory. In addition, Father Lemaître made the first statements regarding what would later become Hubble's Law, and he provided the first observational estimation of Hubble's Constant (Physics of the universe, (n.d.); American Museum of Natural History, 2000; and David, personal communication, June 5th 2019).

Another Catholic contributor to science is Father Nicanor Austriaco, a priest from the Dominican Republic who began his life as an atheist with a degree in biological engineering. His scientific work led him to determine that the ordering and complexity of biological life was simply too much to have risen from nothing by Darwinian principles. He later converted to Catholicism, joined a monastery in the Dominican Republic, and together with his fellow friars started a website called ThomisticEvolution.org to answer questions related to evolution and Catholic beliefs. The work of Father Austriaco and other Dominican friars is based on the ideas of St. Thomas Aquinas and his views on evolution, including the possibility that God designs by chance. Altogether, these friars have written at least 30 essays discussing disputed questions related to Christian faith and evolution (Austriaco, Brent, Davenport, & Ku, 2016).

In addition to the works of Catholic individuals like Father Lemaître and Father Austriaco are the words and works of three modern era Popes: Pope Pius XII, Pope John Paul II, and Pope Francis. Each garner great respect, and their thoughts are currently being used to shape Catholic doctrine towards the sciences, and especially evolution.

Pope Pius XII was the first to make official statements about the Catholic Church and evolution in his 1950 *Encyclical Humani Generis*, where he called for more research but did not condemn the theory. Specifically, Pope Pius XII (1950) stated,

The Teaching Authority of the Church does not forbid that, in conformity with the present state of human sciences and sacred theology, research and discussions, on the part of men experienced in both fields, take place with regard to the doctrine of evolution. (para. 36)

However, in the very next sentence of his writing, Pope Pius XII also stated that while the teaching of evolution was permitted in Catholic schools, it must be done in such a way that allowed for both pro-evolution and anti-evolution opinions to be expressed and respected.

Forty-six years later, Pope John Paul II (1996) spoke to the Pontifical Academy of Sciences and said, “Almost half a century after the publication of the encyclical, new knowledge has led to the recognition of the theory of evolution as more than a hypothesis” (para. 8). Pope John Paul II (1996) also spoke to the nature of science surrounding evolutionary theory by stressing that “a theory’s validity depends on whether or not it can be verified; it is constantly tested against the facts; wherever it can no longer explain the latter, it shows its limitations and unsuitability. It must then be rethought” (para. 9). Overall, Pope John Paul II and Pope Pius XII shared the same thought on human origins: that the physical body may have come from natural elements, and thus be subject to natural laws and theories, but the soul was of and by God, and no natural theory could affect the soul.

In his 2015 *Encyclical Letter Laudato Si*, Pope Francis primarily spoke of the need for greater respect for the environment and nature by the human race. However, Pope Francis’s work did include a section where he pressed the uniqueness of the human race. He allowed that

humans may have experienced an evolutionary process but noted that evolution was unable to explain the uniqueness of humans, namely humans' ability to reason, create arguments, and be creative (Pope Francis, 2015).

While there may have been a time that some official stances of the Catholic Church made them seem anti-science, one would be hard pressed to say that the current environment within the Catholic Church is anti-science, especially as it relates to the teaching of evolution within Catholic schools.

Sociobiology and Faith and Reason

The St. Arthur Academy staff was very candid in their efforts to provide students with relevant and rigorous science classes. Their approach sometimes included courses typically seen in college (for example, genetics), but it also included courses designed specifically to encourage debate and critical thinking about topics related to science and faith. At St. Arthur Academy, two courses existed to examine the relationship between evolution and faith: Sociobiology from the science perspective and Faith and Reason from the religious perspective.

The Sociobiology course, an elective course offered to upperclassmen, had a basis in the work of E. O. Wilson and utilized contemporary works by Frans de Wall and Jaak Panksepp, among others. The course focused extensively on evolution and how social aspects of the human experience may have evolved. The inclusion of Jaak Panksepp's (1998) *Affective Neuroscience: The Foundations of Human and Animal Emotions* was so students could explore development of the human brain and general human emotions. The course encouraged students to examine their own lives and personalities and discuss the possibility of evolution of their thought processes and emotions. The course primarily focused on physical and emotional attributes that do not directly involve the concept of the human soul. This distinction is purposeful for two reasons: (a) the

Catholic Church representatives maintained that God created the soul, therefore, it is not subject to evolution; and (b) the Faith and Reason course handled discussions related to the soul. As such, it is safe to assume that the Sociobiology course concentrated mainly on the science realm and left faith and religious matters to the Faith and Reason course.

A theology teacher taught the Faith and Reason course at St. Arthur Academy to all eleventh graders. One of the theology teachers, David (pseudonym), stated, “The whole point of my Faith and Reason class is trying to show that, you know, there is no inherent contradiction between science and religion.” To illustrate this point, the class focused heavily on the works of noted Catholics. These individuals and works included official statements and publications from Pope Pius XII, Pope John Paul II, and Pope Francis; thoughts on evolution from St. Thomas Aquinas and Father Nicanor Austriaco; and scientific works by Catholics such as Father George Lemaître. The class only briefly mentioned evolution in a direct fashion, leaving that topic to the science teachers. Instead, the course encouraged students to examine scientific concepts through a religious lens and, through debate and research, determine what “truth” was and how it applied to their lives.

David, the Faith and Reason teacher, and John (pseudonym), the Sociobiology teacher, engaged in lengthy collaboration to intentionally teach these courses. John purposefully redirected most questions of a theological nature to David and the other theology teachers, while David redirected most science questions to John. Another unique aspect was that David and John frequently met on their own to discuss the two classes and ensure the classes were using the proper framing. All told, these two courses offered students a unique way of learning about themselves and evolution from both a scientific and theological perspective.

Performance on the AP Exam

At St. Arthur Academy, all students who enrolled in the AP Biology course had to take the AP Biology exam. Unlike many of their counterparts in public schools, students in St. Arthur Academy had to pay for the AP Exam. While representatives from St. Arthur Academy declined provision of year-by-year statistics, they indicated that the average pass rate for the exam over the past five years was 63%, which aligned to the 63% national average reported by the College Board for that same period. While it is not possible to compare specific AP exam performances with the corresponding data from College Board, the data demonstrate that students at St. Arthur Academy were performing similarly to the rest of the nation on the AP Exam.

Participant Portraits

The researcher asked five individuals from St. Arthur Academy to participate in the study. All five of the individuals agreed to participate. The participants were one administrator and four teachers. Three of the teachers were science teachers, while the fourth was a religion teacher. The summaries from the five individuals at St. Arthur Academy follow.

Joseph. Joseph, the principal of the high school at St. Arthur Academy, was in charge of students in grades 9 through 12. He began his career teaching English in public schools, spending a total of 13 years in the classroom. He then moved into administration and had spent the past 23 years working in private schools as an administrator.

In his youth, Joseph attended Catholic elementary school but attended public middle and high school after his family moved to an area without a Catholic school option. Joseph did not remember any teaching of evolution from his elementary years, but he did remember middle and high school teaches introducing him to evolution. However, he did not remember details of how his teachers addressed evolution during his public school years.

Joseph's collegiate endeavors included a bachelor's degree from a small liberal arts university, a master's degree from a large state public university, and a doctorate from an urban state university, with all of his degrees in English. Joseph also did not remember any formal evolution instruction from his college years, largely because his degrees were in English. He did not receive training to teach evolution, nor had he received any formal training since beginning his career in education.

Joseph was religious. He stated, "I'm a practicing Catholic, so much of my religious beliefs line up with Catholicism and the Catechism of the Catholic Church. Actually, all of them do so—I'm pretty much very Catholic."

When asked what he liked about the educational methods of a private school, Joseph answered that he liked the freedom and independence that private schools have. Joseph stated:

We belong to several national umbrella organizations that help give us (guidance) and maintain perspective, but at the end of the day, because we're independent with very few exceptions, we make decisions based on what we think is the best way or the right way for our student population.

Joseph further explained that St. Arthur Academy used the umbrella organizations of the National Association of Independent Schools (NAIS), the Southern Association of Independent Schools (SAIS), the National Catholic Educators Association (NCEA), and large national organizations like Association for Supervision and Curriculum Development (ASCD) to evaluate the curriculum. They also based a great deal of their educational model off of Robert Marzano's works, using Marzano's ideas for professional development and for teacher's observations and professional growth.

When specifically evaluating the daily curriculum, Joseph said a collective of all the teachers within the department determined the task of what to teach. Teachers examined curriculum documents from national educational organizations and national curriculum standards to ensure that what they taught was in line with what other students received.

Joseph chose to work at St. Arthur Academy for professional reasons. Prior to being at St. Arthur Academy, he had been a headmaster at a large private school in a nearby county, but ultimately decided he wanted a different position.

When asked about his acceptance of evolution, Joseph stated, “Yes, I—I believe science has a role to play in helping us understand, but I’m a, at heart, a creation, you know; I believe God created the world, and then evolution began from that point on”. Based on Joseph’s definition of his acceptance of evolution, he displayed the characteristics of a theistic evolutionist.

Joseph stated that there was no issue with teaching evolution at St. Arthur Academy, but he acknowledged that the religiosity of his teachers would likely impact how they addressed the topic. He also stated that being an administrator meant he rarely dealt with students in a manner that would cause students to ask him about his views on evolution.

David. David was a theology teacher at St. Arthur Academy. He worked primarily with students in grades 8 through 12. He had been teaching for four years, all of them at St. Arthur Academy. David’s primary teaching responsibility was the *Faith and Reason* course, which he taught to all juniors at St. Arthur. He was also one of the teachers who instructed sophomores on Moral Theology.

David attended public school for his K-12 education, but he did not remember much from his science courses in high school. David stated that his teachers did not appear as overly

religious. He doubted they had a problem with teaching evolution, but he was not interested enough in science to retain much.

His college years started at a major public university majoring in history, but after two years, he transferred into a Catholic seminary, whereupon he finished his bachelor's degree. Upon graduation from the Catholic seminary, he attended the Pontifical University of St. Thomas Aquinas in Rome, Italy, completing most of his master's degree in theology. David then returned to the United States and finished his master's degree in theology at Christendom graduate school. Although David received a master's degree in theology from Christendom graduate school, he was not a formally ordained priest. Rather, he conducted any formal duties with the local Catholic Church and the Catholic private school as a layperson.

David did not remember much formal education in evolution from his college years, largely because he was not majoring in science nor intentionally taking courses that gave him in-depth study into scientific concepts. Additionally, he had not been formally trained, before or after becoming a teacher, in how to teach evolution, but he spent a great deal of time speaking with the science teachers at St. Arthur Academy to help ensure that the science he covered in his courses was done so properly. David stated that he wanted to take a professional development course at the University of Notre Dame that helps Catholic teachers to better understand how faith and science interact. A large portion of the Notre Dame professional development targets the Catholic Church's understanding and stance on evolution.

David liked the relationships and focus on students that private schools offer. He stated, "I think the kind of fact that private schools seem to focus more on—on human formation as well as education, right? I mean we're not just giving them facts, but we're trying to help them grow holistically as a human being".

David chose St. Arthur Academy because its officials were the first to offer him an education job after he came to the area to work at the local Catholic church. He had since found the environment to be extremely welcoming, and the attention to holistic student education to be such that he continued to want to pursue his career in education at St. Arthur Academy.

David was religious. He stated, “I am Orthodox Catholic as in, like, I am a pretty faithful and active Catholic. Roman Catholic.” Even so, David readily accepted the theory of evolution:

Yes, I am accepting of the theory of evolution, I guess, at least in its scientific state, right? I mean, I guess there’s a lot of distinctions to be made there, but yes, I am—I accept evolution as a scientific fact or theory. And to be honest with you I don’t know—and this is probably why I don’t remember a lot of it in high school is I’ve just never really perceived it as something controversial. I don’t think it is very controversial with Catholic teaching, and so, kind of growing up, studying my faith alongside my kind of science classes I just—I never—I’ve never had a problem with it.

However, he expressed doubts about evolution when considering the stream of consciousness:

Where I do think we need to caution in our modern work is when does, you know, sometimes biological teaching on evolution can kind of cross other boundaries in other fields, right? Where, you know if you start talking about the evolution of thought or the evolution of consciousness, I think we’ve started to kind of drift away from what is biological fact, and we’ve started going into kind of like abstract philosophical theory.

Recall that this particular viewpoint is the official stance of the Catholic Church, and as someone who held degrees from Catholic seminaries, this view was in line with the teaching he received.

Based on the statements made during the interview, David displayed the characteristics of a theistic evolutionist.

David believed that evolution should be taught within schools, and science and faith do not have an implicit conflict. On the subject of teaching both evolution and creation principles, he stated:

If this is a scientific truth (evolution), like good, we need to know that, and then we—and if God is a truth, we need to know that, and then we don't need to be afraid they're going to contradict, right? So, I think the beautiful thing about my school's curriculum is there's no fear that—you can dive in as deep as you want in your field, and it's not going to mess up another field.

Because of his course on Faith and Reason, individuals frequently asked David about his thoughts on evolution. During the Faith and Reason course, he openly told the students,

I think both—both Catholic teaching is true, and evolution is true. But I'll say pretty quick that I don't think the soul is something evolved. That—that is kind of my big stickler thing, and I think that's the stickler thing of Catholicism.

Despite his own background and beliefs, David encouraged the students to think for themselves and to make up their own minds about what the truth is.

John. John was a high school science teacher at St. Arthur Academy. He taught college prep biology, geology, and the sociobiology elective. He had been in education for nine years, with eight years of that in a private school.

John attended public school for his K-12 education. Of these years, he remembered primarily learning about evolution in his high school biology course but acknowledged that it was only last two to three weeks at the end of the school year. He also remembered a small amount of evolution discussion during his anatomy and physiology course, but again, it was limited instruction.

For college, John attended a very conservative religious university affiliated with the Churches of Christ. John majored in exercise science (Bachelor's degree) and education (Master's degree), with both degrees coming from the aforementioned university. John did not experience much teaching in evolution, and directly attributed this to having attended a very conservative university. He stated that most of his evolution education has been self-taught through personal study and reading.

When asked about being religious, John stated a local clergyman he was friends with described him as the "most religious non-religious person you'll ever meet". John also described his view of religion as "there's a God, and I'm not him" and that religion is "all describing some type of psychic fact that we just haven't been able to deal with yet". Based on John's statements, it would be incorrect to describe him as adhering to any particular religious tradition, but it would also be incorrect to describe him as atheistic. Instead, John understood many of the tenets of both religion and science, and he allowed his understandings to guide his actions.

John described the difference in public and private school as being about relationships:

In the public school it's so—I would say there's an attempt to be curriculum based and to do exactly what is required of you by your governing body and those things outweigh—in a lot of senses those things outweigh relationships. Those things outweigh doing what it is that maybe an individual kid needs . . . Private school, don't know what it is, but there is a more genuine interest in the relationship between the teacher and the kid that's sought by both sides more consistently, is my observation.

The power of relationships is also what brought John to St. Arthur Academy and what kept him there. He stated, "There are people at this school who I trust to help me in my future endeavors

and that I want my future endeavors entrusted in and so—anyway I told them I'd come here for a few years

John added:

The people of St. Arthur inspired me to be a good teacher, you know, it's very easy to be a good teacher here. You have the support system, you have high expectations, you have a demand to do the right thing because you're holding the kids to such a high standard behaviorally.

John accepted the theory of evolution and based his thoughts on the evidence he saw from science.

I think for me the biggest—the biggest thing is the observable. The observable patterns that you see when you start making the comparisons between the fossil records. When you start making comparisons between—plant evolution and how plants evolved really, really sold me.

John also specifically referenced that he disliked when people say they believe in evolution: “And so, I—we—every time—do you believe in evolution? No. Like, please don't. Look at it, wrestle with it, mess with it. It's a hypothesis, it's a—multiple hypotheses put together.

He was also a proponent of teaching evolution in as many ways as possible and in as many schools as possible. When asked specifically about teaching evolution in private schools

John responded:

I think it would make private—I think it would make any school—any school that taught evolution from as early of an age as possible throughout as a mode of thinking, a mode of looking at the world, they would out compete everybody else.

Within his college prep biology courses, students consistently examined biology through the lens of evolution. Not only did students spend a fifth of their curriculum studying evolution for its own merits, they also spent the rest of their biology course exploring how evolution played a role in all aspects of life.

In addition to the college prep biology courses, John also taught the sociobiology course, which offered an in-depth exploration of the progression of evolution and the role it possibly played in many social constructs. In both classes, John pressed students to critically examine the tenets of evolution and decide for themselves what is truth. He explained that students need to be “learning to wrestle with it. Both—wrestle with both. Wrestle with the soul, and wrestle with Darwinian theory, and then evolutionary theory after that, which is infinitely greater than just the Darwinian concepts.”

Students frequently asked John about his thoughts on evolution, which, as mentioned earlier, are much more about acceptance than belief, but John shared something interesting thing:

I tell them early on, hopefully it’s (evolution) wrong. Hopefully there’s a better way of looking at it that’s more—that’s easier to understand and more—God, it’d be nice if it was more objective. If we could get it to be more objective consistently.

Clearly, although he accepted evolution and wanted his students to be well versed in what evolution is and means, John would have liked to see continued examination, testing, and refinement of the concept.

Rachel. Rachel was a high school grades teacher at St. Arthur Academy. In recent years, she had taught biology, AP Biology, and forensics. Rachel had two years of student teaching in a public school before transitioning to St. Arthur Academy. She had completed 10 years in the private school setting.

Rachel attended public school for her entire K-12 experience. She remembered evolution as taught in her secondary school, but she did not recall evolution as taught with much depth. She explained, “We talked about it as a theory, uh, but we really didn’t go—I’m going to say I don’t think we went into as much detail in public school as—as I do, even here.

Rachel then attended a small, liberal arts public university to obtain both her bachelor and master’s degrees. In college, Rachel recalled taking biology and evolution courses specifically. However, she also stated that she had one professor with a heavy background in fossils and other evolutionary evidence, and because of his influence, she had copious exposure to evolution.

Rachel liked the educational freedom of the private school. She felt that while there were guiding curriculum documents, by not having standards dictated by the state, the teachers received greater freedom to play to their strengths. She acknowledged the stricter nature of the AP Biology course and its specified guidelines from College Board. Within the AP class, Rachel followed the AP guidelines.

Rachel was drawn to St. Arthur Academy after leaving a scientific research position. She heard from others about the teaching position. She interviewed and, upon her hiring, St. Arthur Academy officials credited her research experience as teaching years.

As part of her master’s degree, and before entering the classroom, Rachel took a course on how to teach math and science. During her time as a student teacher, she was mentored on many facets of being a teacher, including how to address potentially controversial topics such as evolution. Since entering the classroom, she had attended a science and faith training at the University of Notre Dame that helps attendees to better understand the stance of the Catholic Church towards many scientific concepts, including evolution.

When asked about accepting the theory of evolution, Rachel responded:

With my background, I'm accepting of microevolution. I don't think right now even where I am in the college that I've—I still have questions about macro . . . there's evidence out there, and even going through college and having the teachers and professors that I've had, I still say I'm—the jury's out on that one (macroevolution) for me.

Within her classroom, Rachel described evolution as being extremely prevalent throughout the AP biology course. This was to be expected because of the emphasis placed on evolution by the College Board. Within her Honor's Biology course, evolution was not as prevalent, but she still covered the topic in a good deal of depth:

As far as introducing it (evolution), by that point they know how things change over time. I do start with micro first and then kind of go through the different mechanisms of microevolution, and then we do get—and we do touch on macroevolution in Honor's Bio, a little bit. There's mechanisms that we have for that too, and then we go over each one, you know, like ontogeny and the vestigial (structures) and other stuff.

Rachel absolutely believed evolution has its place in science classrooms:

It is how things develop a certain way. I mean it's how certain things have come to where they are now. It's why certain population maybe die out and other not. I mean, it's—it is a driving force behind life on the planet . . . I don't think you can teach bio without having evolution in there.

However, Rachel still maintained that there were things that evolution cannot explain:

You can say things change over time without actually saying we got here by chance. And that ultimately is my issue. It's just the fact that you can say that things change—things just randomly came together and by chance and here we are. That's what—that basically

is my issue with it. And you can teach evolution without actually having to go into—into that necessarily.

Rachel acknowledged that students frequently asked her about her thoughts on evolution. Her response to the students was to express her thoughts on micro and macro evolution as detailed here. However, she told the students that even with all the college instruction she had, she was still trying to figure out macro evolution. She told them this to encourage them to do their own research and make sense of evolution for themselves instead of simply believing what a teacher tells them to believe.

Rachel considered herself to be religious and identified as Baptist. Based on the answers that Rachel gave and her identification as religious and Baptist, she displayed characteristics of a theistic evolutionist.

Emily. Emily was a high school teacher at St. Arthur Academy. In recent years, she had taught chemistry, botany, genetics, experimental design and biology. Emily had been teaching for 16 years, all of them in a private school.

Emily attended private school from the time she was four years old through her twelfth-grade year. Emily remembered taking evolution in her secondary school years. In her instruction, the teacher did not mix evolution with creationism, but rather treated it as a scientific topic.

Emily then attended a large public university to obtain her bachelor's degree before going to a small liberal arts public university to obtain a Master of Arts and Teaching. In undergraduate college Emily focused on science, with an emphasis on genetics and evolution. Accordingly, she took multiple classes in evolution and genetics and worked on field studies to examine evolution of insects and how viruses were changing tick DNA.

Since deciding to become a teacher, she has not had any formal training in how to teach evolution, but she has had discussions with theology teachers at St. Arthur Academy to ensure she is teaching in accordance with Catholic doctrine.

Emily liked teaching in private schools because of the freedom to teach to her curriculum strengths and the freedom to teach in the best method for her. The school maintained expectations that she teach everything in her curriculum, and there were agreed upon curriculum requirements to which all teachers at the school had to adhere, but Emily felt she was able to allow her natural strengths to shine through in the classroom more effectively.

Emily was drawn to St. Arthur Academy out of need for a job. She explained:

St. Arthur had an opening that was coming up in the middle of the school year so it was really like God just plopped me here, because just to have an opening in the middle of the school year, someone that did not go to school to be a teacher, and then St. Arthur gave me the chance to come in and teach.

Emily did not have any training in how to teach evolution before taking her job at St. Arthur. During her master's work, there was some exposure to teaching science, but most of her instruction on how to address topics like evolution came from visits to other classrooms and her own self-taught endeavors.

When asked about accepting evolution, Emily responded:

I feel like I'm totally accepting of it. I think after having the conversation, that led to the lens of God created the process of that (evolution), that—that, to me, allowed me to be able to be accepting of micro and macro evolution.

Additionally, Emily recounted a piece of advice that she received from one of the theology teachers at St. Arthur Academy. The advice was simply: "Who's to say that God didn't create the

process of evolution to create all the organisms and animals?” This allowed Emily to see evolution and faith as not being in competition, but rather being some form of complementary truths.

Within the classroom, Emily stated that she addressed evolution as a scientific concept with little religious interference:

In the biology classes, we go through all the mechanisms—we’re really not bringing up creationism, we’re really not bringing up the religious aspect, we’re—we just teach them, these are the processes. Now, if a kid has a question, then we open the floor for discussion, but it’s not like in our teachings we’re saying, “Here’s what the Bible says; here’s what science says.” We’re not crossing those, but we are an open community to where if the kids do have a question . . . we’re just hearing all sides of the argument and we’re just discussing.

The takeaway is that while Emily might address student questions related to creationism and how it compares to evolution, she felt that creationism was not the focus of the science courses, and she did not use it as a counter to evolution.

Emily stated that students frequently asked her about her thoughts on evolution, which she told them. She added that she also fielded a number of questions from students related to the religious side of the evolution debate. In those instances, rather than trying to explain to students the religious perspective, she encouraged her students to make appointments with one of the theology teachers.

Emily considered herself to be religious and identified as nondenominational, although definitely Christian. Based on her answers and her identification as Christian, Emily would classify as being a theistic evolutionist.

The Role of Freedom

An interesting theme that emerged from the interviews of the participants at St. Arthur Academy was that most individuals cited “freedom” as a reason for working at St. Arthur Academy, even though the researcher did not ask participants about freedom or autonomy. Instead, the researcher questioned the participants about what they liked about the way teaching occurs in a private school (see Appendix, Question 8). For the participants, “freedom” was frequently about the bureaucratic portions of education. For example, Rachel stated,

We didn’t have standards that we had to cover that were dictated by the state and it— there was a document that we had that was developed by the teachers and we can lean to our likes or strong points.

Similarly, Emily stated,

There’s guidelines and thinks like that, but it’s not really scripted. So, if you’re really stronger in a topic you can really show your passion for that topic. As long as you’re still covering all the topics, you’re not told exactly what you have to teach and how you have to teach it.

Other participants identified being able to best utilize their teaching strengths. For instance, Emily stated, “I think we get the support of our administration to really use our talents and use what we can bring to the table and it’s not so much scripted as what we have to teach”

Similarly, David stated, “We know our field really well, and we love it, and we’re given the freedom to kind of move around in our field with our own expertise and kind of help the students fall in love with it.

Summaries from St. Arthur Academy

RQ1 and St. Arthur Academy. The first research question, in reference to St. Arthur Academy, asked: How is the teaching of evolution approached? In answer, faculty at St. Arthur Academy began curriculum realignments by examining the guidelines of major academic governing bodies and state standards when making decisions about their teaching curriculum, a process that occurred at least once every three years. While the curriculum documents of St. Arthur Academy may differ from the state standards, teachers at St. Arthur Academy strove to ensure that their curriculum was comparable to the state standards. Related to science and evolution, administrators with St. Arthur Academy not only permitted the teaching of evolution to all of its students, but they also created a class that delved deeper into what evolution might be and encouraged students to critically think about and endeavor to determine the possible impacts of evolution on society and self.

When asked if the administration had ever put pressure on the teachers to cover evolution or creation in a certain way, every interviewee stated no. The only individual to elaborate on the question was David, who stated, “No. I have not . . . my classes have been supervised before, my administration knows my views largely because, like I said before, they’re the Catholic views, and so there’s never been any kind of enforcement there.”

When asked if parents have ever tried to apply pressure to teachers to teach evolution or creation in a particular way, the results were mixed. David, Rachel, and John had not received negative pressure from parents. David commented:

No, I haven’t. It’s interesting, I’ve had a lot less parent complaints than I thought I was gonna have, you know. Teaching moral theology and Faith and Reason in today’s world I thought I would have a lot more complaints . . . It’s funny, like, my experience has been

kind of the opposite with parents coming to me and asking how does God and science line up?

Emily stated that while she had not had a negative experience from a parent, there had been instances in which students came to school having conducted what she described as “table talk” with their parents and then wanted to have a large number of questions about evolution and creation answered. Emily also said that while she would address the specific questions the student had, the focus of her teaching was not in addressing creation as a counter to evolution.

Given the information determined about teacher religiosity, how teachers perceive student religiosity, and considering the method of determining curriculum and presenting evolution, it can be concluded that faculty at St. Arthur Academy approach evolution as a viable and important scientific theory that needs to be properly addressed within the science classroom. Additionally, there was insufficient evidence to suggest that faculty at St. Arthur Academy actively address the concept of creationism alongside evolution, although the science teachers willingly answered student questions related to creation if posed. Specific instruction of faith-based ideas was reserved for the theology classes, and while the theology classes encouraged students to think critically about their faith and how their faith interacted with scientific concepts like evolution, there was no effort at St. Arthur Academy to pit evolution against creation or too wholly dismiss evolution.

SRQ1 and St. Arthur Academy. The first of the secondary research questions asked: Does the type of private school impact the teaching of evolution? In the case of St. Arthur Academy, the faculty took pride in being a Catholic-affiliated educational institution and helping students to understand the role of faith in their lives. Admission policy allowed enrollment of every type of student, not just Catholics and members of other Christian denominations. The

faculty encouraged students to examine their own faith and required students to attend Mass at specified times. However, the main function of the school was not to proselytize amongst the students.

St. Arthur Academy personnel also prided themselves as a college-preparatory institution. Consequently, they ensured that students were capable of attending the best colleges and universities in the nation. When it comes to evolution, the implications of this college-preparatory focus were quite clear: teachers presented evolution in a scientific manner as much as possible. Creation and other religious topics might find their way into some of the science classes as matters of comparison, but teachers typically deferred religious topics to the theology teachers and the Faith and Reason and Moral Philosophy classes.

Based on these observations, the researcher concluded that the religious nature, specifically Catholic tradition, of St. Arthur Academy was not impeding the scientific presentation of evolution. If anything, the acceptance of evolution by the Catholic Church allowed the teachers to be more at ease with covering the topic. Furthermore, it reduced conflict with stakeholders when educators taught evolution to its proper scientific extent.

SRQ2 and St. Arthur Academy. The second of the secondary research questions was: Does teacher religiosity impact teaching of evolution in private schools of Middle Georgia? At St. Arthur Academy, the religious worldviews of the teachers and administrator interviewed for this project were incredibly varied. While the variety of religious viewpoints demonstrated by the St. Arthur Academy faculty may not be by design, it does not appear to be subject to discouragement either. By not requiring a statement of faith from students or teachers, the school willingly promoted a culture open to a diverse set of worldviews.

The data revealed that the individuals interviewed for this work presented four different religious worldviews from amongst the five individuals interviewed, and while four of the individuals did express faith in a form of Christianity, one individual described himself as being simultaneously religious and non-religious. Also, none of the individuals interviewed, save the theology teacher, came to work at St. Arthur because of religious views. As such, for those individuals interviewed, describing religious preferences as the primary catalyst for employment would seem inaccurate.

The two individuals adhering specifically to Catholic beliefs, and thus most closely aligned to the original religious founding of St. Arthur Academy, were the administrator and the theology teacher. The administrator stated that he did not directly pressure teachers in how they were to teach any topic, much less evolution. Combining his statements with statements from other interviewees, which also described an administration that did not pressure them to teach evolution in a particular manner, it is determinable that the administrator's religiosity was likely not preventing teachers from presenting evolution in a scientific manner. Conversely, the theology teacher used his religiosity to directly impact students. However, sharing his faith and his faith's impact on science was a mandated part of his job as theology teacher. Therefore, while his religiosity impacted students, there were indications that it occurred in the proper, nonscientific method called for by his station.

The three interviewees that directly taught science courses all maintained that teaching of evolution should occur in science classrooms without interjection of religious beliefs. Rachel and Emily explicitly stated that teaching one's beliefs would be inherently biased and intended to sway a person's thinking rather than informing students of the scientific theory as intended in the concept of school. In addition, instead of just teaching the typical high school version of

evolution, John taught evolution in great depth by also having a course dedicated to teaching students a much deeper version of evolution and even asking students to evaluate if it is possible that human emotions and personalities are evolved. Evaluation of the evidence points to the conclusion that the participants were cognizant of the potential biases of allowing their personal religiosity to interfere in the teaching of their students. Consequently, they took measures to limit interference.

SRQ3 and St. Arthur Academy. The third of the secondary research questions was: Do perceptions of student religiosity impact the teaching of evolution in private schools of Middle Georgia? The student body at St. Arthur Academy was intentionally religiously heterogeneous. Students did not have to be Catholic, nor religious at all, to attend the school. As such, students of many religious and nonreligious backgrounds attended the school, each with his or her own view of the role of evolution and creation.

During his four years at St. Arthur, David had conducted an informal poll of his juniors. Each poll asked the students to identify their thoughts on the theory of evolution, selecting from: 1) evolution is true and disproves God; 2) Evolution proves that if God exists, he is a distant, deistic God; 3) God and evolution work together; or 4) God is real and evolution is false. Although David was unable to produce his data for this project, he stated that year after year the results had been consistent, with approximately 80% of students answering that evolution and God work together. The other three answer choices each receive a few votes each year. Another trend that David has recognized deals with students and their faith: “My general perception is that students are more likely to accept evolution over their faith . . . and I want to say that they are eager to chuck that out (their faith) a little too fast and without a critical enough eye”.

Although many of the students enter St. Arthur with some sort of prior understanding of the evolution/creation debate, Rachel stated that her experience was that students struggle with what to believe and if it actually mattered to them in the distant future. Rachel explained:

Students act like, “Oh my gosh, I’ve got to know, got to know whether it’s this way or that way” . . . they’re really struggling with whether evolution was started by God or whether everything just happened by chance.

However, Rachel, Emily, and John all felt that students were willing to accept evolution, even if they were timid about voicing their support or getting their questions answered.

Rachel said:

I would say they are closer to the for it side (evolution) . . . some of those few ask questions, and then some people don’t ask questions because they don’t feel like they should say anything. They don’t want to be embarrassed by their question, but I would say overall the majority—they are closer to the for it side (evolution) . . . I do not think they are having trouble piecing the two (evolution and faith) together . . . maybe a couple of topics or something that they may not understand or it’s just not, something is not clicking in their head.

Emily said:

They’re not questioning does this contradict their religious beliefs, they’re just saying, this is how things have changed. So, they’re not doing that higher order thinking or they’re just accepting of this is how the mechanism in which things have changed without having any issues with it . . . I don’t feel like they have an issue with one or the other. They’re not overlapping them. They’re just—believing in one doesn’t mean you don’t believe in the other. I just don’t feel like they have an issue with them overlapping.

John said:

There has not been a kid here that I—as St. Arthur that I’ve had to sell (on evolution).

Very receptive. Almost they’re passively accepting of it. Like, yeah, that makes sense.

Cool. I do wish they would wrestle with it more. Or have more skepticism about it.

This information leads one to conclude that perception of student religiosity impacted the teaching of evolution at St. Arthur Academy. Teachers had admittedly prepared themselves for resistance from students and other stakeholders, although no teacher could point to any specific instance of resistance. Additionally, teachers consistently remarked about wishing students would take more time to engage the learning of evolution. This would suggest that teachers were perceiving students as passive learners, which caused teachers to seek out methods they felt would engage students more with the topic. It was not determinable from the interviews if teacher perceptions of students were factually correct or if their attempts at better engagement were proving effective, but it was clear that teachers felt their students were not adequately interacting with evolution.

Case Study 2: Calvin Academy

Founded in 1987, Calvin Academy (pseudonym) was an offshoot of an already established Presbyterian-affiliated private school in Falls County. The founding members of Calvin Academy felt that the original Presbyterian private school no longer accurately represented their religious views and sought to establish a new institution that more closely aligned with their religious views. In this case, views were more conservative than the original Presbyterian school. During the split from the Presbyterian school, Calvin Academy chose to charter itself as an independent Christian school rather than to affiliate with any specific religious denomination.

Another aspect of Calvin Academy was the requirement for all faculty and staff to be professing Christians. Additionally, there was a requirement for each student who attended the school to have at least one parent that was a professing Christian. The students themselves did not have to be professing Christians, although a large percentage of students either entered the school as professing Christians or made the decision to become Christian while attending the school. It is important to note that students who did not make a profession of Christian faith could remain at the school, and they were not grouped with other nonbelievers.

Calvin Academy representatives identified its curriculum as Christian Classical Education. This curriculum, heavily based in biblical values, promoted a classical education rooted in foreign language, reading, and speaking. Calvin Academy offered three Advanced Placement (AP) courses: AP Government, AP English, and AP Biology. The rationale for these subject choices was because they were the easiest to incorporate into Christian Classical Education. As with the other two schools, the inclusion of AP Biology significantly increased the likelihood that students received instruction in evolution.

Christian Classical Education

Calvin Academy teachers utilized an instructional method they termed Christian Classical Education that emphasized “the seeking after truth, goodness, and beauty and the study of liberal arts and the great books” (Classical Academic Press, 2019, para. 1). Most iterations of classical education focus on the writings of thinkers, such as Plato, Aristotle, and St. Augustine among others, as their examples of individuals seeking after truth and goodness. Traditional classical education blends writings of the aforementioned thinkers with memorization, debate, and critical thinking as a means to educate students on the process of learning to think for themselves and develop the capability to rationalize the world in which they exist.

However, while the educators at Calvin Academy taught the students based on the methods of memorization, debate, and critical thinking, they did not typically use the writings of Plato, Aristotle, St. Augustine, and other well-known philosophers within the curriculum. Instead, their version of classical education was Christian Classical Education because they believed and taught their students that the “truth” referred to in classical education methodology was found in Jesus Christ. As such, the texts used at Calvin Academy usually possessed a Christian undertone, or the authors were well-known Christian authors or theologians.

More in-depth examination of the use of Christian Classical Education at Calvin Academy revealed the faculty and staff wholly embraced the teaching method. For instance, Elizabeth, the AP Biology teacher at Calvin Academy, stated she felt that Christian Classical Education “deals more with forming a child than with meeting standards. So rather than being concerned with external—with an external checklist, we—classical education is more concerned about how what they’re learning shapes their character”.

Kevin, an academic dean at Calvin Academy, summed up Christian Classical Education as “an underlying philosophy that infiltrates the—everything that you do based off the developments of the child with the pursuit of truth grounded in Christ with a biblical framework”. Kevin also stated,

We’re seeking to develop the head, the hearts and the hands of the students and you can’t do that if you don’t have a foundation to build upon. So, if you take God out of the picture your philosophies, your foundation, your reasons, your motives, everything just falls short.

Like traditional forms of classical education, the Calvin Academy administration grouped the students into three phases. The first was the grammar phase, which encompassed grades

kindergarten through sixth. In this phase, students typically learned through repetition, chants and songs, and other memorization techniques. The administration then slightly augmented the traditional classical education model by grouping their seventh and eighth grade students together for the logic phase and their ninth through twelfth grade students together for the rhetoric stage.

During the logic stage of education, classical education methodology focused on the natural tendency of teenage students to be argumentative and questioning. In the seventh and eighth grade years, students learned the proper way to question and evaluate what they were learning. To accomplish this, students had access to both academic and Christian texts. This encouraged students to examine the texts to see if they contained assumptions and/or truths held up to logical examination.

During the ninth through twelfth grade years, students at Calvin Academy followed the traditional classical education format of rhetoric stage, learning to be independent thinkers and communicators. It was at this stage that students did their most in-depth research and writing, which culminated with a required senior seminar. Seniors spend the year researching a topic of their choice, writing a thesis, and then presenting their findings to a panel of adults.

Calvin Academy also sought to expose students to “great books” like those called for by the Classical Academic Press. To accomplish this, Calvin Academy curriculum focused on reading entire texts. Elizabeth stated:

As they’re coming through, the littlest children are reading real books written by brilliant authors, rather than snippets here and there of basal readers or little readers that aren’t full of context. So, they read real books starting from the very earliest ages.

At Calvin Academy this meant having students read well-known texts like the *Chronicles of Narnia* by C.S. Lewis and *Cul-de-sac Kids* by Beverly Lewis.

Overall, the design and implementation of Calvin Academy's classical education was synonymous with what Classical Academic Press (2019) described as a key goal: The classical approach teaches students how to learn and how to think. Individuals within Calvin Academy had similar thoughts:

Elizabeth (Principal) stated, "We want to—them to be learning the very best, what is most true, good, and beautiful."

Kevin (Academic Dean) said, "The philosophy can be described as we're trying to train a mind that is able to learn and to adapt to any environment and circumstances versus training specifics for that environment and circumstances because those environments and circumstances change."

Sarah (biology teacher) said, "I love the idea that we're not programming a kid, we're actually teaching them to be learners for life."

Typically, the textbooks used at Calvin Academy typically contained a biblical worldview, prompting students to examine their holistic learning experience from a perspective that encourages a religious self-reflection while learning is occurring. The exception to the biblical worldview textbooks was in the AP courses, most notably in AP Biology. The AP Biology teacher used the Campbell Biology text so commonly found in public school AP courses. The AP Biology teacher, students, and parents all understood that the presentation of science, especially evolution, was significantly different with the College Board-approved text in comparison to the other textbooks used at Calvin Academy.

It was clear that the faculty of Calvin Academy believed in the classical education methodology and how it benefitted their students. It was also clear that placing Jesus Christ at the center of their pursuit for truth gave Calvin Academy a unique position within the classical education method, a position they felt helped to set them apart from other private schools of the Middle Georgia area.

Performance on the AP Exam

At Calvin Academy, students who took the AP Biology course received encouragement to take the AP exam, but they could decline. Unlike their counterparts in public schools, students in private schools are frequently required to pay for the AP exam, which the Calvin Academy representative cited as a reason that not every student taking the AP Biology course takes the exam. Representatives also stated the number of students taking the AP Biology course at Calvin Academy had also been low, with the average class size being less than 10 students. According to data provided by individuals at Calvin Academy, the average AP Biology exam pass rate over the past five years was 51%, with a high of 75% and a low of 20%, which is lower than the national average (63%) reported by the College Board, as well as the year-by-year average (high of 64.7%, low of 60.5%) for the same period. While the extremely small sample size of students taking the AP Biology exam each year makes it very challenging to adequately compare year-over-year data with the corresponding data from College Board, the data suggest that students at Calvin Academy were not performing in-line with the rest of the nation on the AP Exam.

Participant Portraits

For Calvin Academy, the researcher asked a total of five individuals to participate in the case study. Of those five individuals, four individuals agreed to participate in an interview, while one individual declined. The individual who declined did not provide a reason for declining,

simply stating that she was not interested in participating. The findings from the four individuals who did participate follow.

Elizabeth. Elizabeth was the principal of upper grades at Calvin Academy. She was in charge of students in grades sixth through twelfth. Elizabeth had worked at Calvin Academy for 11 years. She had been a public school teacher prior to making the move to private school.

Elizabeth attended public school from elementary to high school. She did not remember much instruction in evolution before high school, but she recalled that her high school teacher was an evolutionist and she received a traditional public school exposure to evolution because of those efforts.

Her undergraduate work was at a small, private Baptist university. While there, she majored in chemistry and received some instruction in evolution, but she recalled that it did not differ from what she had received in high school. Elizabeth later went to a small private, women's university and a medium-sized, public liberal arts university to get advanced degrees in education. Elizabeth's master's degree, which was from the private women's university, focused on how to teach science to young children, including how to teach origins of the world. However, her course work at that university did not go further than basic origins. Once Elizabeth began attending the public liberal arts university, she focused in general education and no longer took specific science courses.

Although she received training in how to teach elementary science, including origins of the world, while obtaining her teaching degrees, she did not receive any formal training in how to teach evolution, nor did she receive any formal training in teaching evolution after becoming a teacher. However, Elizabeth did learn about STEM (science, technology, engineering, and

mathematics) education and instructing using hands-on science while she was teaching public school.

Elizabeth first made the move to private school because of her children. As her children began to age into the middle school arena, Elizabeth wanted a “better” social-structure for her children. The search for a “better” social structure led her to Calvin Academy and now impacts the differences she sees in private school and public school.

When asked what about the social structure of Calvin Academy drew her and her family, Elizabeth said,

(I liked) the like-minded sense among the faculty and the other families here. Feeling that what I believe to be truth would not be undermined or compromised continually for my own personal children. So, what is truth is taught throughout—throughout the school.

When asked what she liked best about private school, Elizabeth replied:

I would say the relief was that we hold to high standards here. The artificial standards are not mandated and the red tape and the paperwork, teachers are free to look at their students and determine professionally what they need at the time and what’s best and take longer with units that they need to take longer with. So, there’s a lot more freedom in education in the private school setting. As a Christian, I also love that all subjects are centered around Christ. So, while we are very academically rigorous the – the center on Christ, as a Christian, for me gives new meaning to a lot of what I was teaching in public school.

When asked about accepting the theory of evolution, Elizabeth stated that she accepted evolution as a scientific theory. She then provided an interesting take on the relationship between evolution and creation/faith:

I do believe that truth is truth. So, if something is true and something else is true, they can't conflict right? So, truth is truth. So, if I have one truth that is true and another truth that seems to conflict, there's a problem either with my understanding of one or the other, right? So, in looking at evolution as a Christian believing that the truth is God created, I also see validity in the science that is done surrounding evolution. So, personally, I do believe in microevolution, I think that that is seen throughout and demonstrated throughout science. However, I do not accept many of the ideas in macroevolution; species jumping from one species to another.

As a point of clarification: Upon examining the full context of the transcript, when Elizabeth mentioned "species jumping" she was referring to the process of speciation and the long-term common ancestor process. Elizabeth's skepticism is fairly common for individuals who possess a high level of religiosity.

When asked to describe how her school address's evolution, Elizabeth said that the teachers "teach truth and present both views". She also said, "We don't want our student to go out into the world never having been presented with what the opposing or other view would be." Elizabeth also felt that her teachers and students had nothing to fear from teaching evolution because the "truth" always prevails, and she wanted students to have the freedom to come to terms with different viewpoints and make their own decisions about what is truth.

As a teacher of a senior seminar class, she was asked about her personal beliefs on evolution, but she stated that she hesitated to express her views with the students because they were supposed to be researching truths for themselves as they created their thesis.

Elizabeth was religious and identified as being an evangelical conservative Christian. Based on her acceptance of evolution and her belief in God as the creator, Elizabeth was a theistic evolutionist.

Sarah. Sarah was a high school science teacher at Calvin Academy. She primarily taught biology, anatomy and physiology, and environmental science. She had been in education for 29 years, with 24 of those years in a private school.

Sarah attended public schools for her K-12 education, but she did not remember encountering evolution until her high school biology courses. Even then, she only remembered evolution covered as part of one or two chapters of the textbook. She largely attributed this treatment of evolution to her attending a high school in conservative South Georgia during the late 1960s and early 1970s.

For college, Sarah attended two public universities. The first university she attended was primarily an agricultural school that dealt with human and animal medicine. While majoring in pre-med, she received exposure to evolution that would be typical of human anatomy. It was at the second university that she got a much more in-depth education in evolution. Initially intending to continue her education with a medical bent, Sarah changed her major to focus on biology. She recounted that while at the second university she took many different evolution classes, most of which were not named evolution. This included courses such as developmental biology, courses on natural history, and psychobiology. Within these classes, Sarah faced many concepts that went against her beliefs of creationism, causing her to examine and compare her beliefs to what she was learning in college. The end result for Sarah was a deepening of her belief in creationism and a more pronounced skepticism towards evolution.

Even though Sarah took many science classes in college, she did not recall receiving any specific instruction on how to teach evolution while she was in college. Since becoming a teacher, Sarah had been involved in a number of professional development classes, especially through NASA. She found that, while she enjoyed the information provided in the NASA trainings, she found it frustrating that the presenters and attendees were often openly condescending of any viewpoint that was not pro-evolution, with increased denigration toward those who believe in creation. Although these trainings provided Sarah with an enormous amount of information related to science and evolution, none of the training actually addressed how to teach evolution.

Sarah enjoyed teaching in a private school and specifically at Calvin Academy because of the freedom she received in the science classroom. For Sarah, this freedom was twofold. First, she liked the freedom from state mandates of what can and cannot be taught in the science classroom. Second, she liked the freedom to express her beliefs about science to her students:

I love the fact that I can be teaching on this part of the anatomy, and then I can pull back and say, “Whoa, you know, think about a creator and all that’s involved in that creator getting to that point, and everything that would have to fall in to place for that to fully work, and—the theory of irreducible complexity—that one feature could not have evolved on its own.” I love to be able to stop and do that. Not teaching Bible but teaching the—the idea of an intelligent creator.

Sarah was drawn to Calvin Academy because she wanted her children to be presented with more than one side of issues, especially issues such as evolution. She specifically started teaching at Calvin Academy because she knew the founders, believed in what they wanted to do, and then accepted an offer from them to become a teacher.

When asked if she believed she should address evolution in her classroom, Sarah responded that you cannot fight an idea if you do not understand what that idea is saying. She further stated:

They need understand it (evolution). They need to understand if they agree or disagree with it. Not what the book says. Not what the teacher says because they can go through and believe everything that I tell them, and then they go off to college their freshman year, and they're gonna start believing what someone else tells them. They need to understand it in their mind. They need to make an intellectual decision and be able to discern any other scientific material coming down as to whether there's truth in it or not truth in it.

Sarah frequently received questions about her personal views toward evolution. She stated that students typically come to her in a very curious manner, with many having heard that evolution is a bad word and wishing to know why. Sarah told the students what she believed, but she also told them, "I don't want you to believe this just because I'm saying this". She wanted the students to figure out the truth for themselves.

Sarah was religious, adhering to the teachings of PCA Presbyterians and believing in the inerrancy of the Bible. Sarah identified as a six-day creationist and did not personally believe or accept evolution. Based on her statements, Sarah displayed the characteristics of a biblical literalist.

Kevin. Kevin was an academic dean at Calvin Academy. He formerly taught high school math courses. In his position of academic dean, he helped to ensure teachers taught at a high level and students met all graduation requirements. He had been in education for nine years, with all of those years being in a private school.

During Kevin's K-12 education, he attended a private Christian school connected to a fundamentalist Baptist church. Kevin stated that this school drew a sharp dichotomy between what was sacred and secular, posturing that those ideas that were of the church and/or sacred were good, and any other ideas were bad. As such, Kevin had no instruction related to evolution, and he felt that the topic was most likely forbidden. He remembered that the schoolteachers taught creation exclusively and treated Genesis like a science textbook.

He later attended a private Christian college where he majored in math. At college, his only science course was astronomy. This course exposed Kevin to some ideas about the origin of the Earth, and therefore, some evolution. However, Kevin explained:

It wasn't evolution as in the common perception where things evolved from one thing to another. It was, okay, God could have worked in this way or this way. There's five perspectives the Presbyterians hold to, and if you are okay with one of these then you're okay with what the Bible says.

Kevin liked teaching in private school because of the freedom it offered, but also he said, "We are seeking after truth and we're not afraid of hard questions". Continuing with the ideas of truth and hard questions, Kevin stated:

If you look at different cases, you have to balance what they do with their world view. Here are the holes. Here are the problems. Here are the questions that arise within an opposing world view. And here's the holes, here's the questions that arise with our world view. So how are they answered, what goes on? So, we try to give—we're very firm in what we believe, but we are not afraid to present other things. Eliminating straw men. Eliminating easy believism, and I like that aspect. I think it increases the rigor when you

are exposed to more than one idea, and you're taught, your mind is trained to interact with any ideas that come your way so that you're not surprised by something new.

Kevin came to work at Calvin Academy by what he described as an act of God, stating that he had conducted numerous interviews with a highly respected public school system, and he was prepared to take a job there. It was when the public school system declined to hire him that he seriously considered Calvin Academy. That situation is what led Kevin to feel that his working at Calvin Academy was divinely inspired.

He did not remember receiving any specific instruction in science or evolution, nor did he remember any instruction in how to teach evolution. Given that Kevin's focus was in math, this was not surprising.

When discussing his thoughts on accepting evolution, Kevin stated, "Nobody denies the microevolutions. The evidences for that are the different vaccines, different things becoming immune to different things and just going on like that". However, Kevin also stated that he was very much against macroevolution and what Kevin termed *the mainstream interpretation* of the theory of evolution. Those he regarded as anti-God. Although Kevin did not provide specific examples of his belief that macroevolution was "anti-God", his statements insinuated he believed teachings that espoused species creation by any method other than creation by God were incorrect and were contributing to a belief that science and evolution disprove a need for God.

Students had asked Kevin about his thoughts on evolution, and he said they were often surprised by his answer. Recall his thoughts on accepting microevolution while rejecting macro evolution. However, what frequently stymied the students was that Kevin believed in the Big Bang Theory, citing that the faith community first discussed the theory, and many interpreted it as proof that God does exist.

When asked about being religious, Kevin stated that it was about relationships, not just religion. However, he did state that he believed in Jesus Christ. Kevin also personally held to the idea that God created the Earth in six literal days. Based on his statements, Kevin was a biblical literalist.

Rebecca. Rebecca was a high school science teacher at Calvin Academy. Within the past few years, she had taught physics, chemistry, biology and AP Biology. Rebecca had been in education for five years, all of which were at Calvin Academy.

Rebecca attended public school for her K-12 experience. Upon reflecting upon this experience, she was unable to recall much about evolution instruction. She also stated that 30 years ago when she was in the K-12 experience, evolution was not a culturally popular topic, especially where she grew up. She believed that had an impact on the instruction that she received.

She attended a private, Christian college to obtain her bachelor's degree. However, even though she attended a private, Christian college, she recalled an extensive look at evolution in college. She stated that the professors presented evolution as a viable but very fact-based theory in which professors addressed "holes" in the theory only if students asked specific questions. Rebecca's primary evolution professor believed that faith and science should not disagree, and he gave students a great deal of information about how evolution worked. However, he did not discuss the faith side of the evolution/creation debate with much regularity or depth. Instead, the professor encouraged students to reconcile on their own and make their own decisions. This caused Rebecca to initially struggle with understanding how the two concepts interacted with each other.

Rebecca had never had any formal instruction in how to teach evolution, but she had extensive experience in chemistry and running a pharmaceutical lab, a position that allowed her to experience the genetic arms race between pathogens and pharmaceutical companies. The lab experience was the reason Calvin Academy representatives asked her to become a teacher, and it gave her perspective on evolution that differed greatly from that of most of her colleagues.

Rebecca liked the freedom that existed within a private school, noting, “Not that it’s not rigorous, not that there’s not accountability and oversight, but I do have some freedom in what I can teach and in-depth I can go”. She did not see herself going into public education, nor did she see herself attaining any further degrees.

Rebecca was drawn to Calvin Academy because the administration respected her as a scientist and provided her a way to have a stronger presence in the education that her children received. Rebecca addressed it thusly: “As parents, I do feel like we delegate who educates our kids. I feel like it’s our responsibility as parents, and so then we delegate . . . I have three boys in this setting, which is where I wanted them.”

Prior to entering the classroom, Rebecca received her AP Biology certification. This was the extent of her training in how to teach evolution, but as she said, “You don’t just step into an AP class. And so that was an intensive training”.

Rebecca’s training experience for teaching AP Biology troubled her. While she was willing to accept many of the tenets and teaching points of evolution, she found the texts and College Board-approved methods of teaching to often lie outside of the bounds of what she believed. Rebecca stated:

I was the only Christian private school teacher at that training with about, I’d say, 15 to 20 other people, and they were talking about one thing, and I was like, I don’t think that’s

going to go over well with my students, the approach. And they're like "What?" I said, "It's a Christian school and that leaves God out of the picture, not just leaves him out, but removes any possibility that there was a God, and it was a stretch." I said, "There's no evidence, there's no facts for that. You can't just say that that's the way it is."

Rebecca also expressed another participant of the training troubled her. This participant had ascertained that students would believe whatever the teacher said and therefore, to not worry about particulars. Additionally, since she had become a teacher, Rebecca had not received any additional training in how to teach evolution.

When asked if she accepted the theory of evolution, Rebecca fell back to both what her scientific background and faith told her. She stated:

I believe in some of the theory of evolution certainly. Anything that doesn't go against scripture. Anything that's good science I'm on board with because I am a scientist, I think like a scientist . . . but what scripture does say is God created something out of nothing, and so there was a beginning, and it originated with a creator. Those things I would not doubt. That life happened by accident? I would not believe. That God put it into motion using the Big Bang, maybe, but God put it into motion . . . The difference between microevolution and macroevolution? We see natural selection all the time. I see it, there's evidence for it. We do a lab for it . . . We see adaptations, we see microevolution. I have no doubt that that's real. Now macro—did we come from sponges? There's no evidence that there is—yes, I can see simple to complex. I can see linear progressing of complexity. Yes, we can follow that logic, but that this became this? It's really hard to follow.

The concept of microevolution and macroevolution was not the only evolutionary topic Rebecca discussed. She also addressed the origins and particularly the theory of biogenesis with its concept that life came from the mixing of nonliving molecules. Related to biogenesis, Rebecca stated:

The chemistry world, the professional and academic chemistry world is adamantly against a biogenesis and/or something from nothing. That you can have organic molecules mixing together, and then there's life. They (chemists) say there's a leap that can't happen. The book here (*Campbell Biology*) says that's exactly how it happened. Now, they would say this is a theory, they do say that. They do recognize it as a theory, but then it's presented as the only option. So, the book would present evolution as a theory, the origins, biogenesis as a theory, but then the rest of the book teaches based on that foundation and gives no other alternatives . . . the chemist side of me so no, there's no way that these molecules join together and made these protocells. So, origins is [sic] very hard.

When asked how she addressed evolution in her classroom, Rebecca said, "Do I teach it? Yeah, this is what the biology world believes. It is their world view, it is—I teach them that. Do I teach them it's the only thing? No, we talk about the holes in that". Rebecca tried to properly execute teaching evolution in her class by making sure to expose students to the concept and give them the time and space to wrestle with the concept. Her students completed the required AP labs and frequently practiced with AP study books and released questions. Rebecca allowed students to discuss the issues they had with the theory, but she did not allow the class to be a theology class.

Rebecca considers herself to be religious and identifies as belonging to the Presbyterian Church in America (PCA). Based upon her religious views and her scientific views, Rebecca was a theistic evolutionist.

The Role of Freedom

A noteworthy theme from the participants at Calvin Academy was that each individual cited “freedom” as a reason for working at Calvin Academy, even though the researcher did not ask participants about freedom or autonomy. Instead, the participants answered questions about what they liked about the way teaching occurred in a private school (Appendix, Question 8).

Kevin stated, “I like the freedom. We are seeking after truth and we’re not afraid of hard questions.”

Elizabeth had a similar sentiment when she stated,

While we hold to high standards here, the artificial standards are not mandated and the red tape and the paperwork. Teachers are free to look at their students and determine professionally what they need at the time and what’s best and take longer with units that they need longer with.

Rebecca delved even further into “freedom” at Calvin Academy as curriculum based when she said,

I love the freedom that we have. Not that it’s not rigorous. Not that there’s not accountability and oversight, but I do have some freedom in what I can teach and in-depth I can go. I can pull outside the textbook, outside of whatever curriculum we’re using. I feel like it’s a whole-person approach versus teaching my one thing, aligning to these objectives and that’s it.

Finally, Sarah took “freedom” further into the realm of curriculum when she said,

What I love about teaching science in a private Christian school is that I can share my beliefs, and I can share why I believe that as far as science. You know, share the real science and not have to worry about legal problems.

Summaries from Calvin Academy

RQ1 and Calvin Academy. The first research question, in reference to Calvin Academy, asked: How is the teaching of evolution approached? Representatives from Calvin Academy readily admitted that they taught both creation and evolution. Elizabeth, the head of upper school, stated:

It's my understanding that our science teachers teach truth and present both views. Of course, we hold to creationism as a Christian institution, a Bible believing Christian institution. However, we don't want our students to go out into the world never having been presented with what the opposing or other view would be. Or other views, there are so many other views.

All of the interviews corroborated Elizabeth's statement, with the participants repeatedly affirming that students need the presentation of all the options and the freedom to make their own decisions on what is true. Specifically, Kevin stated, "Both sides (creation and evolution) are presented as fairly as possible. And questions are raised about both sides." He also said, "Christian private schools seem to be one of the very few settings that actually examine both perspectives."

"Examining both perspectives" is another topic that was either stated explicitly or implied with frequency by participants: the teaching about or referencing to an intelligent creator or intelligent designer within the science classroom. As previously discussed, the Discovery Institute coined the term intelligent design, and it became the focal point of the court case

Kitzmiller et al. v. Dover Area School District (1971). Court rulings effectively banned the use of the term and attempts to teach about intelligent design within public schools. However, due to their designation as a private school, Calvin Academy is not subject to the prohibitions from teaching the concept. The ruling in *Kitzmiller et al. v. Dover Area School District* stated that teaching intelligent design was nothing more than teaching creationism, just with a different name. Therefore, when teachers at Calvin Academy invoked the concept of an intelligent designer, they were bringing the concept of creationism into the science classroom. The scientific community strongly discourages mixing science and creationism within a science classroom in any form, including intelligent design, because it can lead to ineffective teaching of scientific concepts. Despite the statements from the scientific community, Calvin Academy personnel felt they served their students best by allowing for coverage of both topics in the science classroom.

When asked if the administration had ever pressured the teachers to teach evolution and creation in a certain way, all of the participating teachers replied in the negative. The administrator said that she had never had to reprimand a teacher for using a method to teach evolution. When asked if parents had tried to apply pressure to teachers to alter the way in which educators taught evolution, Sarah, Elizabeth, and Kevin had the following responses:

Sarah said:

Parents want their kids to understand evolution because you cannot walk out the doors of here and go to any college, any public college, without understanding or having a knowledge of what it is. It would be suicide for us to send our kids out without them having a background of knowledge of evolution.

Elizabeth said:

One time, and it's a rare thing, but we do have some families who are very literal seven-day creationists and so anything that comes up in the science books that we have that talks about millions of years or the age of the earth. That creates conflict for them because how is the earth millions of years old if the earth was created in seven literal days?

Kevin said:

I know that parents have pressured teachers, and we've had teachers who wouldn't give their stance because they want the students to be able to observe and draw conclusions and interpret it through a biblical world view, and so the teacher didn't give their stance, and they were pressured by parents, "Who do you believe? Why are you teaching like this?"

Sarah said: "This child's father was a well-known doctor here in town, and he was not a believer, didn't really want his kids over here, and so he way—he would bring books by, evolutionary books."

However, Rebecca had not experienced parental opposition, which she admitted surprised her. She did state that at the beginning of the school year she met with all the parents of students in her AP courses and let them know what topics she would cover, including an in-depth focus on evolution. Whether or not this singular meeting is the reason she did not experience conflict or whether parents just accepted the curriculum as a part of the AP experience is unknown, but the overall result of not getting opposition from parents is the same.

Given the conservative nature of the school, the most pressing question related to science and evolution would be: are students receiving the quality of instruction that colleges expect? When asked about how the curriculum is determined, Rebecca stated, "The administrators and

directors, they get together with the counselor who knows all the state laws and what's expected because, I mean, we're a school, we want our kids to get into great colleges and have great careers, and so we don't willy nilly teach whatever." Rebecca elaborated:

In our science classes, especially life science, it (evolution) needs to come up. It needs to be talked about. It's a theory. Whether or not we believe it's a valid theory, it's a theory that's widely believed, especially in the academic biology world. That's what they believe, and all their research is focused with that foundation.

Coupling Rebecca's statements with the ideas presented about teacher and student religiosity reveals that teachers presented evolution and Calvin Academy personnel were not afraid of engaging in academic controversy in the name of teaching students to think.

There is no question the students of Calvin Academy received instruction in both the scientific and nonscientific worldviews of life's origins and species change within science classrooms. Representatives of Calvin Academy stated that allowing both topics to be taught in the science classroom encouraged students to think more deeply. However, without research data from within the classroom, gathered over an extended period of time, it is not possible to ensure that the "logical reasoning" and "students discovering truth for themselves" is occurring. It is possible teacher bias and/or teaching methods are still steering students in a manner that is less open educational process and more religious dogma. Additionally, evaluation of data established that students at Calvin Academy lag the nation in average performance on the AP Biology exam, yet the extremely small sample sizes make real comparison difficult. Therefore, while creation and evolution were definitively being mixed within the science classroom, it was nonetheless impossible to fully evaluate the validity or effectiveness of Calvin Academy's process based solely on the data from this project.

SRQ1 and Calvin Academy. The first of the secondary research questions asked: Does the type of private school impact the teaching of evolution? In the case of Calvin Academy, it is one of the more conservative educational institutions. The use of Christian Classical Education and the enrollment requirement that at least one parent of each student was a professing Christian are but two examples of the religious initiatives under which the school operated. The use of Christian Classical Education means every educational situation at the school was in some way tied back to the Christian faith and no area of the curriculum was exempt from this methodology. Because the Christian faith influenced every portion of the curriculum in some way, the curriculum could potentially become religiously dogmatic.

An examination of the Calvin Academy curriculum revealed that science and particularly “controversial” topics like evolution, seemed to elicit the most attention from teachers, parents, and students. Kevin explained this phenomenon the following way: “We are creationists, and the people that come here are creationists overwhelmingly”. Assuming that Kevin’s statement is factual, it is easy to understand what Kevin believed to be a potential issue with evolution:

When you take Christ out of it, there’s no point, there’s no purpose, which is one of the reasons why we are opposed to evolution. If we are here by chance and by accident, and we just evolved, then there’s no point or purpose to our existence, and there’s no point or purpose to morality.

To be certain, not every individual associated with Calvin Academy shared Kevin’s view, but given what is known about the school at large, Kevin’s words help to explain the mindset that led to the formation and operation of Calvin Academy.

The overall conclusion is that, as a Christian, conservative educational institution, the instruction that students receive at Calvin Academy intentionally contains Christian belief and

influence. Accordingly, it is extremely likely that the teaching of evolution also included religious challenges and the presentation of alternative ideas.

SRQ2 and Calvin Academy. The second of the secondary research questions was: Does teacher religiosity impact teaching of evolution in private schools of Middle Georgia? According to the history of Calvin Academy, all faculty of Calvin Academy must be professing Christians. As such, it is possible that teachers possessed an opinion related to evolution, and given the conservative nature of the school, it is likely that many of those opinions were of a conservative nature. Collectively, this indicates that teacher religiosity at Calvin Academy was likely quite high, as exemplified by the interviewees' statements.

Sarah stated that as a creationist she did not believe or accept evolution as a viable theory, but rather she presented evolution to students as a philosophy. She gave them as many facts as she knew and understood about evolution and then encouraged the students to use the skills of logic that they were learning at Calvin Academy in order to evaluate for themselves the validity of evolution versus creation. Sarah also stated:

[I] learned to look at anything coming out and say where's the verification? And is there anything contrary to that verification because if there is, if there's any good science out there that is—that contradicts that, then it's still not a theory yet. So, I'm very careful what I call a theory and law. I make sure my students understand what laws are versus what a theory is versus what is a philosophy. And so, I point that out to them, and right now evolution is just a philosophy.

Compare Sarah's statement to statements from Kevin about being a biblical literalist and believing that education without a center on Christ misses the point of holistic education. There are also statements from Elizabeth about using Christian-themed novels to help teach reading

and statements from Rebecca about her frequent discussions with students about the issues she sees with origins and speciation.

All of the evidence would seem to point to a situation where teacher religiosity encourages an education rooted firmly in religion and creation while downplaying or dismissing evolution. Teachers at Calvin Academy suggested that the intent of their adherence to religious doctrine within the school, while allowing instruction in topics such as evolution, was to teach students how to think critically and evaluate all types of evidence. Two participating teachers felt the controversy between evolution and creation should be taught, while another teacher felt that his personal feelings, expressed or not, had no impact on how students interacted with the learning. Both of these viewpoints illustrate that Calvin Academy representatives intended evolution and creation to be purposefully debated within the science classroom, and even if the teachers intended to separate their personal feelings from the instruction, the danger is that personal feelings will in fact influence the way teachers address the issues. The conclusion is that teacher religiosity was impacting the way that evolution was addressed at Calvin Academy. Whether this phenomenon was entirely by design or partly a symptom of like-minded individuals electing to work at the same location is unclear. However, because the faculty of Calvin Academy actively instituted creationist religious principles into the curriculum, it is unsurprising religiosity influenced classroom instruction.

SRQ3 and Calvin Academy. The third of the secondary research questions was: Do perceptions of student religiosity impact the teaching of evolution in private schools of Middle Georgia? Three of the four participants from Calvin Academy expressed some measure of skepticism in how they viewed students responding to evolution. Elizabeth felt that students tend to be very skeptical towards evolutionary theory when they view it alongside God as a creator.

Elizabeth also felt that student opinions only changed a little as students progressed to graduation, and when asked if student acceptance of evolution increased during their high school years, she stated, “It’s probably half and half. The students who take AP biology and who are more exposed to it (evolution) tend to have a better understanding of how to defend what they believe without shutting down”.

Sarah’s experience led her to believe that students have steadily become more shallow thinkers, less willing to critically think about topics. When considering evolution, Sarah felt that many students were becoming less willing to intellectually wrestle with what evolution is or to consider evolution’s alternatives. Rather she saw students as seeking to get just enough to pass tests and then move on.

Largely, Rebecca felt that most students were largely indifferent to evolution. However, she found a few trended toward a more hostile viewpoint. Conversely, Rebecca also viewed most of the students were “hungry to learn, especially things that are outside of their realm of learning”.

These viewpoints demonstrate that Calvin Academy teachers, describing a classroom context that seemed replete with laissez-faire student attitudes, perceived students as unwilling to fully engage with evolution. The student attitudes in science classrooms discussed by the participants included examples of *pump-and-dump* learning, learning just enough to pass a test, and unwillingness to engage in discussions about the topics at hand. Overall, participants expressed frustration with students’ responses. However, when considering if teacher perception of student learning is based upon teacher religiosity, the answer appears to be maybe. The participants did not reference matters of religion in their assertions that students were not

engaging with discussions about evolution, but it is impossible to disregard that teachers expected a particular religious based response that they were not getting.

Case Study 3: Wimbledon Academy

Wimbledon Academy was a secular, non-religiously affiliated private school founded in the early 1960s and, like many Southern private schools, developed because of the federal lawsuits related to school integration. Although Georgia, and Falls County specifically, fought integration for many years, the wealthy and affluent of Falls County, especially those of Caucasian ancestry, could see that change was coming, and many wealthy individuals banded together to form private schools that would allow school officials to control who was educated at the school. From this beginning, Wimbledon had become a somewhat racially diverse school where teachers pride themselves on providing a very rigorous education to every student who entered the school, no matter the student's race/ethnicity or religious beliefs.

Curriculum

Teachers at Wimbledon Academy conducted periodic curriculum audits by examining the knowledge requirements for students in public schools. The science department staff then examined their own offerings to determine the necessary changes to ensure that students received exposure to the most rigorous curriculum possible. Because of this disposition toward offering the most rigorous courses, Wimbledon provided courses often reserved for much larger high schools or even college. Examples of these courses include genetics, microbiology, and zoology, as well as teaching some parts of high school level biology to students as early as seventh grade.

In addition to their standard curriculum, Wimbledon offered 21 AP courses, including AP Biology, AP Chemistry, and AP Environmental Science. As with the educational curriculum at the other participating institutions, the inclusion of AP Biology at Wimbledon significantly

increased the chance of evolution instruction. Of further significance with the list of AP courses was that Wimbledon had on occasion ceased to teach a high school level course in favor of the corresponding AP course. Specifically mentioned during this project's interview process was that educators no longer taught high school level environmental science at Wimbledon. Instead, Wimbledon Academy offered ninth grade students AP Environmental Science.

An interesting debate that arose from the interviews was whether or not to break instruction of evolution into micro and macro evolution. Jennifer, a new teacher, felt it appropriate to present students with the differences in microevolution and macroevolution, especially when students progressed into the upper level sciences. Danielle, the AP Biology teacher, expressed no opinion about separating microevolution and macroevolution. However, Matthew, a veteran teacher with a heavy science background, felt that the separation of microevolution and macroevolution was more of a distraction than real science. Matthew commented, "I think the problem comes in saying one is valid and the other is not." Matthew continued:

So, I don't break it down into micro and macro. We look at some smaller scale evolution as well as much longer time frames. And it rarely comes up, that kind of dichotomy between micro and macro evolution. It's the same process, it's just about how long a time frame you're looking at.

In the end, it does not appear that Jennifer's desire to teach the difference between micro and macroevolution and Matthew's desire to not delineate between the two made any difference for how the educators taught students. Since Jennifer taught primarily the intro-level biology courses, she did not have to go into the depth necessary to facilitate a real discussion on micro and macro evolution. As for Matthew, since he dealt more with upper classmen, his decision to

teach evolution without the micro and macro delineation meant that his teachings often mirrored the teaching done by lower grades teachers.

Performance on the AP Exam

At Wimbledon Academy, all students who took the AP Biology course had to take the AP Biology exam. Representatives of Wimbledon Academy declined to answer if the students had to pay for the AP exam or if school funds paid for it, although the typical practice for private schools is to require students to pay for the test.

Representatives also stated the average class size for the AP Biology class was 24 students, with a high of 31 students and a low of 18 students. According to data provided by individuals at Wimbledon Academy, the average AP Biology exam pass rate over the past five years was 85.7%, with a high of 100% passing and a low of 69% passing, which is higher than the national average (63%) reported by the College Board, as well as the year-by-year average (high of 64.7%, low of 60.5%) for the same period. While it is not possible to compare specific AP exam performances with the corresponding data from College Board, the data suggest that students at Wimbledon Academy were surpassing expectations as compared with the rest of the nation on the AP Exam.

Participant Portraits

For Wimbledon Academy, the researcher asked six individuals to participate in the case study. In the end, only three individuals were able to participate because two individuals declined to participate and one other individual, initially interested in participating, eventually was unable to schedule time for the interview. The findings from the three individuals who did participate follow.

Jennifer. Jennifer was a high school teacher at Wimbledon Academy. She taught biology, human anatomy, and physiology. At the time of the interview, she was beginning her second year in the classroom, with all of her time as a teacher spent in a private school.

Jennifer attended a total of three private schools during her K-12 experience. Two of the private schools had religious affiliations, while the third school was a specialty private school designed to help students overcome specific learning disabilities. The private school where she spent her fourth through twelfth grade years attending had affiliations with the Presbyterian church. Jennifer did not remember any instruction related to evolution until her high school biology course. In the course, the teacher presented evolution and was open-minded about presenting the Christian creation story. Jennifer recalled that the biology teacher presented evolution very scientifically and told the students that, just as they had studied other scientific theories, they would be studying evolution. She also took AP Biology and remembered there being more instruction on evolution in that course.

For her bachelor's degree, Jennifer attended a private, liberal arts college without religious affiliations. She had not yet obtained any graduate work. While in college she double majored in neuroscience and science education. Accordingly, Jennifer recalled a great deal of exposure to evolution. In addition to the standard introductory biology courses, Jennifer also took classes in human morphology, human anatomy, genetics, and sociobiology. Based on her course load, Jennifer described her exposure to evolution as "it was more about what the evolution purpose of it was rather than the—going through the stages of evolution".

Jennifer chose to work in a private school because of her experience with attending private schools. She understood that private schools allow teachers more freedom to choose the educational path that she took with students, which permitted her to teach more to her strengths

and spend more time on those topics students seemed to struggle with the most. What drew her specifically to Wimbledon Academy was wanting to work at a private school that would not impede her ability to teach evolution to her students. Having spent a large amount of time studying evolutionary principles, it was important to her to be able to teach others about evolution without worrying about possible interference due to religious beliefs.

When asked about accepting the theory of evolution, Jennifer replied that she accepted evolution because of the evidence she had seen presented, focusing primarily on evidence like fossils, homologous structures, and vestigial organs. She stated that she liked things she could physically see, and that was likely a driving force for her decision toward evolution. She also stated that she believed it was important to delineate between microevolution and macroevolution, especially for higher level sciences, because it allows students to better focus their thinking.

Having been in the classroom for only one full year, Jennifer admitted she had not yet experienced much with the teaching of evolution. She stated that she approached the topic as a full scientific theory with no attempt to bring creation into the class. She discussed the works of Darwin and Lamarck and taught most of the major topics that high school biology typically covers. Given more time to gain experience, she felt that she would expand her offerings related to evolution and lead students to more depth of understanding.

Jennifer stated that when she was young, she participated in religious functions. However, as she moved into high school, she no longer attended church regularly and no longer saw Christianity as an important part of her life. Accordingly, while religion had played a role in her life, and she was not anti-religious, she stated, "I would also say I don't attend church or

really do any religious functions besides major holidays”. Based on her statements related to evolution and her religious faith, Jennifer was an evolutionist.

Matthew. Matthew was a science teacher and science department chair at Wimbledon Academy. He had been in the teaching profession for 26 years, with his first three years being in the Peace Corps and his remaining 23 years being at Wimbledon Academy. In past years, he taught biology, college preparatory and accelerated chemistry, AP chemistry, and human genetics. Until the past few years, he focused mainly on biology, but with the hiring of new teachers to take over the biology courses, he transitioned to human genetics and chemistry.

During Matthew’s primary school years, his family moved frequently and lived overseas at times. For his middle school and high school experience, he attended public schools in a rural portion of Western Kentucky. He remembered exposure to evolution through his high school biology course and his advanced biology course (precursor to AP biology). Matthew recalled his biology teacher “tiptoeing” around the topic of evolution. He also remembered that his advanced biology teacher was a very religious individual, but the teacher taught evolution, and specifically the mechanisms of the evolution. Matthew recalled the advanced biology teacher saying he did not believe that the mechanisms of evolution were able to explain the full diversity of life on earth. It was unclear to Matthew whether his teacher referenced a creator or some non-Darwinian mechanism of evolution.

Matthew started his collegiate career at a private, liberal arts school where he majored in biology and did copious work with cell and molecular biology, similar to work and topics generally considered macro-biology. After receiving his bachelor’s degree, he enrolled at a private research university, intending to work on a Ph.D. in a biological field. However, Matthew decided he did not enjoy the research field of biology and joined the Peace Corps to teach. After

leaving the Peace Corps, Matthew moved to Middle Georgia, where he completed the last of his degrees, a master's degree in arts in teaching from a public, liberal arts college.

While completing his master's degree, Matthew received some instruction on how to teach evolution in the classroom, with most of the instruction coming from the time he spent student teaching. Since entering the classroom, Matthew had attended many state and national science conferences, seeking to better his overall understanding of science education. These conferences comprised the full extent of the additional training he had related to teaching evolution.

Matthew enjoyed working at a private school because "we're more free to teach the material that we teach in the classroom, without as much bureaucratic burden as you might find elsewhere". He acknowledged that there was still oversight, since the departments audit what was taught and the administration then had to sign off on it, but the educational environment began at specifically meeting student needs rather than meeting arbitrary pacing guide expectations.

Matthew was drawn to the Middle Georgia area because of having family that also lived in the area. He began his career at Wimbledon Academy because of a friend who heard of an opening. When hired, Matthew had only intended to teach at Wimbledon for a few years before moving on, but he ended up staying because he married another teacher at the school.

Matthew took the experience from his student teaching days and used it to fuel how he taught evolution. Matthew stated,

I think science should be based on the evidence. We try to teach our students to think like scientists. What does the evidence show us? Not just evolution happens and here's the results of it, but why do we know what we know?

Within his genetics courses, Matthew had students frequently focus on case studies. In these case studies, students examined the spread of genetic conditions and diseases. Students investigated how the genes move through the population and how the population is both benefited and harmed by the condition.

Matthew did not consider himself to be particularly religious. He stated he attended the Episcopal church when he was growing up and participated quite regularly in church activities. However, as he grew older, he drifted away from regular church attendance and did not currently attend church frequently. Based on his statements and beliefs, Matthew was an evolutionist.

Danielle. Danielle was a science teacher at Wimbledon Academy. At the time of this project she taught AP Biology on a part time basis. Overall, she had been teaching for 10 years, with all 10 years spent in a private school.

Danielle attended Wimbledon Academy for her own K-12 experience. She remembered that evolution instruction in her freshman biology and AP Biology courses. She also remembered learning all of the scientific theories while in secondary school. Danielle attended a large, public university for her postsecondary education, but her degree at that time did not require her to take courses in evolution, meaning that she did not receive any more training in evolution before exiting the classroom as a student.

Prior to becoming a teacher, Danielle did not have any formal training on how to teach evolution. Since becoming a teacher, the extent of her formal training comprised taking the AP Biology preparation course offered by the College Board. She had no other trainings in teaching evolution other than the AP training course.

Danielle enjoyed teaching at private school for the flexibility, smaller setting, and smaller classes. Flexibility was important for her because of her desire to teach part time, something not

frequently done in public schools. The smaller setting was important to her because it allowed for a more individualized education for students. For Danielle, teaching at Wimbledon Academy was more than just a job. She wanted to teach at Wimbledon because it was also the school she attended during her K-12 experience. While attending as a student, she had formed many relationships with both students and faculty, and teaching at Wimbledon allowed her to continue those relationships.

Danielle stated that she accepted the theory of evolution and believed that it should be taught within science classrooms. Regarding her own classroom, she stated, “I teach the theories and focus on science”. Danielle also believed that it was important to teach evolution to students, noting “it leads to insightful conversations. Life is pretty amazing”. Danielle considered herself as religious and an Episcopalian. Based on her beliefs related to religion and evolution, Danielle’s thoughts classified her as a theistic evolutionist.

The Role of Freedom

A notable theme from the participants at Wimbledon Academy was that each individual cited “freedom” as a reason for working at Wimbledon Academy, even though the researcher did not ask participants about freedom or autonomy. Instead, the researcher questioned the participants about what they liked about the way teaching occurred in a private school (Appendix, Question 8). Jennifer described her freedom as “I was looking to be able to teach without having strict rigid guidelines on what I could teach.”

This was similar to the freedom described by Matthew, with Matthew adding that he enjoyed the reduction of educational bureaucracy:

I like the—the freedom to—the autonomy that I have in the classroom. We don’t have to submit lesson plans to the administration on a weekly basis, some of the things that you

find in public schools. So, I like that we're not burdened with a lot of those bureaucratic sorts of requirements.

Finally, Jennifer identified "freedom" as being able to teach evolution and admitted that she sought out a school that would allow her to do so:

One of the things that I was looking at when I was looking at jobs and doing interviews, was I wanted a private school that would allow me to teach evolution. So, I didn't want one where I was gonna have to have strict constructs on what I could say in the classroom and what I could present.

Summaries from Wimbledon Academy

RQ1 and Wimbledon Academy. The first research question, in reference to Wimbledon Academy, asked: How is the teaching of evolution approached? Faculty and staff of Wimbledon Academy prided themselves on being a college preparatory school, with their focus on AP courses and other rigorous classes as testament to their desires to see students achieve at the highest levels. Also, by being a secular private school and eschewing all formal associations to a religious affiliation, the teachers received the freedom and encouragement to teach evolution as a scientific principle without inclusion of religious thought.

The interviewees suggested that the administration had never put pressure on them to teach evolution in a particular way, especially with a religious bias. Jennifer commented,

That was something I was looking for coming into a school (teaching evolution). So even when I was doing interviews, if I knew or if the school was like, "We don't teach evolution, we don't support teaching evolution", I would automatically kind of be like, "This isn't the place for me."

Additionally, the interviewees stated that they had seen little pressure from parents. Matthew stated, “It (evolution) is a fundamental part of our curriculum and most families know that. That it (evolution) is an integral part of modern biology and it’s gonna be taught”.

Based on the interview it seems clear that the administration of Wimbledon Academy was not seeking to alter the teaching of evolution in a pro-religious manner within the school, nor were the teachers experiencing or giving in to parental pressure to alter the teaching method. Jennifer perhaps provided the best cumulative statement on how the faculty of Wimbledon Academy approached teaching evolution:

I think the way we presented it (evolution) was a good way that kind of appealed to all the students. Whether they were religiously inclined and didn’t believe it, whether they were religiously inclined and believed it, whether they believed it and were not religiously inclined, I think we did a good job of presenting it fairly.

Given the information gathered about teacher and student religiosity and the information related to the method by which teachers addressed evolution within the science classroom, it is possible to conclude that faculty at Wimbledon Academy approached evolution as a viable and important scientific theory. Further, Wimbledon Academy did not officially endorse any religious viewpoint and, as such, did not endorse the teaching of any religious viewpoint within the science classroom. Accordingly, at Wimbledon Academy students were likely to receive an exclusively scientific education in the theory of evolution when attending science courses.

SRQ1 and Wimbledon Academy. The first of the secondary researchs question asked: Does the type of private school impact the teaching of evolution? Wimbledon Academy was well known as a secular private school, a label the faculty and staff proudly wore. Wimbledon Academy welcomed students of all faith traditions, but administrators unashamedly stated the

school was secular, and it did not present curriculum with a religious lens. The fact that Wimbledon Academy was a secular private school was readily apparent in the science classrooms. In those rooms, the teachers were presenting science as science, without a religious perspective. The teachers who participated in this project spoke specifically about not mixing religious views with the science curriculum. Topics deemed controversial at other private schools (i.e. evolution) were simply an integral part of the curriculum that needed to be taught to the fullest possible extent. The overall conclusion was that Wimbledon Academy's secular charter and adherence to an intentionally secular education for the students was providing an educational experience in science classrooms that emphasized a science education devoid of overt or organized religious instruction.

SRQ2 and Wimbledon Academy. The second of the secondary research questions was: Does teacher religiosity impact teaching of evolution in private schools of Middle Georgia? By operating as a secular institution, Wimbledon Academy did not require teachers to maintain an active faith tradition, potentially allowing for teachers who did not participate in a religious tradition to feel more welcome within the school. Accordingly, it is possible that more non- or semi-religious individuals would find their way to teaching at Wimbledon Academy. When accounting only for the participating individuals, Wimbledon Academy showed a higher degree of non- and semi-religious individuals, with 67% of those interviewed identifying as such. This number is significantly higher than the other participating schools, but the high percentage of non- and semi-religious individuals interviewed at Wimbledon Academy may not be an accurate representation of the school at large.

Within the science classroom, the lower teacher religiosity of those interviewed manifested as teachers who were much less likely to entertain student questions of a religious

nature when said questions challenged evolutionary theory. The following participant responses demonstrate this.

Jennifer stated:

Last year when I presented, we were going to be talking about evolution immediately a girl raised her hand and she's like "are you Christian? Do you believe in God? If you believe in God how do you believe in evolution?" I basically told them I wasn't answering that question and it had nothing to do with religion. It has to do with it being a theory in science and that we need to walk through understanding theories and evolution.

Matthew said: "I've gotten this question: 'So do you believe in evolution?', and that's my segue into discussion that it's not a belief system."

Danielle added that as the AP Biology teacher, she focused only on the AP curriculum. When the curriculum called for teaching evolution, she did so as dutifully as possible, without bringing her personal thoughts into the classroom.

In conclusion, teacher religiosity had a definite impact on how teachers addressed evolution at Wimbledon Academy. Since most of the individuals interviewed expressed little or no religious proclivity, their religiosity was low. Even the individual who did identify as religious specifically stated how she avoided bringing religion into the classroom. Given that the science teachers intentionally suspended religious discussion related to evolution and purposefully avoided discussing religion themselves, it must be concluded that the lower religiosity of Wimbledon Academies teachers impacted how they approach evolution in the science classroom.

SRQ3 and Calvin Academy. The third of the secondary research questions was: Do perceptions of student religiosity impact the teaching of evolution in private schools of Middle

Georgia? Just as with teachers, students attending Wimbledon Academy did not have to make a faith statement. Additionally, since Wimbledon Academy did not maintain a religious affiliation, it is possible students who did not have a faith practice or have a faith practice that was a minority in the area were more comfortable attending.

The teachers felt that students were very receptive to the ideas of evolution, and that acceptance was partially rooted in the fact that religious options do exist in the area for those seeking an education with less evolution emphasis. The following demonstrates how the interviewees summarized it.

Matthew said:

By and large they are receptive to it (evolution). Like I said, there being other options in the region I don't think we get a whole lot of students that are gonna be inclined to challenge the curriculum, at least in any serious sort of way.

Jennifer said:

I didn't have a whole lot of push back or anything like that. When we really talked about evolution, and I kind of have that question of "well, do you believe it or not?", I don't really get a lot of students asking about that. Also, because this school isn't religiously affiliated for just one religion, we have a lot of mix of religion at this school. I think overall our students try not to really talk about religion as much as if we were at a Christian related school.

The teachers also felt student's religiosity existed more in the backdrop rather than being a defining feature for the education of the students. Jennifer summed it up as:

I think overall most of them are probably indifferent. You could tell that there are some people who are more like "I obviously don't believe this", they're more religiously

inclined but they still knew “I have to learn and take the test on it anyway”. So, I would say it’s probably a small part, a minority that doesn’t believe evolution, is upset by it.

The information gathered indicated that the teachers believed student religiosity was having little impact the way they taught their classes. Teachers were comfortable providing students with only the science side of evolution, and they were not seeing much pressure from students, nor their families, to include more religious versions. Teachers did mention that they would like for students to be more willing to engage in learning related to evolution, but it was not clear if the existing lack of engagement was due to student religiosity or simply teenagers wanting to be doing other things.

CHAPTER 5

DISCUSSION

Summary of Findings by Research Question

The purpose of this study was to explore the perceptions, experience, and thinking of teachers at three private schools in Middle Georgia to determine how different private schools approach the teaching of evolution. To support that purpose, the researcher developed the following research question:

1. How is the teaching of evolution approached in private schools in one county in Middle Georgia?

To inform the interpretation of the question, the researcher also created the following sub-research questions:

2. Does the type of private school impact the teaching of evolution?
3. Does teacher religiosity impact teaching of evolution in private schools of Middle Georgia?
4. Do perceptions of student religiosity impact the teaching of evolution in private schools of Middle Georgia?

RQ1

In this study, faculty in all three private schools showed willingness to address the theory of evolution in the curriculum, even if each school approached evolution in its own unique way. The secular private school, Wimbledon Academy, with its curriculum devoted only to academic pursuits and devoid of religious influences, demonstrated the most scientific address of evolution and showcased the effectiveness of their process by consistently having students score above the national average on the AP Biology exam. The Catholic affiliated school, St. Arthur Academy,

exposed students to both scientific viewpoints and religious viewpoints, but largely separated the two into courses designed to teach either science or religion. St. Arthur Academy also presented students with the most in-depth examination of evolution by offering an elective class in sociobiology. Students consistently scoring in line with the national average on the AP Biology exam demonstrated the effectiveness of the teaching method at St. Arthur Academy. Teachers at the Christian, nondenominational school, Calvin Academy, presented evolution but frequently incorporated religious ideas into the science curriculum. Students frequently scoring behind the national average on the AP Biology exam demonstrated the impact of their teaching method.

Faculty at Wimbledon Academy, a secular institution, treated evolution as a scientific theory and rarely engaged religious discussion within the science classroom. The success of their methodology was evident in the achievement of students at Wimbledon Academy on the AP Biology exam, consistently beating the national average for the test. The faculty and staff of St. Arthur Academy provided an interesting blend on the teaching of evolution. At St. Arthur Academy, the teachers purposefully exposed students to both evolutionary teaching and religious teachings, but each received instruction in classes specifically designed for the topic. As such, at St. Arthur Academy, teachers primarily dealt with evolution in the science courses and covered religious topics in the various religion classes the school required. While overlap occasionally occurred, the teachers of the science and religion courses met regularly to ensure they addressed any overlap. Additionally, St. Arthur Academy offered a course on sociobiology, which exposed some students to a level of understanding of evolution far beyond the normal high school student experience. The achievement scores of students demonstrated on the AP Biology exam, comprised of consistent scoring in line with the national average for the test, confirmed the success of the teaching methodology at St. Arthur Academy. Calvin Academy educators taught

evolution but also actively taught creationist ideas within the science classroom. Calvin Academy representatives chose this approach to encourage students to examine both ideas and to decide for themselves what the actual truth is.

SRQ1

The combined case studies of this project demonstrated that the type of private school does impact how teachers approach the theory of evolution. Of the participating schools, Calvin Academy was by far the most religiously conservative, verging on full immersion in creationism, and exhibiting the greatest religiosity amongst its faculty and students. Faculty religiosity found its way into every classroom, including science classrooms, and influenced both the perception faculty had of what students entered the school accepting and what faculty presented within the classroom. The fact that faculty at Calvin Academy adhered to classical education practices led the school to expose students to evolution in a way that encouraged logical examination of the information, but the faculty also encouraged students to examine evolution alternatives with the same logical lens. As such, data suggest that students at Calvin Academy were exposed to evolution and creationism in nearly equal amounts within the science classroom.

St. Arthur Academy, affiliated with the Catholic Church, based teaching on the curriculum format provided by the Sisters of Mercy and their educational arm, the Mercy Education Systems of America. The faculty at St. Arthur Academy stated they were trying to prepare students in the most stringent of manners for what they would encounter in college. As such, they did not shy away from teaching evolution and even offered an elective course in sociobiology. Because it was a Catholic institution, the students experienced exposure to religious ideas, including the Catholic view of creation, courses of morality, and discussions of the uniqueness of the soul. However, by design, faculty at St. Arthur Academy sought to separate

the religious and scientific components by offering both religious classes and science classes and teaching each component in its respective class. Additionally, the faculty who taught the religious and science classes regularly conversed with each other to ensure that they were instructing students properly when having discussions. The success the students showed on the AP Biology exam, with success rates virtually mirroring the national averages, demonstrated the success of the educational method used in St. Arthur Academy. Overall, faculty at St. Arthur Academy sought to educate students both academically and religiously, but they largely separated the two entities, allowing a mostly nonreligious teaching of evolution within the science classrooms.

Wimbledon Academy was intentionally a secular school, eschewing any formal affiliation with a religious entity. The school protocol did not require students to renounce their religion in order to attend, but representatives also made it plain that religious ideology was not a driving force at Wimbledon Academy. Within the science classrooms, teachers taught students exclusively evolution, quickly redirecting any mention of religious ideology. Many of the science teachers at Wimbledon either agreed to work at the school because of its adherence to teaching evolution only, or they had continued to teach there because they agreed with the stance. Overall, it is clear that students attending Wimbledon Academy experienced evolution taught as a viable scientific theory with little influence from religious ideologies.

The overall conclusion is that students at each of the participating schools could adequately learn about evolution regardless of which school he or she chose to attend. It is also true that teaching methods at each of the schools varied substantially, with some students having exposure to copious amounts of religious ideology in the science classroom, while others received an almost exclusively scientific presentation. Given this, it is highly likely the depth of

evolution knowledge will be considerably higher for those students at St. Arthur Academy and Wimbledon Academy, although without seeing domain information from the AP Biology exam it is impossible to fully verify this.

SRQ2

This project demonstrated that teacher religiosity unequivocally impacts the teaching of evolution. The first impact was in the grouping of faculty. The participating faculty of Calvin Academy displayed a belief system that classified them as theistic evolutionists and biblical literalists. The participating faculty of St. Arthur Academy identified as theistic evolutionists, with one individual being an evolutionist. The participating faculty of Wimbledon Academy identified as evolutionists, with one individual being a theistic evolutionist. This demonstrates that, at least within the study population, individuals of like- or near-like-mindedness were likely to work together and espouse similar beliefs.

The second impact was how teacher religiosity manifested within the classroom. The statements provided by the participants from Calvin Academy demonstrated that religious belief was an integral part of all classrooms, science included, and they perceived the inclusion of religious evolution alternatives as a good method of teaching students to learn to think and reason logically. The statements of participants from St. Arthur Academy revealed that religion and science were integral parts of the entire learning culture but separated into different classes and taught largely independently of each other. The result was that while students might receive encouragement to contemplate both evolution and religious ideology, typically they did not experience pressure to do so within the same classroom. The statements of participants from Wimbledon Academy demonstrated that evolution was the primary concept taught and that little

religious influence occurred, creating a situation where students learned almost exclusively about evolution.

The third impact of teacher religiosity was the overall mission of the school. Both Wimbledon Academy and St. Arthur Academy billed themselves as college preparatory institutions, with their faculty seeking to instruct students in a manner conducive to academic success. St. Arthur Academy provided and required some religious based classes, but those classes did not impede on the overall mission of preparing students for college. On the other hand, the mission of Calvin Academy was a focus on the whole student. For faculty at Calvin Academy, this meant working on both the academic and spiritual portion of a student. The result was a curriculum that frequently placed academics and religion on the same footing, and in some cases, meant teaching a topic from the religious perspective.

SRQ3

Teachers at all the participating schools described students as receptive to the concept of evolution. However, even with most students being receptive, a constant refrain from the participants was the concern that students would challenge evolution. Of the push back teachers received, Calvin Academy students were most willing to make the challenge, but even then the number of students that teachers described as being willing to challenge evolution was still quite small. Teachers perceived that students were unlikely to challenge evolution because some students wholly believed in evolution and did not see any issue, regardless of if the student possessed a faith practice or not. However, interviewed teachers suggested that students at all the participating schools were more willing to accept evolution for the purpose of the required testing than for any other reason. This troubled many of the teachers, including teachers at

Calvin Academy, because it suggested to them that students were not fully engaging with the learning.

There were of course some students that teachers perceived as actively against evolution, but, regardless of which school was reporting, the interviewed teachers described those students as being a distinct minority. The teachers reported few students as challenging when learning evolution, and even fewer were willing to continue a challenge to the teaching of evolution once the teacher was at least willing to consider their thoughts. In totality, teachers from all of the participating schools repeatedly described situations in which students desired to have questions answered and then became willing to learn about evolution as presented. The students who teachers perceived as being most positively engaged with evolution were those taking the sociobiology course, a course that many may consider very controversial. The teachers of this course described students as not only willing to learn about how emotions and social constructs might have evolved, but also often seeking to explain their own behavior through evolutionary processes.

The Impact of Worldview on Evolution Teaching and Learning

It was evident that participants at the three participating schools all had widely different worldviews that influenced how they conducted their jobs. These worldviews ranged from the conservative Christian worldview of Calvin Academy individuals to the moderate, Catholic worldview of St. Arthur Academy individuals to the secular worldview of Wimbledon Academy individuals. What was readily apparent about the various worldviews was the manner in which worldview influenced individuals and overall approach at each institution.

Representatives at Calvin Academy were extremely open about their use of the Christian faith to influence all aspects of their educational process. Their collective worldview featured

Christ and learning the Christian stance on life as an integral part of the curriculum, and all aspects of education at Calvin Academy highlighted this worldview. For the participants, the conservative worldview their religious beliefs fed was an extremely important part of the education that they provided to students. There were those who evaluated everything from a near biblical literalist stance and encouraged their students to do the same. Even the individual possessing the most moderate worldview supported viewing everything through a religious lens.

The worldview of Kevin and Sarah led them to act as selective teachers (Griffith & Brem, 2004), for they had so effectively mastered the use of coping strategies, namely avoidance (Calver & Bryant, 2017; Hermann, 2012), that for them the use of biblical ideas to disprove scientific ideas was quite normal, effectively placing science and religion in conflict (Aflalo, 2018; Barbour, 1990). Elizabeth maintained a slightly less religious worldview than did Kevin and Sarah, and Rebecca's worldview moved even a bit closer to scientific. However, both Elizabeth and Rebecca were conflicted teachers (Griffith & Brem, 2004), having spent more time examining evolution and seeking ways to ensure students have a viable understanding of it. Statements by Elizabeth and Rebecca, as well as Rebecca's previous work history in a research lab, illustrated that they were in favor of affirmative neutrality (Calver & Bryant, 2017; Hermann, 2012) between evolution and religion, and they preferred for there to be a stance of dialogue (Aflalo, 2018; Barbour, 1990) between the two.

At St. Arthur Academy, faculty were amenable to the school's religious component, but their focus was more on being a high-quality college preparatory school than influencing students to a religious faith. Therefore, even though Catholic teachings were interwoven into the course offerings (i.e. the Faith and Reason course), religiosity was not the primary focus of instruction at St. Arthur Academy. The participants all demonstrated a worldview that was more

scientific than that of participants at Calvin Academy. For these participants, religion was still frequently an integral part of their life and worldview, but religious ideals did not prevent them from being able to examine evolution and see it is largely viable. David, Rachel, Emily, and Joseph were conflicted teachers (Griffith & Brem, 2004), since they saw reason for both evolution and religion. For them evolution and religion covered two extremely different entities, similar to the idea of independence as described by Barbour (1990) and Aflalo (2018).

Additionally, all four felt the best method of addressing evolution and religion was through procedural neutrality (Calver & Bryant, 2017; Hermann, 2012), designating the science classrooms to discuss science and religion classrooms to discuss religion. The last participant, John, was much more of a scientist teacher (Griffith & Brem, 2004), having a strong personal love of science and believing that all students need full exposure to the ideas of evolution. John suggested a connection between evolution and religion that was effectively equal parts independence and dialogue (Aflalo, 2018; Barbour, 1990), for while he taught that the two should be separate, he also felt there should be dialogue between the two and that both hold merit to overall understanding. John also felt that procedural neutrality (Calver & Bryant, 2017; Hermann, 2012) was the best method of addressing student thoughts, and like the others, he felt science should stay in science classes and religion in religion classes.

Wimbledon Academy faculty were unique in that the school's academic charter fully focused on traditional education without specific inclusion of a religious component. This led Wimbledon Academy staff to focus extensively on the college preparatory method of education, but it also largely prevents faculty from bringing religiousness of any sort into the classroom. This overall lack of classroom-embedded religiousness was also evident in the participants, for all three of their worldviews were decidedly more scientific than the collective of the other

school participants, with only one participant demonstrating a worldview actively influenced by a religious tradition. The one individual actively maintaining a religious tradition was Danielle. For her teaching evolution was a certainty, and she did not waver from doing so. Matthew and Jennifer both possessed worldviews largely not influenced by religion, despite the fact that religion had played a greater role in their past.

For the teachers at Wimbledon, teaching evolution was the norm. Collectively all three were scientist teachers (Griffith & Brem, 2004), and all three felt an independent approach (Aflalo, 2018; Barbou, 1990) was best for addressing evolution and religion. When dealing with the inevitable religious questions that would arise in science class, Danielle applied procedural neutrality (Calver & Bryant, 2017; Hermann, 2012), allowing students a few questions or statements before refocusing on evolution. However, Matthew and Jennifer were more likely to employ advocacy (Calver & Bryant, 2017; Hermann, 2012), immediately halting student questions of a religious nature or instructing students to bring their questions to an after-class scenario.

In this project, the worldview of the individuals in each participating school contributed to and aligned with the school structure, selection of faculty, admission procedures for students, and determination, execution, and resources of curriculum was. More importantly, the worldview of each individual directly impacted how he or she approached evolution in the classroom.

The Role of Autonomy in Teaching Evolution

An unexpected commonality mentioned by every participating individual was that working in a private school offered a higher degree of autonomy, described repeatedly by the teachers as “freedom”. What made this “freedom” interesting is that each person had a different version of what “freedom” was. For some of the interviewees, “freedom” revolved around

processes and liberation from bureaucratic regulations. For many interviewees, the “freedom” dealt with what was taught, rather than how, with some individuals describing “freedom” as the ability to teach Christian doctrine, including teaching creationism alongside evolution. Still other interviewees enjoyed the “freedom” to set their own curriculum order and pace, while another group of individuals appreciated the “freedom” of teaching at the private school because of the guarantee that the school would teach evolution without interference from religious doctrine.

What makes “freedom” as described by the interviewees so interesting is that it ties so closely to worldview. While there were representatives from all three schools for freedom from bureaucratic requirements, the enjoyment of academic “freedom” was much more tailored to which school in which the interviewee worked. Those individuals who worked at the conservative Calvin Academy were much more likely to value their “freedom” to include Christian doctrine in the classroom. Those individuals working at the Catholic St. Arthur Academy valued their “freedom” to teach to their respective strengths and try to influence students to “love” an academic subject. Finally, those individuals teaching at the secular institution were more likely to value autonomy in the classroom or a dedication to teaching evolution without religious interference.

Addressing Concepts of Micro- and Macroevolution

During the interview process, the researcher did not directly ask participants about accepting microevolution or macroevolution. Instead, the researcher asked participants, “Would you describe yourself as accepting the theory of evolution, and can you describe what led you to that conclusion?” (Appendix, Question 16). All but one participant (Matthew) immediately addressed the question as a matter of microevolution versus macroevolution, with the overwhelming response being an acceptance of microevolution and a skepticism toward

macroevolution. Lewin (1980) defined microevolution as “changes within a population” (p. 883) and stated that these changes are “accepted as a consequence of shifting gene frequencies” (p. 883). Lewin (1980) also defined macroevolution as “changes above the species level—involving the origin of new species and the establishment of higher taxonomic patterns” (p. 883). The definitions for microevolution and macroevolution have held fairly steady since 1980 with the University of California Museum of Paleontology stating that microevolution “is simply a change in gene frequency within a population” (n.d., p. 2) and macroevolution “generally refers to evolution above the species level” (n.d., p. 2). The participant (Matthew of Wimbledon Academy), who did not make his acceptance of evolution about microevolution and macroevolution, stated that he saw no reason to delineate between the two.

This made for an interesting line of thought because most evolutionary scientists do not delineate between microevolution and macroevolution. However, many within the public sphere, including many schoolteachers, do tend to establish a difference between the two. The source of proposed delineation between microevolution and macroevolution appears rooted in a hesitancy for many to accept that new species of organisms can arise without direct deistic influence, as evidenced in the 2017 Gallop poll referred to earlier, which has consistently found that 80% of Americans believe God has directly influenced the creation and evolution of humans.

Limitations. One defining limitation of this project was that it only included 12 participants from three private schools in one county of the Middle Georgia area. Additionally, not every person requested for an interview from each institution agreed to participate. Further, while this project was conducted in a case study format, inclusion of classroom observations and interviews with students would have allowed for a wider view of the educational landscape at each school. Lastly, the researcher was the sole examiner of all of the information gathered.

Without input from additional researchers, all results are subject to the personal biases of the sole researcher. Accordingly, the results of this project are not generalizable, and there not be any assumption of them as correct for other study areas due to the unique nature of the study sites and curricular options presented at each site.

Implications of the Study

The findings of this project have interesting implications for science education in a private school. First, this project demonstrated that private school educators are teaching evolution. While this might have been an expectation for secular and religiously moderate private schools, the fact that teachers in the religiously conservative private school were also teaching evolution, is a good sign. If this were true in other private schools, especially those that are religiously conservative, it could demonstrate that students in private schools have a greater chance at scientific rigor than many in the public education sector believe.

The second impact is that this project demonstrates that students receiving some form of religious instruction related to science scored lower than did their counterparts on the AP Biology exam. In fact, the greater the combination of science and religion, especially in the classroom, the lower the scores on the AP Biology exam. Further study is necessary to determine if these findings represent a trend or if they display an anomaly, but the data provided here are clear.

Recommendations for Further Research

While the researcher examined three separate private schools representing two different religious leanings and a secular private school, there is still a great need for general research into this subject. Additional areas to explore include: (a) private schools in other areas of Georgia, both urban and rural, to determine if the results of this project are also evident in those areas; (b)

private schools in other states and other regions of the United States to determine if the experiences in those schools are similar to those found in the Falls County area; (c) studies dedicated to examining multiple schools of the same religious orientation, including non-Christian religions, would be beneficial in determining if the conclusions found here are systemic across most schools of similar orientation or if the private schools of Falls County are anomalies within the bigger picture; and (d) studies dedicated to examining multiple secular private schools, including nontraditional private schools like Montessori, would be beneficial in determining if the conclusions found here are systemic across most secular private schools or if the school in Falls County was an outlier.

Conclusion

This project demonstrated that the majority of participating individuals (9 of 12) representing three private schools in Middle Georgia held a view that incorporates a belief in a creator-God into their views on evolution. The other three participants did not outright reject the idea of a creator-God; instead, it was not a focus for them in relation to evolution teaching. Of the nine who did incorporate beliefs in their teaching, two of them were of the biblical literalist mindset, while the others maintained a view allowing for the coexistence of God and evolution. These viewpoints are similar to the results of the 2017 Gallop poll on evolution and creationism, where 80% of respondents stated they believed God was either partly or wholly involved in the creation and evolution of humans. Where this project did differ from the Gallop poll was that less than 20% of participants believed that God created without any evolution occurring (versus 38% in Gallop) and that nearly 60% of participants believed that God and evolution could be working in tandem (versus 38% in Gallop). However, given the small sample size, it is necessary to test these findings further to determine their accuracy in the wider populace.

It was also determined that religiosity played a substantial role in the lives of all the participating individuals. Not one person demonstrated an ability to fully divorce religion from their classroom or position, with incorporation of religiosity running the spectrum of options from full incorporation to attempts to largely remove religion from the classroom. Two individuals who were biblical literalists largely demonstrated an unwillingness to accept evolution, a phenomenon described by Lovely and Kondrick (2008); Moore et. al. (2009), and Taber (2017). The majority of participants positioned themselves in between creation and evolution, a phenomenon address by Lovely and Kondrick (2008) and Taber (2017).

Similar to the findings of Glaze and Goldston (2015), the results of this study revealed all of the participants expressed that their faith informed their teaching or leading. Additionally, the participants expressed that how they taught evolution, and whether or not they included creationism, depended on their own religious beliefs, a finding also reported by Moore (2004) and Deniz and Donnelly (2011).

There were also those participants, particularly at Calvin Academy, who declined to teach evolution as a viable theory because they viewed evolution as controversial or incorrect, a finding previously discussed by Schulteis (2010). However, the participating individuals were not addressing religion in a manner that was contrary to what the administration and board of directors endorsed. As such, even though many teachers, acting as street-level bureaucrats (Lipsky, 1980), go against the directives of their governing bodies, the individuals participating in this study were acting within the desires of their overseers.

The participants also spoke heavily about teacher autonomy and how it impacted their teaching. Some of the participants enjoyed the autonomy to teach what they wanted and how they wanted, reinforcing the findings of Lipsky (1980) and Glaze and Goldston (2015).

Additionally, some participants desired to spend extra time on those topics related to evolution and/or creation they found particularly valuable, a finding similar to that of Berger and Luckman (1966). Of equal interest is that even though the participants were able to experience a higher degree of autonomy, there was still some degree of pressure on them to teach the curriculum agreed to by the teachers and administrative leaders. This finding is similar to that found by Schulteis (2010) and Goldston and Kyzer (2009).

In final analysis, this study makes clear that the assumption that private school teachers do not teach evolution is speculative, and the inquiry should be how they are approaching evolution instead. While the teaching methods employed at private schools may be significantly different than those of a public school, this study demonstrated that some private schools are making a concerted effort to ensure exposure of their students to evolution. Additionally, teacher religiosity played a major role in not only the method by which they addressed evolution, but also how teachers interpreted student perceptions of evolution. Individuals with higher self-described religiosity were more likely to find evolution objectionable and treat it as such in the classroom, whereas individuals who self-identified as having less rigid views of religiosity were more likely to approach evolution as a viable scientific theory. In summation, evolution continues to represent a challenge to teachers in both public schools and private school settings, making the need to explore both further of great importance in 21st-century science education.

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APPENDIX
INTERVIEW QUESTIONS

Personal Background

1. Please describe the type of school(s) that you attended for primary and secondary school.
2. Please describe any teaching you received related to evolution in primary and secondary school.
3. Please describe the type of college/university that you attended for your undergraduate and then any colleges/universities you attended for graduate work.
4. Please describe any teaching you received related to evolution at each college/university.
5. Would you currently consider yourself to be religious?
 - a. If Yes: Would you please describe your religious leanings?
 - b. If No: Would you consider yourself to have ever been religious and could you please describe the experience you had?

Professional Background

6. What are you currently teaching? (Classroom teachers only)
7. How long have you been in education in total? How long in a private school setting?
8. What do you like about the way teaching occurs in a private school?
9. Have you ever taught in a public school setting?
 - a. If yes: 1) How long did you teach in the public school setting?
 - 2) Please describe the differences you see in how teaching occurs in a private school and a public school.
 - 3) What caused you to want to switch from teaching in a public school to teaching in a private school?

4) Is there a scenario in which you would you consider going back to teaching in a public school?

b. If no: 1) What drew you to wanting to teach in a private school versus a public school?

2) Please describe the differences you see in how teaching occurs in a private and a public school.

3) Is there a scenario in which you would you consider teaching in a public school?

10. Can you describe what drew you to wanting to teach in this private school?

School background

11. How is the science curriculum determined for your school?

a. Follow up if not asked: Who determines what is taught in science classrooms?

12. Does the administration, or anyone else, provide specific guidance about how the curriculum should be taught?

Teacher training

13. Please describe any specific training you may have had in how to teach a science discipline before you became a teacher.

14. Please describe any specific training you may have had related to how to evolution before you became a teacher.

15. Please describe any specific training you have had in how to teach evolution since becoming a teacher.

16. Would you describe yourself as accepting the theory of evolution, and can you describe what has led you to that conclusion?

17. Can you please describe how you deal with the topic of evolution in your classroom?
18. Would you please share with me your thoughts on the teaching and learning of evolution in the classroom?
19. Has any school official ever tried to challenge the method in which you teach evolution?
 - a. If yes, can you describe what happened?
20. Has any parent ever tried to challenge the method in which you teach evolution?
 - a. If yes, can you describe what happened?

Student responses

21. Can you describe an instance in which students specifically asked you about your thoughts on evolution?
22. Can you describe how students typically respond to any reference, including teaching, of evolution?
23. What would you say student opinions tend to be toward evolution?
24. Is there anything else that you would like to add?