

PUBLIC SCHOOL ADMINISTRATORS' KNOWLEDGE AND PERCEPTIONS
REGARDING THE LAWS THAT GOVERN THE TEACHING
OF EVOLUTION IN GEORGIA

by

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ABSTRACT

The teaching of evolution continues to be a greatly debated issue in education. However, little research has focused on administrators' roles in this debate. This research gathered information from middle/high school principals and curriculum directors in 36 districts served by the three northernmost Regional Educational Service Agencies in Georgia. This research focused on administrators' knowledge of the laws governing the teaching of evolution, intelligent design, and creationism as well as their familiarity with state standards. A 43-item quantitative survey was mailed to 491 administrators. The first 14 items were categorical inquires that were correlated to two exam scores using the chi-square method. The first exam score was related to the administrators' knowledge of the laws that govern the teaching of evolution in the United States, and the second exam score was related to the knowledge of the evolution standards in the Georgia Performance Standards. A qualitative component accompanied the survey research. Twelve administrators were individually interviewed about the laws governing the teaching of evolution, their understanding of curriculum mandates concerning the teaching of evolution, and the issues they face in their own schools concerning this topic. The research study indicated that Georgia administrators were highly lacking in the knowledge of the laws that govern the teaching of evolution and the Georgia Performances Standards on evolution. Building- and district-level issues on evolution were a rarity in the schools of Northern Georgia. Graduate administrative coursework and professional development were deficient. While principals agreed that evolution should be taught, several also wanted creationism and intelligent design in their science classrooms. Principals often left their religious

feelings at the door and expected teachers to follow the state standards. Many reported creationism and intelligent design were being taught by their staff as they turned a blind eye or did not realize it was against the law. Historically, most studies on evolution in public schools revolve around the curriculum, teachers, parents, or students. This study is important because it focuses on the administrator's knowledge and experiences regarding evolution.

DEDICATION

I would like dedicate this dissertation to my family. I dedicate this study to my late father, who instilled in me the American Dream that even little boys from Appalachia could be successful with determination and a positive work ethic. I dedicate this dissertation to my mother, who always pushed me to do better and set high goals for myself. I dedicate this work to my late grandparents, who were part of the greatest American generation. They taught me to have love and compassion, and to smile though adversity. Finally, I would like to dedicate this work to my wife, who encouraged me to be a better scholar, co-worker, husband, and father.

LIST OF ABBREVIATIONS AND SYMBOLS

ACLU	American Civil Liberties Union
AEA	Arkansas Education Association
BSCS	Biology Science Curriculum Study
CNN	Cable News Network
CRCT	Criterion-Referenced Competency Test
DDT	Dichloro Diphenyl Trichloroethane (Insecticide)
DNA	Deoxyribonucleic Acid
EOCT	End of Course Test
GHS GT	Georgia High School Graduation Test
GPS	Georgia Performance Standards
GSSA	Georgia Science Supervisors Association
H_a	Alternative Hypothesis
H_o	Null Hypothesis
ID	Intelligent Design
IRB	Internal Review Board
NCSE	National Center for Science Education
QCC	Quality Core Curriculum
RESA	Regional Education Service Agency
SARS	Severe Acute Respiratory Syndrome

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CHAPTER 1

INTRODUCTION

Science investigates; religion interprets. Science gives man knowledge, which is power; religion gives man wisdom, which is control. The two are not rivals. They are complementary. (King, 1963, p. 15)

When Charles Darwin published his book *The Origin of Species* in 1859, he set into motion a conflagrative tidal wave of debated discourse and litigation that still endures today. It would take over 60 years from the release of Darwin's original text for the courts to try the first major case concerning the teaching of the theory of evolution in the United States. The teaching of the theory of evolution in secondary public schools has been a topic of embroiled controversy since the 1920s (Campbell, 2003; Scott, 2006). However, the conservative politics of the late 1990s, up to the election of President Obama, fostered an emergence of numerous court cases which tried the validity of teaching evolutionary theory in American public schools (Gregg, 2003; Potter, 2007). Teachers are often caught in the melee. They are required to teach their state's mandated curriculum concerning evolution while walking on eggshells with administrators, parents, clergy and school boards (Beardsley, 2004; Maldonado-Rivera, 1998; Wylie, 2003). In many states, teachers have avoided evolution by not teaching the topic; however, many state departments of education are now forcing the hands of schools by adopting standards dealing with evolution (Dean, 2005; Mead, 2009; Moore, 2002, 2005; Nickels, 1987; Rutledge, 2002). To further complicate the matter, studies indicate teachers are actually lacking in content knowledge skills concerning evolution which further agitates the situation (Chuang,

2003; Potter, 2004; Wylie, 2003). Many teachers and administrators are not well versed regarding the laws that govern the teaching of the theory and of the landmark cases that have created the laws (Moore, 2004a). Surprisingly, many of these cases are not just limited to the conservative southern states. California, Ohio, Missouri and Pennsylvania have all seen recent attempts to weaken the teaching of evolution in their respective states. Georgia has also been the focus of national attention in the public arena of evolution legislation along with other southern states such as Tennessee, Oklahoma, Florida, Texas, and Alabama.

Philosophically, the acceptance of evolution seems to be in juxtaposition between the general public and academia. In the early 21st century, Darwin's evolved theory has been fully accepted by the vast majority of biologists and geologists at major public universities (American Association for the Advancement of Science, 1989; Miller, Scott, & Okamoto, 2006; Moore, 2000; National Academy of Sciences, 1999; National Research Council, 1985; Nelson & Skehan, 2000; Rutledge & Warden, 1999; Trani, 2004). However, the majority of Americans still view evolution as a questionable theory (Berkman, Pacheco, & Plutzer, 2008; Ching, 1984; Edwards, 1981; Holden, 1988; Kelley, Bryan, & Hansen, 1999; Moore, 2000; National Association of Biology Teachers, 1997; National Science Board, 1989; Newport, 2007, 2009; Shermer, 2006; Wallis, 2005). A 2009 Gallop Poll noted that only "39% of Americans say they believe in the theory of evolution" (Newport, 2009, ¶ 1). Newport's study further noted Americans that attend church weekly only believed in the theory by 25% (Newport, 2009). The media and lawyers feed off this philosophical difference leaving school personnel caught on a merry-go-round powered by methamphetamines trying to avoid costly lawsuits and bad publicity in their respective communities. As Campbell and Meyer (2003) explained,

The teaching of evolution in public schools has been a flashpoint in American education. As in all long-standing controversies, positions harden and disputants speak chiefly to

rally their own supporters. The debate ebbs and flows in public awareness until a local school board decision catapults it once again into the lead story or back onto page one. (p. xi)

Statement of the Problem

In 2005, the new Georgia Performance Standards (GPS) in English and science were delivered by the Georgia Department of Education officials through training sessions. Content teachers selected by their respective school districts in science and English, district content specialists, and some administrators of middle and high schools attended the sessions. There were seven days of training for each educator to master the roll-out model of the new GPS. The educators then returned to their districts to redeliver the training to their colleagues. In science the training focused on a delivery model using a standards-based curriculum in earth science, life science, and physical science in the middle schools and biology, chemistry, physical science, and physics in the high schools.

Content knowledge was not discussed in detail in any of these subjects during the state mandated trainings. Two areas of the GPS that were pertinent to this study were the standards in evolution in 7th grade life science and high school biology. Starting in the fall of 2005, teachers were required to follow the new Georgia Performance Science Standards (Georgia Department of Education, 2005) and phase out the Quality Core Curriculum (QCC). For the first time in Georgia history, the word “evolution” was mentioned in the state curriculum. All seventh grade students study life science and the vast majority of high school students study biology. In biology and life science, one out of the five curriculum strands deals directly with evolution. For many Georgia science teachers, this was the first time they had used the term “evolution” without using euphemisms for the subject such as “change over time.” For other Georgia science

teachers, it was the first time they had ever taught the topic. These two courses had mandated state tests to assess the students' knowledge: The Criterion Reference Competency Test (CRCT) in seventh grade and the end-of-course test (EOCT) in biology. Each of these tests had approximately 14-15% of their questions regarding the standards for evolution. Georgia teachers were accountable for teaching evolution and they could no longer skip the content without risking lower scores on state assessments. Starting in 2008, all of Georgia's students in the graduating class of 2011 were required to take biology. This was the first high school science course specifically required by the state of Georgia. In addition, students were required to take three other courses in science to graduate. Before 2008, students were required to take three science courses but no particular course or sequence was prescribed by the state.

Due to the controversial nature of the topic, teachers, principals and district level administrators needed to be knowledgeable of the laws that govern the teaching of evolution. Georgia teachers and administrators were searching for the best ways to teach evolution in the conservative, Christian majority state without repercussions from students, parents, clergy and school boards. Educators needed to be cognizant of the laws that govern the teaching of evolution to ensure they could resist the pressures from outside sources. They, likewise, need to know what is not allowed, such as teaching creationism and intelligent design in the science classroom, to avoid possible litigation. In Georgia, no state training was offered concerning evolutionary law as it relates to the public school classrooms as the standards were rolled-out. The classroom teachers are the deliverers of the curriculum to the students. However, it is the principal who is the instructional leader of the school and ultimately decisions concerning curriculum fall on his or her shoulders. If there is curriculum controversy, it is often the principal who gets the angry calls from parents. The answer provided to the parent could lead to

litigation if the response is not carefully crafted and legally accurate; therefore, a study was needed to gauge administrators' knowledge and perceptions of evolution law. This study focused on principals since they are the instructional leaders of their respective schools and the responsible agents to ensure the laws are being administered properly on their campuses. District level administrators' knowledge and perceptions were also explored because building level principals often seek guidance and content expertise from central office staff. Administrators' personal feelings and clinical experiences were explored regarding the teaching of evolution in an effort to have a more in-depth interpretation of the subject from administrators' points of view.

Significance of the Study

This study was significant for several reasons. The primary reason revolved around the fear of litigation expressed by educators regarding teaching evolution, intelligent design and/or creationism. Administrators need a strong working knowledge of the laws that govern the teaching of biological origins and their change over time in order to avoid costly lawsuits to their respective school districts, and to ensure the curriculum is being delivered in an ethical manner to their students. The study was significant because evolution is viewed by most scientists as the unifying concept in biology (Georgia Science Teachers Association, 2004). The understanding of evolution is paramount to increasing the rigor in biology which is tied to future advancement in agriculture and medicine. Due to increased terrorism in the early 21st century, future citizens need to fully understand the process of micro-evolution as biological terrorism experts speed up evolution to create a pathogen that can wipe out more humans than any bomb. Finally, this study was important because administrators who are knowledgeable about the laws regarding evolution

will not be easily swayed by outside forces. Teachers will be empowered to deliver the standards to their students without the fear of repercussions from their administrators who potentially lack knowledge of the law regarding the teaching of evolution. The teaching of evolution can lead to tension between science teachers and their administrators without a common understanding of the curriculum and the laws.

Teachers in public schools need to be aware of the laws that are relevant to their respective content areas. Administrators face the task of being legally knowledgeable about all areas of the school from physical education to the cosmetology lab. The science department in secondary schools flirts with a variety of litigation issues: science safety and storage, cosmogony, sex education, medical ethics, pharmaceuticals, genetic engineering, dissection and evolution. Evolution is a topic that can get a school district into hot water quickly or if taught incorrectly can land a teacher in the unemployment line. There have been numerous cases regarding the teaching of evolution in the public schools. Since the 1925 Scopes Monkey Trial case in Tennessee to the present, there have been at least nine landmark cases that shape the manner in which evolution is taught to students in American public schools (Moore, 2002a; Moore & Decker, 2008; National Academy of Sciences Institute of Medicine, 2008). These nine cases are presented in greater detail in the literature review.

The entire public education community is constantly in controversy concerning the topic of evolution. Teachers are caught in a vortex that forces them to be mindful of high stakes tests, standards-based curriculum, their own religious beliefs, and the feelings of the community, school officials, and students. Administrators are faced with their own beliefs, teachers who are concerned about teaching evolution, parents who want different theories taught on the origin of life, and students making passing marks on state tests that have evolution. This study was

significant because it served as a basis to gauge administrators' knowledge about evolution law in the public schools and explored administrators' perceptions and experiences regarding evolution in their respective schools. The study assessed where administrators attained their current knowledge of evolution law and what types of professional development experiences they had throughout their careers. Knowledgeable administrators make informed decisions based on the laws that govern the teaching of evolution as they are battered by a myriad of forces. Administrators can bolster the confidence of classroom teachers by offering informed support based on their knowledge of the laws that govern the teaching of evolution in Georgia public schools.

Purpose of the Study

There were two main purposes for this mixed-methods study. The first purpose was to gauge the knowledge level of administrators regarding evolution as it related to public school law in the three northernmost Regional Educational Service Agencies (RESA) in Georgia through the use of a quantitative survey. The instrument used in this study was developed initially in 2004 by Dr. Randy Moore at the University of Minnesota and was modified by the author to make it more relevant to Georgia and the needs of the current study (Moore, 2004a). Moore's study assessed the knowledge of Minnesota's biology teachers regarding their understanding of the legal issues associated with the teaching of evolution. The main difference between the two studies was the subjects. The Georgia study focused on central office science administrators, assistant principals, and principals in the three northernmost RESAs in the state. No teachers participated in the Georgia survey. The changes to Dr. Moore's survey instrument are detailed in the methodology section of this study.

The second purpose was to assess administrators' perceptions and experiences regarding the teaching of evolution in their tenure as Georgia administrators by using interview data and analysis. Subjects were selected at random to take part in the interview process. Four districts were randomly selected in each RESA to take part in the interview process and at least one middle school principal, one high school principal, and one central office staff member was chosen. Twelve different school districts took part in the process. Open-ended questions allowed administrators to express their thoughts about the current laws; their personal thoughts about the topic of evolution; their clinical experiences with issues regarding evolution; their professional knowledge growth on the topic; and their general knowledge of evolution. Administrators were encouraged to express their own "beliefs" and future changes they felt were needed in the law or curriculum. The administrative group was broken into two groups: principals and their assistants and system level administrators in charge of science. In large districts this person could be solely responsible for science curriculum, but in smaller districts one person may cover the entire spectrum of curriculum k-12. The interviews were conducted using an interview protocol that was developed by the researcher and the dissertation chair. The instrument was reviewed by college professors, advanced placement biology teachers, principals and central office staff for validity purposes.

Research Questions

Question 1: What is the current knowledge level of middle and high school principals and assistant principals in 36 North Georgia public school districts regarding the laws that govern the teaching of evolution?

Question 2: What is the current knowledge level of district level administrators who are responsible for science curriculum in 36 of North Georgia school systems regarding the laws that govern the teaching of evolution?

Question 3: Do school administrators have a strong working knowledge of the Georgia Performance Standards regarding evolution and the topic of evolution in general?

Question 4: What building level issues have administrators faced in their clinical experience regarding evolution, creationism, and intelligent design?

Question 5: What district level issues have administrators experienced with evolution, creationism and intelligent design in their respective school systems?

Question 6: What is the level of initial and on-going training regarding evolutionary law experienced by administrators?

Question 7: What are the beliefs of administrators regarding the teaching of evolution in public schools of north Georgia?

Definition of Terms

The definitions listed below were used to identify the meaning of terms used in this study and in its research instruments.

Cosmogeny. The study of the age and the origin of the universe; in particular the earth and solar system (Lapidus, 1987).

Creationism. The Judeo-Christian version of the origin of the world and its inhabitants: God willed everything into existence (Milner, 1990, p. 98).

Criterion-Referenced Competency Test (CRCT). A test used to assess mastery of 7th grade life science standards by students in Georgia.

Deoxyribonucleic acid (DNA). A biological molecule composed of subunits known as nucleotides strung together in long chains. (National Academy of Sciences Institute of Medicine, 2008, p. 4).

Dichloro-Diphenyl Trichloroethane (DDT). An insecticide used to kill mosquitoes that accumulates in toxic quantities in food chains.

Drosophila. Genus name for the common fruit fly.

End-of-Course Test (EOCT). A test used to measure mastery of high school biology standards by students in Georgia.

Evolution. Change in the heredity characteristics of groups of organisms over the course of generations (National Academy of Science, 1998, p. 13).

Geologic time scale. An arbitrary chronologic arrangement of geological events, usually presented in chart-like form: the oldest event and time units are at the bottom, and the most recent at the top (Lapidus, 1987, p. 161).

Georgia High School Graduation Test (GHSGT). A Georgia state test used to measure mastery of 11th grade students' understandings of science, writing, language arts, math and social studies. Students must pass all five portions, regardless of Carnegie credits earned, before they can graduate.

Georgia Performance Standards (GPS). The current standards-based curriculum developed for the state of Georgia and initially introduced to middle and high school science and English classroom in 2005.

Georgia Science Supervisors Association (GSSA). An association of system, regional, and state level science supervisors. The purpose of the association is to promote effectiveness in supervision, coordination, and teaching of science; to promote research and experimentation for

the improvement of science education; and to offer its members an opportunity to act as a professional group in matters pertaining to science education.

Intelligent Design (ID). The notion that there is a design in the formation of organisms created by a supernatural being (Staver, 2003).

Macroevolution. Large scale evolution, occurring mainly over geological time scales (Benton, 1991, p. 139).

Microevolution. Refers to any evolutionary change below the level of species, and refers to changes in the frequency within a population or a species of its alleles (alternative genes) and their effects on the form, or phenotype, of organisms that make up that population or species (Cander & Monroe, 1989).

Natural selection. A mechanism proposed by Charles Darwin and Alfred Wallace to account for evolution. Greater reproductive success among particular members of a species arising from genetically determined characteristics that confer an advantage in a particular environment (Wicander & Monroe, 1989, p. 560).

Principal. The administrative leaders of the school--this includes assistant principals.

Punctuated Evolution. Model of formation of new species whereby an evolving lineage has relatively rapid and substantial morphological change within geologically short moments of rapid change (Cooper, Miller, & Patterson, 1990, p. 52).

Regional Educational Service Area (RESA). Sixteen strategically located educational centers in the state of Georgia. They serve school districts in the following ways: equipment repair and maintenance, evaluation services, need assessment, program implementation, training, educational consortia, and professional development classes.

Severe Acute Respiratory Syndrome (SARS). A coronavirus that started in Asia in late 2002 and affects the respiratory system of humans often with deadly consequences (National Academy of Sciences Institute of Medicine, 2008, p. 5)

Secondary Education. Grades 6 through 12.

Species. In general, a group of organisms that can potentially breed with each other to produce fertile offspring and cannot breed with members of other such groups (National Academy of Science, 1998, p. 13).

Thremmatology. The science of plant and animal breeding.

Variation. Genetically determined differences in the characteristics of members of the same species (National Academy of Science, 1998, p. 13).

Limitations

1. Science supervisors used in the study were limited to the members of the Georgia Science Supervisors Association and/or district level administrators in the 36 selected Northern Georgia school districts.
2. Principals and assistant principals in the study were middle and high school principals in the 36 selected Northern Georgia school districts.
3. The instrument used for the quantitative study was modified from Dr. Randy Moore's original study given to Minnesota teachers in 2004. The validity and reliability of the instrument was established by a group of professors from Dalton State College, and school level administrators.
4. Only randomly selected participants were asked to take part in the qualitative interview process using a reviewed interview protocol.

5. The study only applied to public schools in the state of Georgia.
6. Thirty-six school systems in North Georgia were utilized. However, due to the controversial nature of the topic, some identified subjects declined participation.

Delimitation

The responses of the participants on the tests were valid and reliable.

Organization of the Study

The second chapter of this study focuses on the literature pertinent to the understanding of the historical progression of the theory of evolution, the laws that govern the teaching of evolution in public schools, teacher experiences regarding the teaching of evolution and the standards movement in education that made evolution a more prevalent topic in American science classrooms. The third chapter focuses on the methodology and procedures used in this mixed method study. The fourth chapter is a presentation of the quantitative and qualitative data collected in this study. The final chapter focuses on discussions, implications and recommendations.

CHAPTER 2

REVIEW OF LITERATURE

This chapter provides a summary of the literature that is pertinent to the understanding of the climate surrounding the teaching of evolution in the United States. The topic evokes strong feelings on many sides of the differing arguments. Some citizens prefer evolution only, others creationism, yet others intelligent design, or blends of these thoughts (Scott, 1996). These feelings are steeped in history and religious tradition, and tempered by litigation. Therefore, a strong foundation in the literature revolving around the emergence and acceptance of the theory, the history of the teaching of evolution, evolutionary education law, and teaching standards on the subject are necessary to understand this research.

The literature review is primarily in chronological order and divided into four main sections. The first section is a synopsis intertwining the historical developments of the scientific theory of evolution with religious reaction and public response to the dynamic theory. The first section is devoid of litigation revolving around the teaching of evolution in American schools because there were no court cases before the 1920s. By the 1920s scientists no longer debated the certainty of evolution. It was at this point the debate shifted from religion versus science to religion versus science teaching. The history of the theory of evolution is contained solely in this section and includes the scientific thinking of the present time. The second section focuses on a summarization of major court cases that are germane to the topic of evolution as they related to American public schools. The verdicts handed down in these court cases had a profound effect on the teaching of evolution from the 1920s to the present; therefore, teacher survey data,

textbook content and curricula changes were addressed. Religious and political developments that impacted the teaching of evolution were included in this section. The third section reviews the standards movement in science education primarily focusing on evolution. Particular detail was devoted to the Georgia Performance Standards since the research in this dissertation occurred in this state. The fourth section is devoted to the gap in the literature.

Section One

Evolving Evolution Intertwined with Religion and Public Response

By the close of the 18th century, the days when scientists were imprisoned and tortured for practicing alchemy or noting the earth revolved around the sun were a distant memory. Scientific advances in the early 19th century were viewed as evidence of explaining the mechanisms of a divine power at work.

In the United States, early 19th-century religious intellectuals (clergy, theologians, and religious scientists and laymen) embraced science as providing proof of design, the existence of God, and other Christian theological positions. Many 19th-century scientists worked within a theological framework and frequently referred to religious views in discussing scientific positions. (Scott, 2005, p. 84)

For the most part, science and religion were harmonious in the beginning of the 19th century. Advances in geology and zoology began to change the amicable relationship. In geology there were more paleontological discoveries that lead to a more complete geologic timescale which was much longer than previously thought. It not only oppugned the creationist timeline but gave credence to organisms changing over millennia as the stratigraphic sequence was expanded due to new fossil discoveries. Geologists began to question the Catastrophism Theory, including Noah's flood, as a mechanism for change in organisms. In zoology more species were discovered and classified. Studies in thremmatology, comparative morphology,

physiology, and embryology began to determine intertwining relationships that fostered the theory of evolution. In particular, the zoological classification of man as a primate with links to a common ancestor riled the religious establishment. Science and religion were soon at odds again and slowly a philosophical debate between the two groups ensued that came to its first climax in a small Tennessee town nearly 100 years later.

19th Century European Evolution

A war of words was waged between European scientists, religious leaders, scholars, and politicians regarding the theory of evolution. Five major works shaped the theory of evolution in Europe. In the mid-18th century, England had established itself as the major military power on the European continent. The vast colonies brought organisms from across the world for English scientists to study and catalogue. Alfred Russell Wallace, the co-discoverer of natural selection, noted in the early 18th century:

The treasures of the whole world of nature were pouring into Europe from the colonized tropics. There was a general impression that we must spend at least another century in collecting, describing, and classifying, before science could hope to tackle that mystery of mysteries, the origin of species. The need of any general theory of how species came into existence was hardly felt. (Milner, 1990, p. 448)

The fledgling theory was given more credence in Europe with the publication of *Vestiges of the National History of Creation* in 1844. The text noted, “Living things adapted to their environments in response to God-created law, rather than being created for that purpose” (Scott, 2005, p. 84). The book set into motion discourse about evolution among science scholars and contemptuous fervor with religious scholars (Van Wyhe, 2006; Moore & Decker, 2008). The writer of the work, Robert Chambers, remained anonymous until his death. “Despite its conciliatory, reverent language, Chambers correctly anticipated the scorn and abuse it would

provoke, and took elaborate precautions to disguise his authorship” (Milner, 1990, p. 448).

Chamber’s work would be edited 11 times in the short 15 years between his first edition and the release of Darwin’s first major work.

The publication of Charles Darwin’s *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* in 1859 would explain the mechanism of evolution as natural selection. The book was immensely popular. Darwin’s entire first edition was sold on its first publication date and went through six editions over a course of 17 years (Milner, 1990; Moore & Decker, 2008; Scott, 2005). “Having established evolution as the most plausible explanation for the facts of geology, paleontology, comparative anatomy, embryology and other specialties, Darwin then proposes a mechanism for the way it [natural selection] works” (Milner, 1990, p. 344). The text ignited great controversy among religious leaders even though there was no discussion of human evolution. Darwin’s work spurred scientists to construct the theory in greater detail. “Darwin’s science would push the boundaries much farther than did Chambers, and *On the Origin of Species* subsequently experienced an even stronger reaction from the religious community” (Scott, 2005, p. 85).

Thomas Huxley’s *Evidence as to Man’s Place in Nature*, written in 1863, correlated natural selection to man and the other primates. Huxley noted to Darwin,

I am sharpening my beak and claws in readiness to tackle the problem of man’s kinship to the apes head-on. It was audacious to even talk about man’s place in nature, implying that he was grouped with other animals in the study of natural history. Up to that time, prevailing thought held that man was somehow outside of nature, imbued with spiritual qualities setting them totally apart from apes and monkeys. (Milner, 1990, p. 291)

The German scientist, Ernst Haeckel, added to the body of evolutionary knowledge by publishing the *Natural History of Creation* in 1863. Haeckel argued “the church with its morality of love and charity is an effete fraud, a perversion of the natural order” (Milner, 1990,

p. 206). While Darwin preferred to avoid public controversy, both Huxley and Haeckel enjoyed it. Darwin added to the correlation between man and other primates by releasing *The Descent of Man and Selection in Relation to Sex* in 1871. By the third quarter of the 19th century, science was much different. It was not influenced as much by scientists that revered religion and the testable approach gained much more favor in the eyes of academia (Scott, 2005). English, German and French scientists embraced the scientific method as an approach to research.

19th Century Developments in American Evolution

Evolution theory in the United States in the 19th century was slow to progress compared to Europe. When Darwin released the *Origin of Species* in 1859, the United States was embroiled with greater controversies revolving around the reasons for fighting a civil war (Numbers, 1998; Scott, 2005). European scientists greatly influenced American scientists through the reconstruction era of American history. In the United States, Darwin and his contemporaries' theories on evolution were scrutinized by academia. At Harvard University, the botanist, Asa Gray, embraced Darwin's theory of natural selection. However, Gray believed the theory was design driven. He noted, "God himself is the source of all evolutionary change" (Moore, 2002a, p. 125). Gray was instrumental in the spread of Darwin's theory in the United States. The Harvard zoologist and geologist, Luis Agassiz, believed in special creation (Gunn, 2004; Moore & Decker, 2008). Agassiz believed that new species could only be created by God and he rejected evolution. However, his view of creation was not the traditional biblical view depicted in the Genesis creation story, and Agassiz was disliked by some Christians because he viewed human creation as involving several races with many people. He was a staunch believer in a series of catastrophic events followed by new God-driven creations (Larson, 2004; Moore,

2002a; Numbers, 1992). These two academic pillars of the institution were at odds and debates swirled around them in the 1860s. At Princeton University in 1874, Charles Hodge noted, “the denial of God’s design in nature is virtually the denial of God. Darwinism is atheism” (Moore & Decker, 2008, p. 168). The debate in the university’s science and theology departments prompted preachers to enter the fray.

Many preachers in the late 1800s were against evolution and deemed it godless. However, some clergy were willing to entertain the idea that both theories could coincide. Most notable was Henry Ward Beecher.

In the 1870s, when many preachers were denouncing evolution as atheistic, Beecher fused religion and evolution into a new form of spiritual evolution. Beecher, who taught Genesis ‘as a poem, not a treatise on cosmogony, claimed that it was inefficient for God to design each species separately, so He designed laws that generated everything. While evolution is certain to oblige theology to reconstruct its system, it will take nothing away from the grounds of true religion.’ (Moore & Decker, 2008, p. 23)

Beecher was chastised by other preachers, and fundamentalism began to take a greater hold in the late 19th century America. As Numbers (1992) eloquently summarized,

By the late nineteenth century, evolutionary notions were infiltrating even the ranks of evangelical Christians, and, in the opinion of many observers, belief in a special creation seemed destined to go the way of the dinosaur. But contrary to hopes of liberals and the fears of conservatives, creationism did not become extinct. Many English-speaking Christians, particularly in North America, remained true to a traditional reading of Genesis and mounted campaigns to contain the spread of evolutionary theory. (Numbers, 1992, p. ix)

After the death of Louis Agassiz in 1873, scientific academia embraced evolution. The paleontologist Edward Drinker Cope noted in 1872, “the modern theory of evolution has spread everywhere with unexplained rapidity, thanks to our means of printing and transportation. It has met with remarkable rapid acceptance by those best qualified to judge its merits, the zoologists and botanists” (Numbers, 1992, p. 6).

The nearly unanimous acceptance of evolution within the American scientific community was spotlighted in 1880, when the editor of the *Independent*, after surveying the teaching of evolution in the colleges of the North, challenged a rival religious weekly, the *Observer*, to name just three working naturalists of repute in the United States--or (it can find one in Canada)--that is not an evolutionist. But besides the Canadian John William Dawson (1820-1899) of McGill, only one could be found: Princeton's Arnold Guyot (1807-1884). (Numbers, 1992, p. 7)

The theory of evolution was accepted and taught in the very late 19th century in most northern universities in America.

Universities in the southern United States were more similar than different with their views on teaching evolution. Numbers (1998), in his book, *Darwinism Comes to America*, devoted a whole chapter to Darwinism in the South from 1860 to 1920. In the period from 1860 to the First World War, there were only two noted cases where evolutionists lost their jobs at southern universities. In 1878, Vanderbilt professor Alexander Winchell wrote a book entitled *Adamities and Pre-Adamites* (Moore & Decker, 2008). Winchell was a theistic evolutionist and noted that Adam descended from a pre-Adamite Black ancestor (Livingstone, 1992). This view of Genesis did not set well with the Methodist bishop of the university. Winchell's dismissal was motivated by race issues that challenged the Genesis story and denuded the Southern notion that Whites were superior to Blacks (Israel, 2004). In the 1880s, James Woodrow was fired because he challenged the literal translation of the Bible at Columbia Theological Seminary (Moore & Decker, 2008). Woodrow espoused the notion that Adam's soul would go to heaven but his body was created by the process of evolution. Even though Woodrow was fired from the seminary, he retained his position at the University of South Carolina and became president of the institution (Numbers, 1998).

Initially, other southern institutions cautiously accepted the theory of evolution and seemed to embrace it in the very early 1900s. In 1875, Henry Clay White at the University of

Georgia began exposing students to evolution in his geology classes (Numbers, 1998). He publically announced that he was an evolutionist in 1887 and there were no repercussions (Stephens, 1994). “White enjoyed fame as the most illustrious member of the University of Georgia faculty from 1880 to the 1920s. His distinguished standing no doubt made it difficult for critics to attack his position as an evolutionist” (Stephens, p. 68). The first biology professor at the University of Georgia, John Pendleton Campbell, also taught evolution openly at the university starting in 1888 (“Evolution controversy,” 2004-2010; Stephens, 2000). At the university a mural was painted in the geology lecture hall illustrating geologic time and depicting evolution. In 1909, both White and Campbell openly celebrated Darwin’s 100th birthday and invited faculty to speak and attend the event. At Tulane and the University of Mississippi, evolution was taught openly in the 1880s (Numbers, 1998). “At other public universities around the South--at Alabama, North Carolina, South Carolina, Virginia and presumably elsewhere--the story was much the same; theistic evolution could be taught with relative impunity” (Numbers, p. 69). According to Numbers, many private religious schools were teaching evolution at the turn of the century in the South: Davidson College, Hamden-Sydney College, Southwestern Presbyterian University, Wake Forest, Baylor, Wofford, and Guilford.

Thinking at the Turn of the 20th Century

In 1896, Andrew Dickson White released his book entitled, *A History of the Warfare of Science with Theology in Christendom*. The text was a comprehensive 20-chapter historical review on the discord between science and the church. The first chapter was devoted to contention between creation and evolution. White (1896) noted,

Darwin’s *Origin of Species* had come into the theological world like plough into an anthill. Everywhere those thus rudely awakened from their old comfort and repose had

swarmed forth angry and confused. Reviews, sermons, books light and heavy, came flying at the new thinker from all sides. (p. 70)

In the very late 1800s only Arnold Guyot, John W. Dawson, John McCrady, and James Dana were viewed as credible scientific creationists in academia. These scientists tried to blend science and biblical creation. They were able to “correlate the Earth’s physical, geological, and biological development with the sequence of creative events sketched by Moses and was widely embraced by Orthodox Christians” (Numbers, 1992, p. 7). James Dana was one of the leading geologists in America during that time period. During his professional career he slowly accepted most of the tenets of evolution with the exception of human evolution (Moore & Decker, 2008). He set into motion a thought that a special creation was used by God to create man. Special creationism would be a popular idea that is still embraced by many Christians even in the early 21st century.

Guyot, Dawson, McCrady, and Dana were among the last North American scientists who held on to their views of creationism. With their deaths, creationism died in most public university science departments and evolutionary teaching became the norm. Numbers (1992) noted,

The intellectual difference between creationists and evolutionists were not always as great as one might assume. Late 19th century creationists such as Guyot and Dawson granted the progressive nature of the fossil record, the antiquity of the earth, the figurative language of Genesis, and the possibility of at least limited organic development, while evolutionists such as Gray and Dana tended to insist on at least some divine involvement, especially with respect to the appearance of the first humans. At times Gray and Dana sounded as much like creationists as Guyot who with Dawson was so moderate in opposing evolution that one historian recently concluded that ‘on the most antievolutionary reading of their position, they can at most be described as doubtful detractors.’ (p. 11)

For nearly 80 years after their deaths, academic scientists would not question evolution.

By the 1880s scientists were strong in their beliefs in evolution in the United States; however, the clergy had dismissed evolution as a questionably weak theory in the mid-1800s. They moved from a more placid stance on the theory to a more active role. By the mid-1880s the clergy had received their wakeup call. Biblical creationists began to preach about the inerrancy of the Bible. There were two veins of thought during this period. One group espoused the notion that the creation story in Genesis was true; however, there was a gap of time missing between day 1 and day 2 of the traditional creation story. This group of Christians was often called the Six Day Creationists or Gap Creationists (Larson, 2004; Scott, 2005). The other camp believed the earth was literally created in 7 days and the age of the earth was approximately 6,000 years old. These groups were the beginning of a Christian philosophy, the old earth creationists and new earth creationists, which would reappear in the future.

Several members of the clergy wrote about issues revolving around evolution and its conflict with creationism. H. L. Hastings wrote *Was Moses Mistaken? or, Creation and Evolution*, in 1896. Hastings, along with most creationists of the era, was most concerned about the origins of man (Numbers, 1992). His treatise allowed for an ample time for a gap in creation but was insistent on God-driven human creation. Robert Patterson wrote two significant works during the period: *The Errors of Evolution* in 1885 and *The Other Side of Evolution* in 1903. Patterson was a prominent Presbyterian evangelist and a prolific writer (Dayton, 1995). Patterson's approach to discrediting evolution was not solely based on scripture (Patterson, 1903). In his 1903 text, over two-thirds of the text was devoted to the discussion of the scientific theory. Patterson was influenced by Dwight Moody.

Moody was one if not the most, influential minister of his day and he created the Moody Bible Institute. One of Moody's last sermons was on temptation (Moody, 1900). Moody warned

that the false doctrine of evolution was leading men down the pathway of temptation (Larson, 2004). Moody advocated the Bible was inerrant and believing in Darwinism was atheistic (Moore & Decker, 2008; Scott, 2005). Luther Townsend was a Presbyterian minister and a professor at Boston Theological Seminary. He believed that the account of creation in Genesis was correct as written. Townsend wrote documents that fueled the controversy: *Evolution and Creationism* in 1896, *Adam and Eve* in 1904, and *Collapse of Evolution* in 1905. These documents set the stage for a fundamentalist movement. Numbers (1992) summarized the views of creationists at the time:

No doubt many Christians, perhaps most, remained unpersuaded by the geological evidence of the earth's great age and continued to believe in a recent creation in six literal days, but these people rarely expressed their views in books and journals. Of those who did, only a tiny minority invoked the deluge to explain the fossil record, the most compelling evidence of an ancient earth. (pp. 17-18)

Due to liberal religious views of many theologians, conservatives were compelled to respond. In 1910,

The Presbyterians at Princeton, who had formulated the doctrine of infallibility of scripture, issued five dogmas: (1) the inerrancy of Scripture, (2) the Virgin Birth of Christ, (3) Christ's atonement for our sins on the cross, (4) his bodily resurrection, and (5) the objective reality of his miracles. (Armstrong, 2000, pp. 171)

Between 1910 and 1915, Amzi Dixon edited a series of pamphlets entitled, *The Fundamentals: A Testimony to the Truth*. Dixon was a Baptist and worked with the Moody Institute. These booklets were immensely popular and supported by rich Baptists at the time (Scott, 2005). There were 12 different pamphlets in all and three million of each was distributed across America (Armstrong, 2000). *The Fundamentals* were responsible for coining the term Fundamentalists. The booklets' main purposes were to denounce a growing liberal denigration of the Bible and to squelch any acceptance of Darwinian evolution.

Eugenie Scott termed the early 20th century as “the growing crisis period” for evolution (Scott, 2005). Scott believed there were “three trends that converged to produce the first major manifestation of antievolutionism in the early 20th century” (Scott, p. 91). The first trend was the growing fundamentalism movement in Protestant America. The second was an increase of Americans attending high schools and being exposed to the theory of evolution in their biology classes (Larson, 2003; Moore, 2002a; Scott, 2005). The third trend was “the association with evolution with social and political ideas of social Darwinism that became unpopular after World War I” (Scott, p. 91). The causes for World War I were shocking to most Christian Americans and were contrary to their morals. Germany’s rise to power was steeped in philosophies tangential to evolution: military supremacy, eugenics, racial superiority, and a growing belief in liberal views on religion (Scott, 2005). Evolution was also blamed for laissez-faire capitalism that allowed individuals to acquire great wealth on the backs of the poor and middle classes (Paul, 2002). The reworking of social Darwinist ideas by Herbert Spencer and William Graham Sumner explained “why the survival of the fittest model filled the need to explain why so many people were being pushed down in the new industrialization: they deserved it!” (Bateman, 2005, p. 190).

The theory of evolution gained credence in part by a curriculum move in universities and high schools at the turn of the 19th century. Biology, as we know it today, was not a course in the very late 19th century. The course came from a compilation of four very distinct courses of study: anatomy and physiology, botany, natural history (naturalism), and zoology (Cretzinger, 1941; Milner, 1990; Scott, 2005; Strauss, 2008; Wylie, 2003). Evolution was an integral part of the “new” biology course. However, Darwinian evolution had one major problem. The theory

could not “account for how variation arose nor how it was maintained in populations” (Wicander & Monroe, 1989, p. 120).

The work of two scientists in particular would enhance the understanding of the theory of evolution. Weismann’s work in the 1890s using rats made “Lamarckian evolution untenable” (Scott, 2005, p. 78). In the early 1900s, the genetic work of Gregor Mendel was rediscovered and affirmed by Hugo DeVries, Carl Correns, and Erich Von Tschermak in three different botanical studies (Dunn, 1965; Moore & Decker, 2008). Mendel’s work set the stage for the mechanism of natural selection (Armstrong, 2007; Milner, 1990). While the instrument for genetics was not fully understood in 1900, the work demonstrated that traits were not blended but remained intact and could be passed to future generations in their original form. As Mendel’s work gained acceptance, a new branch of biology began to emerge. “In 1906 it was given the name of genetics, although the central ideas continued for many years to be referred to as Mendelism” (Dunn, p. 189).

In the early 20th century, genetic research was being explored by many different scientists. “Some log jams had to be cleared before Darwinism and Mendelism could join forces” (Dobzhansky, 1965, p. 206). It took nearly 30 years to understand that Mendelism was not a dualistic theory but was explained by continuous variability. Thomas Hunt Morgan’s work on *Drosophila* demonstrated that genes were located on chromosomes and were responsible for the transmission of heredity (Larson, 2004; Milner, 1990). Morgan’s monumental discovery “set the stage for the revolution of the 1920s and 1930s known as the modern synthesis” (Moore & Decker, 2008, p. 252). He was the first American biologist to be awarded a Nobel Prize in 1933.

The scientific advances in the theory of evolution by 1925 made it an even stronger theory. The theory was being taught in college biology classrooms in America and the topic was

becoming more prevalent in public American high school classes. Academia flaunted evolution and brushed religion away. This was illustrated by W.C. Curtis' address to the American Society of Zoologists in 1918:

Man's picture of himself changed from that of a being, recently created and awaiting a day of judgment in the not distant future, to that of a being originating as part of organic nature and set in a universe without beginning and without end. The by-product of this intellectual revolution was an emancipation of the human spirit from the bounds of authority. Authority indeed remained, but no longer that of a book or pope. In its place came the authority of nature; and so great was the change we have not yet recognized its full significance. Thus science has brought emancipation from theological bondage and set free the spirit of man for higher flights in the future. (Curtis, 1918, pp. 577-578)

In contrast, Fundamentalism, led by William Jennings Bryant, deemed evolution as a social evil that threatened the moral fabric of American children and the Christian way of life.

“Fundamentalists became the ground troops for the campaign to rid schools of evolution” (Scott, 2005, p. 92). Legislation in Southern states began to limit the teaching of evolution. In 1922, the newly formed Georgia Academy of Sciences, led by Henry Clay White, was concerned that rising fundamentalism would squelch the teaching of evolution by means of legislation (Stephens, 1994). In 1924, Tennessee State Representative John Washington Butler wrote House Bill 185. The bill prohibited the teaching of human evolution in Tennessee universities, teacher colleges, and public schools and the legislation passed it into Tennessee law (Israel, 2004; Larson, 2004, 1997; Moore, 2002a). These events led to a perfect storm in 1925 that came to a head in Dayton, Tennessee, in what would be termed “the trial of century.” The result of the *Scopes v Tennessee* trial would have a profound impact on the teaching of evolution in America and the case is summarized in the second section of this literature review.

The Modern Synthesis Theory Era

The modern synthesis of evolution explained some of the inadequacies concerning the lack of experimental evidence in Darwin's original natural selection studies. A more in-depth understanding of statistical analysis associated with Mendelian genetics gave greater credence to the theory (Armstrong, 2007). Genetic biologists, biogeographers, and statisticians worked together to develop the modern synthesis.

Three mathematical biologists from England and the United States were chief contributors to the modern synthesis theory of evolution with respect to statistical evidence. Ronald Fisher's work, *The Genetical Theory of Natural Selection*, examined "the evolution of mimicry, sex ratios, and sexual traits" correlated to natural selection (Moore & Decker, 2008, p. 125). Sewall Wright studied population size as it related to genetics through his work with inbreeding. Wright's work focused on small populations in domestic cattle and his work set the foundation for genetic drift (Moore, 2002a, pp. 149-150). John Haldane worked on a series of theoretical mathematical models on natural selection that culminated in a book entitled *The Causes of Evolution*. The three statisticians worked independently, yet their combined work "showed the theoretical limits of the evolutionary process . . . what could and could not happen given certain assumptions" (Hull, 2002, p. E-13).

Several biologists used the work of statisticians to further develop the modern synthesis theory with related research. George Simpson explained deep time correlated to paleontology. His work explained different rates of evolution and how geographic location can influence punctuated evolution (Milner, 1990; Scott, 2005). Ernst Mayr worked with bird populations on the South Seas islands. His work led to a greater understanding of geographic speciation (Larson, 2004; Milner, 1990). Theodosius Dobzhansky wrote *Genetics and the Origin of Species*

in 1937. Dobzhansky's work was considered key in the formation of the modern synthesis theory. His basic premise was that macro-evolution happens very slowly by very minor changes in organisms over time (Larson 2004; Ruse, 2002). Dobzhansky strongly believed the mechanism was natural selection:

A biologist has no right to close his eyes to the fact that the precarious balance between a living thing and its environment must be preserved by some mechanism or mechanisms if life is to endure. No coherent attempts to account for the origin and adaptation other than the theory of natural selection and the theory of inheritance of acquired characteristics have ever been proposed. (Dobzhansky, 1937, p. 150)

Julian Huxley wrote *Evolution: The Modern Synthesis* in 1942. The text was a 20th century update on Darwinian evolution and included “developments in paleontology, Mendelian genetics, population genetics, systematics and other branches of biology” (Milner, 1990, p. 227). Huxley coined the name modern synthesis evolution theory. The synthetic theory would be attacked by scientists in the future. In the late 1960s, Japanese scientist Motoo Kimura challenged the synthesis theory with his neutralist theory of molecular evolution. Kimura believed that most molecular differences were primarily neutral and they did not have a positive or negative effect on a species. His work would eventually be incorporated into the synthetic theory and would serve as a means to measure the time when species molecularly diverged from one another (Hull, 2002; Milner, 1990). In 1972, Stephen J. Gould would challenge the synthetic theory with his view of punctuated equilibrium. Gould believed that certain species evolved over a few thousand years and did not change for millions of years (Wicander & Monroe, 1989). Over a 20-year period, Gould's work would be incorporated into the synthetic theory (Hull, 2002). The modern synthesis theory stands strong in the early 21st century as the explanation of biological evolution (Hull, 2002).

While American scientists accepted evolution, the public was very weary of the topic. Fifteen states had antievolution bills introduced to their respective state legislatures after 1920 (Bateman, 2006). American religious fundamentalism was given a strong shot in the arm with the result of the Scopes trial in Tennessee. Many other Southern states would follow the trend to curtail the teaching of evolution in public K-12 schools. In public universities the theory was still taught in science departments across the nation.

The Scientific Certainty of Evolution

Increasing scientific discoveries, since the amalgamation of genetics and natural selection, assisted the formation of the modern synthesis of evolution. The modern synthesis still stands in the 21st century as the quintessential explanation of change over time in life forms; however, increasing discoveries have only fostered the acceptance of the theory in the scientific community. The increased fossil discoveries over time helped to plug holes into gaps in the fossil record, providing evidence for change in organisms over time. Several scientific landmark advances in evolution are discussed in this section in an effort to demonstrate the certainty of evolution in the 21st century.

Henri Becquerel and the Curies' discoveries in radiation in the very early 20th century would eventually have a profound impact on the theory of evolution. Radiometric dating allowed scientists to have a quantitative mechanism for assigning ages of geological samples. The work of Bertram Boltwood in 1907 proved that uranium decayed into lead. His early radiometric instruments estimated the Earth's age was much older than previously thought (Boltwood, 1907). The work of Boltwood and others allowed the British geologist Arthur Holmes to create a geologic time scale that was more accurate based on radiometric dating as one solely created by relative dating. Advances in radiometric dating techniques and technology

advanced a greater understanding of deep time as well as recent time. In 1946, Willard Libby mastered radiocarbon dating allowing scientists to calculate the age of life forms less than 50,000 years (Milner, 1990). In 1956, Clair Patterson published his work on the *Age of Meteorites and the Earth*. Patterson gave a tedious estimation of the earth at 4.55 billion years old (Patterson, 1956). This age is the currently accepted age of the earth and has held up to over 50 years of scientific scrutiny. Patterson's work helped to make Arthur Holmes' geologic time scale a more valid work with quantifiable evidence (Moore & Decker, 2008). Darwin lacked the knowledge of the true age of the earth. Vast periods of time explained the necessity for organisms to evolve from simple to very complex forms. Radiometric dating was the key to providing a quantifiable age of organisms and the required time to explain the vast diversity of earth over time.

In the 1940s, entomologists and agricultural scientists worked to create pesticides that were more effective. New chemicals, like DDT, attacked insects with maximum effectiveness. However, a few insects were able to survive the onslaught of chemicals. These surviving insects were considered resistant strains and seemed to have some natural immunity. Darwin's notion of the survival of the fittest was played out on American farms. The surviving insects would breed to create offspring that were resistant to man's created poisons in large numbers. Scientists would have to go back to the lab to create new insecticides to keep the new resistance strains of insects in check. The same sequence of events has been played out with antibiotics in medicine. The creation of new pesticides and medicines to attack unwanted organisms is an ongoing process. Scientists try to maintain the upper hand in this race to keep resistant strains in order:

Just as creatures in nature respond to predators with new defenses, so the targets of human medicine and pest control show an amazing resilience. It's the most common example of evolution 'in action'. Those who claim we 'never see' evolution at work need only look at resistant strains, whose generations are usually very short compared to humans. (Milner, 1990, p. 388)

Just as evolution was the unifying theory in biology, plate tectonics was the unifying theory in geology. In 1858, the French scientist, Antonio Snider-Pellegrini, suggested the continents were once a solid mass and broke apart in the Pennsylvanian period (Wicander & Monroe, 1989). But unlike Darwin's theory, which was quickly accepted, it would take over 100 years before plate tectonics would be accepted by the scientific community. Alfred Wegener was considered to be the father of plate tectonic theory. His text, *The Origin of Continents and Oceans*, was first published in 1915. Most scientists rejected Wegener's theory even though he supplied climatological, geological, and paleontological evidence to substantiate his position. Over the next 45 years geologists would conduct studies in paleomagnetism, subduction zones, sea-floor spreading, volcanic and earthquake mapping, and paleobiogeography. The issue with the acceptance of the theory was identifying the mechanism that made the continents move. The discovery of magma along the mid-Atlantic ridge fostered the notion that convection currents were the active mechanism for continental drift. The theory was accepted by most geologists in the early 1960s. Continental drift helped explain how flora and fauna evolved into new species due to changes in climate and geographic barriers. Paleobiogeographers explained divergent evolution by studying fossil evidence as land masses spread further apart.

By the mid-1930s, most of the amino acids necessary for life had been discovered. John Haldane, Aleksander Oprin, and Harold Urey were scientists that worked on amino acids from 1930 to 1952. The scientists noted the materials needed to create amino acids were readily available in the earth's early atmosphere. Stanley Miller, in 1953, designed experiments to recreate the Earth's early atmosphere. Miller's experiments created amino acids from raw inorganic materials. This research was crucial in the understanding of evolution and the origins of life. The research suggested life could arise from inorganic materials. In 2010, another

scientist would synthesize organic forms. J. Craig Venter synthesized the first cell from bacteria. Venter described the converted cell as “the first self-replicating species we’ve had on the planet whose parent is a computer” (Wade, 2010, p. A17). Venter’s work is highly controversial because it is viewed by many as playing God and others view the creation of new organisms as very dangerous.

In 1869, a German scientist by the name of Frederick Miescher discovered DNA. The young scientist called the material nuclein and he did not realize it was an important component of heredity. For many years scientists would study heredity after the discovery. In 1953, Watson and Crick discovered the double helix structure of DNA. These discoveries led to researchers working on new technologies that would allow scientists to study the genetics of organisms. A new school of taxonomy, termed cladistics, began to emerge which classified organisms based on their genetic closeness or distance to one another. This additional method of comparison gave proof to evolutionary thought that certain organisms not only looked similar but were genetically related. Biochemical testing helped to establish a molecular clock that determined when new species branched from their common ancestors. Human evolution became one of the primary foci of this research. From the 1970s to the present, there had been intense research to correlate chimpanzee DNA to human DNA (Howard Hughes Medical Institute, 2006; King & Watson, 1975; Lovgren, 2005). Studies have found that chimp and human DNA are 96% the same. By studying ape and human DNA, scientists determined the branch between hominids and apes occurred 5 to 8 million years ago. The paleontologists had predicted this branching occurred 20-30 million years ago based on the fossil record. Cladistics coupled with the fossil record has produced a clearer vision of the theory of evolution.

Summary of Section One

By the late 19th century, the majority of scientists believed in evolution. Some scientists clung to a theistic approach to evolution while others moved to an atheistic view. The harmony that existed between science and religion in the early 19th century was shattered in the early 20th century. With the rise of fundamentalism, many scientists divorced themselves from melding science and religion altogether. For most mainstream scientists, there was a true separation of church and state in the United States. Many scientists would look down their academic noses and claim religious folks were ignorant or stupid. A great example of the superiority of science was a quote by James Watson the co-founder of structure DNA. He noted,

The biggest advantage to believing in God is that you do not have to understand anything. The book of the DNA sequence would in time be regarded as more relevant to human life than the Bible. It tells us who we are. I never have read the Bible, so I am not sure I have missed much. (Moore & Decker, 2008, pp. 359-360)

Other scientists would build a wall that separated their personal beliefs of religion and their scientific enlightenment. Science in the modern world is devoid of the supernatural and scientific theories are tested by natural phenomena. The new arena for scientific debate on evolution would not be between scientists and religious scholars, but between the public schools' science classrooms and parents concerned about the teaching of evolution to be mediated in the courts.

Section Two

Section two of the literature review is in chronological order from the 1920s to the present. It is a summary of the jurisprudence that is germane to the teaching of evolution in the public schools of the United States and the laws' effects on public opinion, textbooks, curricula, and teaching. Overall, the litigation has insured that there is a wall between church and state by

favoring evolution over creation science, balanced treatment, and intelligent design. The teaching of evolution has been backed by the courts even though public survey data indicated that most Americans do not believe in evolution or solely teaching the concept of evolution in schools. Textbooks, curricula, and teacher surveys serve as an inferential vehicle to peer into science classrooms of the past.

Constitutional Law

The founding fathers did not write a perfect document and had to make amendments to the United States Constitution. Two amendments, the First Amendment and Fourteenth Amendment, are primarily used to test the validity of new legislation regarding the teaching of evolution. The First Amendment is the most important amendment to evolution legislation. The establishment clause in the First Amendment reads, “Congress shall make no law respecting an establishment of religion or prohibiting the free exercise thereof.” The clause guarantees that the government cannot establish a religion (Brownfield, 2007). The law separates matters of church and state and ensures religious doctrine cannot be established in a public school.

The establishment clause has been used in several court cases prior to 1970 regarding issues of religion and separation of church and state, including prayer in the public schools, public funding to religious schools, religious symbols in public institutions, student led free religious speech, use of public facilities for religious affiliated groups, and laws that prescribe religious conduct. In the 1971 *Lemon v. Kurtzman* case, the judges created a three-prong test to evaluate the validity of a case as it relates to the First Amendment (Hudgins, 1995; *Lemon v. Kurtzman*, 1971).

The Lemon test noted the government statute must first have a secular legislative purpose. Secondly the government's action must not have the primary effect of either advancing or inhibiting religion. The third prong noted the statute must not result in an excessive government entanglement with religion. The Lemon test was very important in deciding most of the evolution-based cases regarding the public schools in the last three decades of the 20th century.

In 1984, Justice Sandra Day O'Conner introduced the endorsement test in *Lynch v. Donnelly* (Jurinski, 2004). The endorsement test had two prongs. The first prong tested to see what message was intended by the government and if that message favored religion or religious citizens. The second prong examined the message received by the public regarding the endorsement or the disfavoring of religion. Both prongs of the test had to be satisfied to ensure that government could not send a message that it favored or disfavored a religion. This test would become very important in the 21st century regarding evolution law.

The Fourteenth Amendment ensures that states cannot make laws that supersede federal legislation that relates to all citizens. The Fourteenth Amendment has been used, for example, when states have tried to enact laws that would prohibit the teaching of creationism in their states' public schools because the Supreme Court had already ruled on this matter. Both the First Amendment and Fourteenth Amendment have served as barometers to gauge the validity of law cases regarding evolution.

The Hierarchy of the Law

In the United States there is a hierarchy within the courts. A flowchart was created to visually summarize the hierarchy and is labeled Figure 1. At the top of the hierarchy is the

United States Supreme Court. All decisions handed down by the United States Supreme Court take precedent over all lower court rulings at the state and federal levels. Any new legislation regarding similar laws decided by the United States Supreme Court would have to be in accordance to the earlier ruling. Below the United States Supreme Court are two courts that have the potential to send cases to the highest court in the land: the Federal Circuit Court of Appeals or a State Supreme Court.

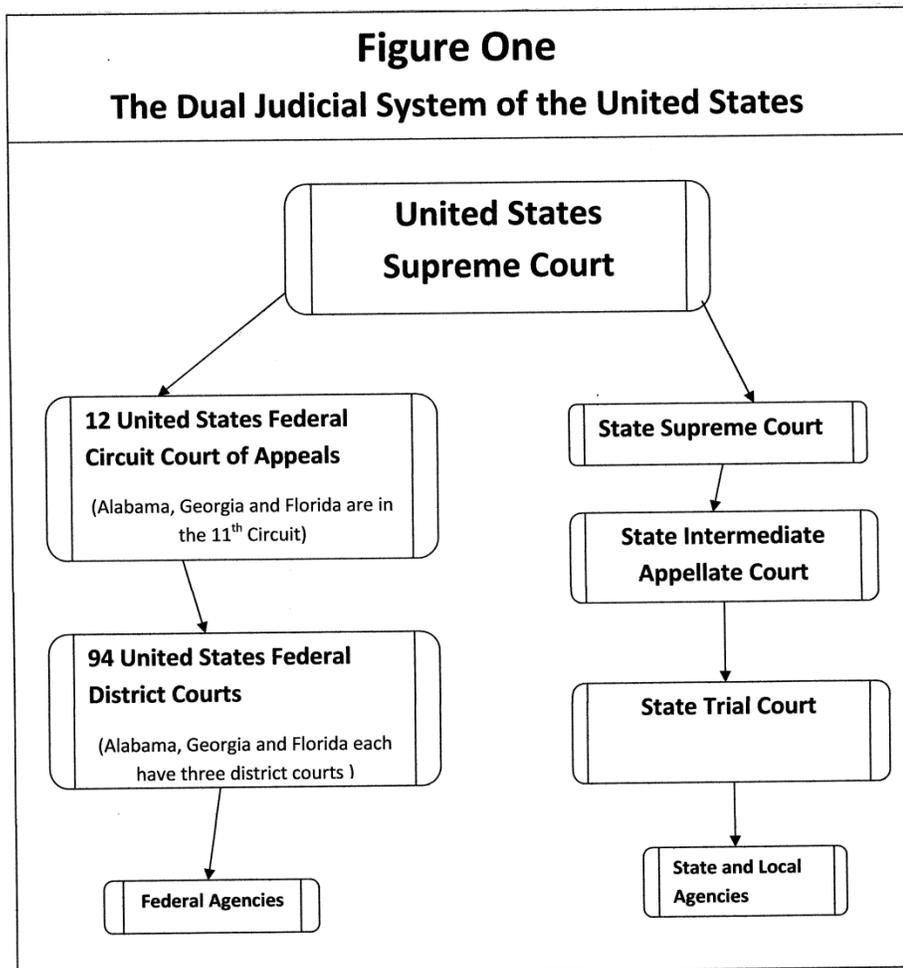


Figure 1. The dual judicial system of the United States.

Just below the United States Supreme Court is the United States Federal Circuit Court of Appeals. There are 12 Federal Circuits in the United States and they serve all states and territories. For example, the Eleventh Circuit Court serves the states of Alabama, Georgia, and Florida. The rulings by the Federal Courts are only trumped by the United States Supreme Court. Rulings by one Federal Circuit Court do not extend to the other 11 Circuit Courts. However, lawyers review other circuit court rulings and use these court decisions to set precedent. “Precedent allows and establishes stability, consistency, and predictability to the law. It may also, however, gives rise to different interpretations of the same issues developing in different circuits or different states. This can muddy the law and impact its predictability” (Potter, 2007). When two Federal Circuit Courts rule differently on the same type of legislation, the United States Supreme Court will often take the case to set a national ruling. Below the Federal Circuit Courts are the Federal District Courts. There are 94 District Courts in the United States. In Alabama, Georgia, and Florida there are three district courts in each state: One court in the northern, middle, and southern regions in each of these respective states. The Federal Circuit rulings apply to the district courts they serve. For example, the Eleventh Circuit court serves the 12 Federal District courts in Alabama, Georgia, and Florida. Federal District court rulings do not transfer from one district court to the other. When two Federal district courts rule differently on the same type of legislation, the Federal Circuit court will often take the case to set a ruling in the geographic region within the Federal Circuit court’s jurisdiction.

The State Supreme courts follow a similar progression. Below the State Supreme Court in 40 states are the State Intermediate Appellate courts. Ten states do not have the intermediate courts and receive trials directly from state trial courts. Below the Intermediate Appellate courts are the state trial courts. “The states’ courts adhere to the rulings of higher courts in their states

but do not have to follow the decisions of other state courts or the Federal courts, except the Supreme court” (Potter, 2007, pp. 21-22).

This hierarchy is germane to this dissertation because different courts create laws and set precedent regarding what is allowed to be taught regarding evolution in the public schools in the United States. The United States Supreme Court has ruled on the topic of evolution and the public schools on several occasions. These cases will be discussed in greater detail later in the dissertation. The difference in the hierarchy allows for disparity between states regarding what can or cannot be taught regarding evolution. A prime example is in the south. In Georgia, a United States District court ruled that a school district could not use disclaimers on evolution in textbooks. Moving across the state line into Alabama, disclaimers on evolution are allowed. If a parent pushes the issue in Alabama and a Federal District court rules that disclaimers are allowed, the Eleventh Circuit court may have to try a case to set a ruling for the states of Alabama, Georgia, and Florida. In the event this future ruling was in conflict with another Federal Circuit court ruling, the United States Supreme Court could determine whether disclaimers on evolution are allowed at the national level.

The judiciary system creates laws through the courts at the state and federal level. There are two other sources of law beyond the judiciary and constitution. One source is from the legislative branch in the form of statutory law. At the state and national levels, there are two bodies of legislature: the House of Representatives and the Senate. Both the House and the Senate must agree on the same form of the bill before it is sent to either a governor at the state level or the president at the national level. Once the chief executive signs the approved bill, the statute becomes law at the respective state or national level. The other source for law is through the executive branch in the form of regulatory law. The role of the executive branch is to

implement, enforce, and ensure the laws are followed. State departments of education and the United States Department of Education create regulations that detail how statutes are implemented, interpreted, clarified, and enforced. These government organizations create manuals and guides to ensure the statutes are followed by schools at their respective national, state, or district levels. Within this legal hierarchy, there are 10 landmark cases that have influenced the teaching of evolution in the public secondary schools of the United States.

The Scopes Trial of 1925 and its Effects

By the 1920s, many Americans were worried by outside philosophies that began to change the moral fabric of the United States. Americans were more educated than ever. In 1890, only 6.7 % of all 14- to 17-year-olds attended high school (Moore, 2002a). By 1910 that number increased to 15.4% and to 32.3% by 1920. In the early 20th century, the theory of evolution was widely accepted by the scientific community and was reflected in the textbooks used in colleges and secondary public schools (Scott, 2004). Many American parents were concerned about the teaching of the theory to their children. The Social Darwinist movement in Europe and the United States enhanced parents' concerns. During the same period, fundamentalism in the Protestant community called for a return to the fundamentals and a more Christian society. By 1925, the social mechanisms were in place for a perfect storm. In the early 20th century,

The antievolution movement became organized, active, and effective. Three trends converged to produce the first major manifestation of antievolutionism in the 20th century: the growth of secondary education, the appearance of protestant fundamentalism, and the association of evolution with social and political ideas of social Darwinism that became unpopular after WWI. (Scott, 2005, p. 91)

Fundamentalists were incensed with their children learning evolution. To them the Bible was inerrant. Evolution was blasphemous and a form of heresy to the fundamentalists. They began pleading to their state legislatures to enact anti-evolution acts to save American children from a Godless society (Jurinski, 2004). The Anti-evolution or Anti-Darwin movement was first tested in South Carolina in 1921 and Kentucky in 1922. Both of these earliest attempts failed. In 1923, the governor of Oklahoma signed House Bill 197, which prohibited the use of textbooks that promoted evolution (O'Dell, 2007). The legislation was commonly called the Montgomery Amendment. The 87 “for” to 2 “against” vote in the Oklahoma house served as a gauge to establish a feeling for the antievolution movement in the South. This was the first piece of legislation that prohibited the teaching of evolution in the United States. The state of Florida enacted legislation that condemned the teachings of Darwin and noted the theory was improper and subversive to teach children. Tennessee, Arkansas, and Mississippi enacted legislation that made it illegal to teach human evolution in their classrooms in the 1920s.

The first and probably the most notorious trial pertaining to evolution was the *Tennessee v. John Scopes* trial of 1925 (Hudgins, 1995). The trial concerned the validity of the Chapter Number 27 House Bill Number 185 law enacted by the 64th General Assembly of the State of Tennessee (*State v. Scopes*, 1926). The legislation was commonly termed the Butler Act and forbade any teacher from teaching human evolution opposed to the divine creation. The court proceedings captured the interest of the whole nation and it was commonly termed the “Scopes Monkey Trial” (Larson, 1997). The trial was set in the small southeastern town of Dayton, Tennessee, and had a circus-like atmosphere (Cruver, 2000; Israel, 2004; Numbers, 1998). One of the reasons for the great interest was the attorneys involved in the case and their backers. Representing the state of Tennessee against Scopes was William Jennings Bryant backed by the

World's Christian Fundamentals Association. Bryant ran for President of the United States three times and was the Secretary of State under President Wilson (Jurinski, 2004; Marzilli, 2004; Numbers, 1992; Thomas, 2006). Even though Bryant had not tried a case in several decades, he volunteered to lead the prosecution for the state. Bryant was the consummate antievolutionist and believed the movement was detrimental to religion, democracy, and morality. John Scopes was backed by the American Civil Liberties Union and defended by Clarence Darrow. Darrow was considered to be among the best, if not the best, trial lawyer in the United States. It was the only case Darrow took *pro bono*. Darrow was an agnostic, an antifundamentalist, and possibly harbored a grudge against Bryan for losing the presidency three times to Republicans (Jurinski, 2004). The general misconception was evolution was on trial. In actuality the teaching of human evolution was the relevant topic. The ruling was that John Scopes broke the law by teaching human evolution and he was fined \$100. The Tennessee Supreme court reversed the decision a year later. The importance of the litigation was it set a foundation for future trials on creationism versus evolution, and put the brakes on the teaching of evolution in the South. The 1925 Tennessee law forbade the teaching of human evolution and stayed on the books until 1967. Arkansas and Mississippi had similar laws restricting the teaching of human evolution. During the 40 years the legislation was in the law books neither Tennessee or Arkansas ever used the law against a teacher with the exception of John Scopes.

The media frenzy that surrounded the Dayton, Tennessee, court case set the stage for future battles on evolution and helped stifle the teaching of evolution (Skoog & Bilica, 2002). Scholars have differing opinions regarding the degree of censorship in schools on the topic, particularly in the South. Ronald Numbers (1998) noted that in the decade of the 1920s, 20 states had introduced 37 pieces of antievolution legislation. By 1929 only Texas and Oklahoma

had legislation introduced and the topic began to wane after repeated losses except in three states. In 1930, it was estimated that “70 percent of American classrooms omitted evolution” (Larson, 2003, p. 85). Scott noted,

Although many leaders of the pre-Scopes antievolution movement were from Northern states, after the Scopes trial antievolutionism became more regionalized, retaining momentum in the South and rural areas of the county, where fundamentalism remained strong. Where fundamentalist held political power, regulations were imposed by school boards to restrict the teaching of evolution. But the demographics of fundamentalism were changing, as it moved from the cities of its origin to the rural South where it largely disappeared from the view of the mainstream press. (Scott, 2005, p. 96)

Jurinski (2004) noted that most teachers in the South omitted the chapters on evolution in an effort to avoid pressure from parents who had fervent religious views (Jurinski). Teachers in urban areas often taught evolution but were not prosecuted. Teachers may have limited the teaching of human evolution, particularly in Mississippi, Arkansas, and Tennessee, where doing so could land them in jail or the teaching of the subject could “offend the sensibilities of students, parents, school administrators, and school boards” (Jurinski, p. 75) .

By examining textbooks of the day, one can examine the effect of the Scopes trial on evolution education. The textbook used by John Scopes was *Civic Biology*. It was one of three main biology textbooks used by students in American biology classes in the 1920s (Grabiner & Miller, 1974). The book used by Scopes did not go into great detail about evolution but it contained a diagram showing man and his position on the evolutionary tree. In contrast, *Gruenberg’s Elementary Biology* and *Moon’s Biology for Beginners* treated organic evolution in a very comprehensive fashion. Moon noted that evolution was the unifying idea in biology in 1921.

In the pre-1925 era, biology textbooks were very content driven and included organic evolution, but in the 1930s a major shift occurred (Reynolds, 1976). Textbooks in the 1930s were learner centered and were written by educators (Grabiner & Miller, 1974; Reynolds, 1976).

Textbook publishers of the era between 1930 and 1960 were in a quandary when it came to the treatment of evolution. The South was highly agricultural and more students took biology than other areas of the country (Grabiner & Miller, 1974). The Southern textbook market was important because most schools used a state adoption process, unlike many Northern States. A new strategy was devised to sell textbooks.

Authors and publishers found that a few simple linguistic tricks were all that were necessary to keep community objections to the adoption of their textbooks to a minimum. Most found that if they substituted a weak synonym for the word “evolution”-- adical development, progressive development, development of change--and fudged a bit when discussing the origin of the human species, they could get on to saying whatever it was they wanted to say. Scopes barely slowed them down. (Ladouceur, 2009, p. 79)

By the late 1930s, evolution was creeping back into textbooks. Scholars seemed to disagree with the influence of Scopes on texts. After the trial, popular opposition to evolution remained high with the result that most textbooks made little or no mention of evolution until the early 1960s. Those that discussed it often omitted it from the index (Robinson, 1995). The squelching of the topic was particularly successful in southern states (Cretzinger, 1941). Scott echoed this sentiment in her 2005 text:

In the South, states and local school districts restricted the teaching of evolution, and teachers and local parents who chose textbooks preferred ones that slighted evolution period. The economic pressures were effective: textbook publishers knew they had to remove, downplay, or qualify evolution if they wanted sales, and they did. Books tailored for the Southern market were of course sold elsewhere, and evolution disappeared from textbooks all over the nation. Because of the influence textbooks have on the curriculum, with evolution absent from the textbooks, it quickly disappeared from the classroom. (p. 97)

Yet Ladouceur's (2009) analysis of evolution in biology textbooks of the 1930s noted that in the nine major biology textbooks, space devoted to evolution greatly increased during the time period (p. 1). Numbers (1998) noted that textbook companies after the Scopes trial only modified their textbooks. "They deleted potentially offensive statements or substituted euphemisms 'development' for 'evolution'" (p. 89).

The first teacher survey on evolution was completed in the early 1940s. Riddle completed several surveys on evolution to gauge if the topic was being taught in American schools (Riddle, 1941; Riddle et al., 1942). Surveys on evolution were "windows into classroom practice and must be treated as inferred evidence from an indirect source" (Wendel, 2006, p. 2). The 1939-1940 survey was distributed to over 16,000 teachers and 3,186 teachers responded. The results indicated that 53.7% taught evolution. However, Southern teachers reported only a 40.1% teaching rate. In a small 1950 study by Laba and Gross (1950), in the state of New Jersey, 71% of the biology teachers reported they taught evolution. The research also discovered that less than one-third of the teachers taught human evolution. From 1950 to 1981, there was no published survey research on the teaching of evolution.

Sputnik and the Rebirth of Evolution Education in Schools

The launch of Sputnik thrust science education into the forefront in American educational circles. Americans realized in order to compete with the Communists, students must be knowledgeable about the major scientific theories. In the 1950s, the discovery of the structure of DNA and the sequencing of amino acids strengthened evolution with more tangible evidence (National Academy of Science, 1998). "Evolution gained prominence in American schools. Instruction in biology was now framed explicitly in evolutionary terms" (Robinson, 2005, ¶ 3).

The historian Richard Hofstaedter wrote, “At this time in American history, opposition to evolution seemed only a very distant memory” (Robinson, 2005, ¶ 13).

One of the most important curriculum pieces resulting from the Sputnik launch was the creation of the Biology Science Curriculum Study (BSCS), which was funded by the National Science Foundation. Prior to 1957, most professional biologists were not interested in biology high school texts and curriculum (Rudolph, 2002). The academics were surprised with the lack of evolution and science skills in textbooks (Grabiner & Miller, 1974; Moore, 2002c; Scott, 2005). Biology teachers had focused more on a kingdoms approach to teaching the topic and most often avoided evolution (Scott). In 1961, Simpson warned that it did not matter how well biology textbooks explained evolution because there were barriers put forth by teachers in presenting the material (Simpson, 1961). Three different reasons were noted by Simpson for not teaching the topic. The first was teachers lacked content knowledge to teach evolution. The second was that many did not believe in evolution. The third reason was fear of teaching the topic because of pressures from school administrators and the community as a whole. The first BSCS books were released in 1963. However, the winds of change were beginning to fan in a new direction.

The BSCS textbooks were attacked. The most concerted campaign was in Texas; attacks were made in church sermons and in the press as well as in the hearing rooms of the State Textbook Commission. But 1964 was not 1926; this time the texts were adopted, unexpurgated. Scientists participated in the hearings. The prestige, the power, the financial support of the federal government were behind the scientists and the new textbooks. In addition, major historical changes had occurred, all militating in favor of the approval of the BSCS books in Texas: the new public interest in improving high school science teaching; the large body of legal precedents limiting religious influence in the schools; and the increasing urbanization and educational level of the people of the South. These same historical forces resulted in the repeal of the Tennessee antievolution law in 1967. (Grabiner & Miller, 1974, p. 836)

The BSCS curriculum focused on a more scientific approach to biology that was steeped in laboratory investigations. Students participated in a more active approach to learning concepts and evolution was not omitted or downplayed in the curriculum.

The Supreme Court Rules on Teaching Human Evolution

In 1968, an old antievolution law in Arkansas would get the attention of The United States Supreme Court in *Epperson v. Arkansas*. This was the second major court case on evolution and it was the first time the Supreme Court reviewed the constitutionality of a statute on evolution (Hudgins & Vacca, 1995; Jurinski, 2004; Moore & Decker, 2008; Scott, 2005). Epperson taught biology at Central High School in Little Rock, Arkansas, the same school that produced the famous *Brown v. Board of Education* law suit in 1954. The Arkansas Education Association (AEA) wanted to challenge the legality of the 1928 Arkansas law that forbade the teaching of human evolution and wanted a teacher to try the legality of the law (*Epperson v. Arkansas*, 1968).

Epperson was a native of Arkansas and devout Christian that graduated from a religious institution (Moore & Decker, 2008). Epperson agreed to test the law for the AEA to resolve her plight to be both a responsible biology teacher and an American citizen. Epperson believed it was her responsibility to teach scientific theory, and if she taught the theory of evolution, she would be breaking the Arkansas law. In addition she believed her free speech rights were being denied and her principal, minister, and several parents supported her position. The court ruled in favor of Epperson. The National Academy of Sciences (1998) summarized the finding as follows:

The court held the statute unconstitutional on grounds that the First Amendment to the United States Constitution does not permit a state to require that teaching and learning

must be tailored to the principles and prohibitions of any particular religious sect or doctrine. (The National Academy of Sciences, p.121)

Because the Supreme Court made the decision, it sent shock waves across the religious South and in conservative America. The case set a precedent that Christianity could not be woven into science curriculum and states could no longer legislatively prevent the teaching of evolution.

“After the U.S. Supreme Court Epperson decision . . . creationists started labeling their body of information supporting the biblical version of creation as ‘creation science’” (Jurinski, 2004, p. 78). This change in the language would result in future litigation.

The Beginning of Creation Science and Religious Neutrality

In the 1960s and 1970s, there were voices that were preaching the evils of evolution; however, during the climate of the sexual revolution, these voices were nearly ignored except in religious circles. The Creation Research Society and The Institute for Creation Research arose during this time period and began to set their agendas for the teaching of creation science. Henry Morris, the father of creation science, began writing books in the 1960s that mixed theology with science (Scott, 2005). Morris was an advocate of the young earth creationist approach whose tenets were based on the inerrancy of Genesis as it was written (Berra, 1990). All creatures and the earth were created in 7 days. The flood of Noah explained stratigraphic layers in the geologic column and the earth was less than 10,000 years old (Patterson, 2006). These organizations had followers, but they remained relatively quiet until the 1980s when conservative politics and ideas begin to rise. Religious Christian conservatives in the South kept evolution squelched in many rural schools. The influential preacher Jerry Falwell was quoted in 1979, “I want you to have all the academic freedom you want as long as you wind up saying the Bible account of creation is true and all the others are not” (Moore, 2003, p. 766). The

creationists began to push a more balanced approach to life origins in the guise of creation science. With the rise in Christian Fundamentalism, the religion versus science teaching war would experience numerous court cases over a 25-year period.

Two Supreme Court cases in the 1960s, *Engel v. Vitale* and *Abington School District v. Schempp*, ruled on the legality of reading state prepared prayer and requiring students to read Bible scripture in public schools. In both instances the practices were ruled unconstitutional. The court set a foundation for favoring religious neutrality in public schools (Moore & Decker, 2008). In 1981, religious neutrality would be tested as it related to evolution. After the Arkansas ruling, 11 states would introduce legislation that would allow a more balanced approach to the teaching of evolution and creationism in their respective states (Wade, 1972).

Nell Segraves was part of the young earth creationist movement. She worked closely with Henry Morris and the Creation Research Science Center to create biology textbooks that would be used in Christian schools. Segraves believed there needed to be alternatives to the BSCS curriculum. In the late 1960s and 1970s, she pressured the California Board of Education to include creation science in science classrooms and ensure that evolution was taught as a theory in the non-scientific definition of the word. Segraves argued “that the scientism of evolution should be balanced with creationist explanations of origins. She claimed that to do otherwise would violate the neutrality requirements and put the State in the position of having adopted a particular religion of secular humanism” (Moore & Decker, 2008, p. 316). Segraves was successful in her quest to have creation science in the curriculum of the state of California. The California Board later dropped the term “creationism” from the curriculum but insisted that teachers take an anti-dogmatic approach to evolution and science in general (National Academy

of Sciences, 1998). Segraves had great influence and advised a very influential conservative, Ronald Reagan, on evolution (Moore & Decker).

Nell Segrave's son, Kelly, put his creationist philosophy to the forefront by suing over the Science Framework approved by the California State Board of Education. Mr. Segraves was concerned that a discussion on evolution was being taught as dogma to his three children. This led to the third landmark case in 1981. In the case of *Segraves v. State of California*, the Creation Science Research Center was also listed as a plaintiff in the case and created much public interest (The National Academy of Sciences, 1998). Mr. Segraves believed the curricular approach violated his children's rights to free exercise of religion, and California's State Board of Education's Science Framework was dogmatic. The judge ruled that the State must present the material conditionally and not dogmatically (Moore, 2002a). The judge believed that both parties acted in good faith. The judge noted that neither side lost; however, he did condemn the State Board for not making publishers and school district personnel aware of the State School Board policy. The ruling regulated that anyone using the California Science Framework should be given a copy of the board policy.

The fourth landmark case was the federal case of *McLean v. The Arkansas Board of Education* in 1982. A new Arkansas law required equal treatment between creation science and evolutionary science in Arkansas classrooms (The National Academy of Sciences, 1998; *McLean v. Arkansas Board of Education*, 1982). The Arkansas Balanced Treatment for Creation-Science and Evolution-Science Act (Act 590) was considered unconstitutional by many of the American Civil Liberties Union because they believed it violated the establishment clause (Ruse, 1996). The state was also sued by many protestant and Jewish clergy, the National Association of Biology Teachers Association, parents, and others. The litigation would culminate in Federal

District Court in Little Rock. Several issues were argued that were of importance. The first was the meaning of the word science. The court determined that the term “creation science” did not meet the criterion for the word science. The court decided the balanced treatment of creationism and evolution violated the Establishment Clause of the United States. The court found that life’s origins were not a part of evolutionary theory and that evolution does not presuppose the presence or absence of a creator (*McLean v. Arkansas Board of Education*).

Even though the Federal ruling in Arkansas had set precedent on the balanced treatment of evolution and creation, Louisiana was not bound by the statute. A similar trial would have to occur and would eventually land in the Supreme Court of the United States. The fifth landmark case originated in Louisiana in 1987. The Supreme Court of the United States decided on *Edwards v. Aguillard* (The National Academy of Sciences, 1998). The Louisiana law required that public school teachers could only teach evolution if they also taught creationism (Wexler, 2003). Don Aguillard, a teacher from Lafayette, responded to a newspaper advertisement by the ACLU. The organization wanted a teacher in the State to sue over the balanced treatment law. Aguillard noted, “I knew this was important. I was not ready to pretend that creation science was legitimate or that evolution didn’t matter” (Moore & Decker, 2008, p. 3). The Supreme Court ruled the law violated the Establishment Clause by endorsing the teaching of religion. The court noted that the law undermined the teaching of evolution and that creationism is a religious idea. The ruling of the trial was described by *Time Magazine* as “a major setback for fundamentalist Christians” (Moore & Decker, p. 4).

Teacher Survey Data from the 1980s

Despite all the court cases on evolution in the 1960s and 1970s, there were no studies completed on the prevalence of teaching evolution, during these decades. By 1980, it had been 30 years since a study had been completed on the teaching of evolution. During the decade of the 1980s, there were five studies that surveyed teachers on evolution. In the early 1980s, William Ellis surveyed teachers in three states; Kentucky, Indiana, and Tennessee (Wendel, 2006). The first state surveyed was Kentucky and over 800 surveys were sent to high school biology teachers. The results discovered that 59.6% of the responding teachers placed moderate or strong emphasis on evolution (Ellis, 1983). The 1982 studies in Tennessee resulted in 67.9% of the biology teachers noting they taught evolution. In Indiana, a 1982 study reported 77.2% of the biology teachers taught evolution moderately or strongly.

In 1986, Michael Zimmerman surveyed high school biology teachers in Ohio (Wendel, 2006). Nearly 300 teachers responded to the survey. He found that 87.7% of the teachers reported they taught evolution (Zimmerman, 1987). Zimmerman reported that 18.9% of the public schools taught a section on creationism. In the study, 10% of the teachers noted they felt pressure by creationists to limit the teaching of evolution and/or to increase the teaching of creationism. Approximately 75% of the teachers noted Creationism was not a science. Zimmerman noted that 5.4% of teachers responded that they felt pressure to teach evolution.

Robert Tatina (1989) did evolution survey research in the state of South Dakota in 1988. His work included data from 93 high schools. Tatina reported that 72.7% of the biology teachers included evolution in their classes and 16.3% included creation. Only 1% of the teachers felt pressure to teach evolution. The South Dakota teachers reported that 34.3% believed that creation science was scientifically valid.

The teacher survey data from the 1980s compared to the survey data 30 years earlier indicated that evolution was being taught more in the science classrooms of the 1980s. Southern states were less likely to teach the concept during both time periods compared to their northern counterparts. Wendel (2006) noted that the survey data indicated that teachers in Southern states were more likely to avoid teaching evolution. During the 1980s there were no major court cases regarding evolution.

The Court Cases of the 1990s

The sixth landmark case was *Webster v. the New Lennox School District* in Illinois in 1990. Ray Webster was a social studies teacher at Oster-Oakview Junior High School. Mr. Webster infused his creationist views into his social studies lessons. A student filed a complaint that the teacher was teaching creation science and the student felt there was a violation of church and state (The National Academy of Sciences, 1998). The superintendent repeatedly warned Webster about using the Christian viewpoint in his classes. The school board sent a letter to Mr. Webster instructing him to refrain from advocating a particular religious viewpoint. Webster believed his free speech rights were violated. He filed a suit based on censorship, and violations of the First and Fourteenth amendments. The Seventh Circuit Court of Appeals ruled that a school district may force a teacher to stop teaching creationism and a teacher does not have the First Amendment right to teach creationism in a public school.

The seventh landmark case was *Pelozo v. Capistrano School District* in 1994. John Pelozo was a biology teacher who believed evolution was a form of religion (The National Academy of Sciences, 1998). Mr. Pelozo felt he was forced to teach the religion of evolution and believed he was harassed and intimidated. He filed suit claiming his Free Speech and

Establishment Rights under the First Amendment were violated. He also believed his Equal Protection and Due Process Rights afforded to him by the Fourteenth Amendment were being violated. The United States Court of Appeal in the Ninth Circuit ruled that evolutionism was not a religion. The court noted that the Capistrano District acted accordingly by expecting a biology teacher to teach the curriculum. One other point of interest was that the court ruled that a teacher may not talk about religion during the school day even when they are not teaching.

The eighth case was in 1999 from the state of Louisiana. The Tangipahoa Parish School Board of Education wanted to have their science educators teach creation science as an alternative to evolution; however, they were advised to take a different route in light of similar court rulings (Moore, 2004 and Shaver, 2003). The school board required all teachers to read a disclaimer about the theory of evolution as they taught the subject. The disclaimer written by the Tangipahoa Parish School Board of Education was as follows:

It is hereby recognized by the Tangipahoa Board of Education, that the lesson to be presented, regarding the origin of life and matter, is known as the Scientific Theory of Evolution and should be presented to inform students of the scientific concept and not intended to influence or dissuade the Biblical version of Creation or any other concept. It is further recognized by the Board of Education that it is the basic right and privilege of each student to form his/her own opinion and maintain beliefs taught by parents on this very important matter of the origin of life and matter. Students are urged to exercise critical thinking and gather all information possible and closely examine each alternative toward forming an opinion. (*Freiler et. al. v. Tangipahoa Parish Board of Education et. al.*, 1999)

In November of 1994, three parents filed suit against the district because they believed the disclaimers were in essence establishing religion (Moore, 2002a). In 1997, the U.S. District court ruled the disclaimer had a purpose of endorsing religion because it contradicted the lessons taught in Sunday school and suggested that evolution was a religious viewpoint. The court ruled the disclaimers were illegal. One note of interest was this case noted that intelligent design was the same as teaching creationism.

Many right-wing Protestant groups began to change their minds about waging the war on evolution in the 1990s. The Supreme Court of the United States had ruled on several occasions favoring the teaching of evolution over creationism. Some creationists devised a new strategy. This new theory was termed, “Intelligent Design.” William Dembski, a leader in the Intelligent Design Movement, defined Intelligent Design in three parts; “1) A scientific research program that investigates the effects of intelligent causes; 2) an intellectual movement that challenges Darwinism and its naturalistic legacy; and 3) a way of understanding divine action” (Dembski, 1999, p. 12).

Baylor University’s Polanyi Center established the first think tank on intelligent design in 1999. This was the first major research university to view the intelligent design movement with some credence. The group gave themselves a name, *The Wedge*, and Phillip Johnson led the group. Adherents of The Wedge “are avidly pursuing a 20-year plan to convince the public that intelligent design is an accepted alternative in the sciences and to promote the influence of design theory in spheres other than the natural sciences” (Forest, 2005, ¶ 2). The actions at Baylor caused great controversy within the teaching staff at this southern university.

Teacher Survey Data of the 1990s

In the 1990s, five survey studies on evolution correlated to teaching were conducted in Texas, Minnesota, Louisiana, and Oklahoma. Shanker and Skoog (1993) reviewed 307 returned surveys from biology teachers in Texas secondary public schools. The survey noted that 87% of the teachers included evolution in their instruction but only 31% devoted more than 30 or more minutes to human evolution. The survey discovered that 56% of the teachers presented creationism in the discussion of origins of life. In 1995, a study was conducted with Texas

biology college students regarding the evolution instruction they received in high school (Wendel, 2006). The study included responses from 443 students. The study indicated that 75.6% of the students were taught evolution and 43.8% were taught creationism in some fashion in their science classes. A 1995 survey of 91 biology teachers in the state of Minnesota revealed that 69% taught evolution and 31% avoided evolution. In 1998, a study was conducted in Louisiana involving 387 teachers (Aguillard, 1999). The study discovered that 77% of the biology teachers included moderate to strong instruction in evolution while 23% reported little to no instruction on evolution. Fourteen percent noted that they instructed creationism with a moderate to strong emphasis, and nearly 20% treated creationism favorably in their science classrooms. The 1999 Oklahoma study examined the results of 224 teacher surveys (Weld & McNew, 1999). The study reported that 67% of the teachers delivered a moderate to strong emphasis on evolution and a 25% strong moderate to strong emphasis on creationism. The survey data in the 1990s indicated that while the majority of the biology teachers were teaching evolution in their classroom, some of their colleagues were teaching creationism.

21st Century Teacher Survey Data

In the early 21st century, there have been three surveys regarding evolution and creation in the public schools. The first survey was conducted by Michael Rutledge and Melissa Mitchell in Indiana. The state of Indiana was important because it had recently revamped its science curriculum before the survey. In a detailed study that correlated eight evolutionary concepts to state standards, only two states satisfied all the criteria: California and Indiana (Skoog & Bilica, 2002). An additional study by the Fordham Foundation found that Indiana was 1 of 10 states to receive an “A” for their treatment of evolution in their science standards (Applegate, 2001;

Lerner, 2000; Moore, 2002c). The Indiana survey included the results of 552 biology teachers (Rutledge & Mitchell, 2002). Approximately 66% of the teachers spent 4 or more days dedicated to teaching evolution in their biology courses. Only 7% of the instructors noted they avoided the topic of evolution. However, 36% of the teachers stated they briefly mentioned evolution in a state that had among the very best evolution standards in the country for the time. The survey found that a teacher's course preparation and religious views had an impact on their view of teaching evolution.

Teachers who lack an understanding of evolution and the nature of science may be incapable of making informed decisions of acceptance or rejection of evolutionary theory, as well as professionally responsible curricular and instructional decisions regarding the teaching of evolution. Further, teachers who do not have a thorough understanding of the nature of science may not be able to differentiate between the scientific validity of evolution and strongly held religious views – a condition that may confound their teaching of evolution. (Rutledge & Mitchell, 2002, p. 25)

In a 2003 study in Minnesota, 91 teachers completed a survey to examine teachers' views on the teaching of evolution (Moore & Kraemer, 2005). This survey was a repeat from a 1995 study. The study noted that 88% of the teachers taught evolution and 12% excluded evolution. Twenty percent of the teachers noted that creationism was included in their biology curriculum. Ten percent of the teachers noted that they spent 6 or more class hours on creationism in their classrooms and 100% of the teachers reported that most scientists accepted the modern theory of scientific evolution as valid. The survey noted that 52% of the teachers reported that their undergraduate methods courses did not prepare them to teach evolution. This was the only survey that asked teachers, "Who pressured them to not teach evolution?" Twenty-five percent of the parents and 8% of their administrators had pressured teachers not to teach evolution. The study also indicated that 22% of the parents and 4% of the administrators encouraged them to teach creationism. Professor Moore continued research on teachers to discover their knowledge

of evolution and the laws that govern the teaching of evolution (Moore, 2004a; Moore, Jenson, & Hatch, 2003). Moore discovered that teachers were lacking much knowledge regarding the laws that govern the teaching of evolution.

In a 2004 Oregon study, 80 teachers were surveyed on the nature of science, evolution knowledge, and their religious beliefs (Trani, 2004). Eight-four percent of the teachers presented evolution and many of them were religious. They had a firm understanding of the nature of science and the theory of evolution. The study indicated the biggest concern was the 16% of the teachers who did not teach evolution. This group of strong to moderate religious teachers had a poor understanding of the nature of science and evolution in general. Trani was most concerned if these religious teachers attempted to teach evolution. Their lack of content knowledge would be more dangerous than if they had not addressed teaching the subject. The study also revealed that teachers in the 16% religious category had difficulty understanding that evolution was not a “belief” system.

21st Century Court Cases on ID and Disclaimers

The 21st century has seen its fair share of evolution litigation based on public pressures to seek a more balanced approach to the topic. The political strategy used was to “wedge” intelligent design into the science classroom as a credible scientific theory and cast suspicion on the “theory” of evolution with disclaimer stickers. This strategy would culminate at the midpoint of the first decade of the century with high profile cases in Pennsylvania and Georgia. To illustrate the political climate regarding the teaching of evolution in the early 21st century, several attempted litigation issues are highlighted to glean an understanding of the political atmosphere leading up to these two major cases.

On September 2, 2003, in Placerville County, California, the Board of Trustees refused to adopt a district policy on teaching evolution. After several months of discussion with teachers, parents, and school board members, many creationist parents wanted arguments against evolution taught along with evolution. One parent noted about teaching evolution, “Since we’re already teaching one religion that’s agnostic or atheist, we need the alternative, too” (NCSE, 2003, n.p.). Teachers were concerned they would have to teach arguments against evolution, which was not part of the California science curriculum. In the final assessment, the board voted to favor not teaching alternative arguments.

In 2004 and 2005, Missouri legislators discussed House Bill 35, House Bill 911, and House Bill 1722. All of the bills concerned evolution. The bills required that equal time should be given to intelligent design as well as to evolution. The bill was full of strong language: “Each public school classroom in this state from Grades 8-12 in which science is taught exclusively shall post a copy of this section in a conspicuous manner” (NCSE, 2004, n.p.). The bill went on to state, “Willful neglect of any elementary or secondary school superintendent, principal, or teacher to observe and carry out the requirements of this section shall be cause for termination of his or her contract” (NCSE, 2004, n.p.). The Bills did not pass.

Several other states have argued bills that would permit the teaching of intelligent design in public schools. House Bill 2607 in the state of Arkansas was introduced in March of 2005 (Martin, 2005). In the same month, House Bill 1007 was introduced to the Pennsylvania house and would allow intelligent design to be taught in this mid-Atlantic state. Similar bills in Michigan, Ohio, and Kansas were introduced.

In March, 2005, Senate Bill 2286 from the State of Mississippi would require a balanced treatment to the theory of scientific creationism and the theory of evolution. House Bill 220, in the State of Texas, was a similar piece of legislation. The author of the bill was quoted,

Some of our books right now only teach evolution, but if you are going to teach one you oughtta teach both. Evolution is theory, not a fact. There is no fact for evolution. Why are we teaching a theory, when we have another position--creation-- that the majority of the people believe in this country. (NCSE, 2005, n.p.)

The two final landmark cases occurred in the early 21st century. The ninth case was *Kitzmiller v. Dover Area School District* in 2005. Since Justice Scalia dissented in the *Tangipahoa Parrish* case, the drummers of intelligent design were waiting and preparing for a new case (Beckwith, 2003; Gunn, 2004; Pennock, 2001; Perakh, 2004; Petto, 2007; Plank, 2006; Wells, 2006). Eleven parents sued the Dover, Pennsylvania, school district for having teachers orally read a statement regarding intelligent design:

The Pennsylvania Academic Standards require students to learn about Darwin's theory of evolution and eventually to take a standardized test of which evolution is a part. Because Darwin's Theory is a theory, it is still being tested as new evidence is discovered. The Theory is not a fact. Gaps in the Theory exist for which there is no evidence. A theory is defined as a well-tested explanation that unifies a broad range of observations. Intelligent design is an explanation of the origin of life that differs from Darwin's view. The reference book, *Of Pandas and People* is available for students to see if they would like to explore this view in an effort to gain an understanding of what intelligent design actually involves. As is true with any theory, students are encouraged to keep an open mind. The school leaves the discussion of the origins of life to individual students and their families. As a standards-driven district, class instruction focuses upon preparing students to achieve proficiency on standards-based assessments. (*Kitzmiller, et. al. v. Dover Area School District, et. al.*, 2005, pp. 1-2)

The teachers refused to read the statement and administrators were forced to read the school board directive (American Civil Liberties Union [ACLU], 2004; Barlow, 2006; Berkman, 2008; Humes, 2007). The teachers believed that reading such a disclaimer to their students would equate the scientific theory of evolution to the nonscientific "theory" of intelligent design in the eyes of their students (Berkman, 2008).

The case resulted in a blistering ruling against the Dover School Board. Judge Jones noted the school board committed perjury, and their actions were of “breath-taking inanity” and an “utter waste of monetary and personal resources” (*Kitzmiller, et. al. v. Dover Area School District, et. al.*, 2005, p. 138). The case was a victory for evolution at the expense of the intelligent design movement. All eight school board members were voted out of office in the next election.

The State of Alabama had 11 anti-evolution bills introduced in the year 2005. One of the major themes in this legislation was academic freedom. These bills wanted to insure teachers and students had the right to express their beliefs opposing major scientific theories. Evolutionists cited the Academic Freedom Act was aimed at evolution and professors that teach it as dogma. House Bill 837, introduced in February 2005, was a similar piece of legislation from the state of Florida. The second major thrust of Alabama legislation was concerned with a revised set of science standards. Most science educators noted the new standards presented a very weak treatment of evolution. In fact, the word was only mentioned once. Mississippi introduced disclaimer legislation in 2009 but it was defeated. Table 1 shows the State of Alabama’s disclaimers concerning evolution.

Table 1

Disclaimers Concerning Evolution

Year	Textbook Disclaimers for Biology Books in the State of Alabama
1996	This Textbook discusses evolution, a controversial theory some scientist present as a scientific explanation for the origin of living things, such as plants, animals and humans.
2001	The theory of evolution by natural selection is a controversial theory that is included in this text book. It is controversial because it states that natural selection provides the basis for the modern scientific explanation for the diversity of living things.
2005	The theory of evolution by natural selection, a theory included in this document, states that natural selection provides the basis for the modern scientific explanation for the diversity of living things.

Georgia has seen similar legislation introduced; however, it has failed. In January 2004, Georgia State Superintendent of Education Kathy Cox raised a maelstrom of controversy over evolution. Cox “removed all references to evolution and the ‘big bang’--the scientific explanations for the diversity of living things and the origin of the universe--and deleted many national standards for teaching evolution” (McDonald, 2004). For a few days, the Georgia science curriculum was the butt of many jokes from late night comedians. Influential Georgians came to the rescue of evolution. Former President Jimmy Carter was quoted as saying, “as a Christian, trained engineer, scientist, and a professor at Emory University, I am embarrassed by Superintendent Kathy Cox’s attempt to censor and distort the education of Georgia’s students” (CNN, January 30, 2004). Carter went on to say omitting evolution would leave Georgia’s students “with a serious handicap as they enter college or private life.” The veterinarian governor, Sonny Perdue noted, “If you are going to teach evolution you ought to call it evolution” (The Macon Telegraph, 2004). On February 5, 2004, Cox was quoted as saying,

I made a decision to remove the word evolution from the draft of the proposed biology curriculum in an effort to avoid controversy that would prevent people from reading the substance of the document itself. Instead, a greater controversy ensued. I misjudged the situation and I want to apologize for that. (Cox, 2004)

Georgia’s second largest school system, Cobb County, was the site for the tenth landmark case. The conflict revolved around the placing of disclaimers in biology textbooks to note that evolution is a theory and not a fact. The disclaimers have been a source of frustration for evolutionists and the school board alike. Over 2,300 parents signed a petition to school officials about textbooks presenting evolution as fact without mentioning rival ideas about the beginnings of life. As a result of the complaints, the school board adopted an anti-evolution disclaimer sticker to be placed in the front of biology textbooks. The sticker read, “This textbook contains material on evolution. Evolution is a theory, not a fact, regarding the origin of living things.

This material should be approached with an open mind, studied carefully, and critically considered.” The six plaintiffs were residents, taxpayers, and parents whose children were attending Cobb County School District. In 2005, the District Court in Atlanta declared the disclaimers should be removed from textbooks in Cobb County (*Selman v. Cobb County School District*, 2005). This was the tenth landmark case concerning evolution and the public schools. Even though the district court in Georgia ruled against the disclaimers, Alabama retained its disclaimers. Mississippi, Texas, and Louisiana have considered disclaimer legislation since the Cobb County case. Borenstein (2008) noted that textbook disclaimers were ineffective and frustrating to teachers. Disclaimers were aggravating because they were introduced by politicians, parents, and other nonscientists who had religious agendas.

Representative Bridges of the 10th district of Georgia, introduced House Bill 179 in January 2005. This bill would have served to weaken the teaching of evolution in the state of Georgia. The language noted that material taught in science classrooms must be fact based and suggest that evolution is not based on facts. The Bill read,

Whenever any theory of the origin of humans or other living things is included in a course of study offered by a local unit of administration, factual scientific evidence supporting or consistent with evolution theory and factual scientific evidence inconsistent with or not supporting the theory shall be included in the course of study. (Bridges, 2005, ¶1)

The bill failed.

Correlation between Court Litigation and Research Articles

In 2006, an extensive longitudinal study on evolution was published regarding evolution controversy in *Science* and *The Scientific Monthly* from 1880 to 2000 (Bleckmann, 2006).

Bleckmann’s research involved approximately 250 articles that revolved around the debate of

evolution and religion. He correlated the incidence of the number of articles to court litigation on evolution in the United States. Jeffrey Strauss summarized Beckmann's work in his 2008 dissertation:

He found three major peaks in the 120 years of his examination; 1925 corresponding with the Scopes trial, 1981-87 the California, Arkansas and Louisiana trials and thirdly, 1996 which marks the time the intelligent design movement started to attract attention and would lead to the Dover, Pennsylvania trial a few years later. It lead him to state these three observations; (1) the evolutionists and creationists positions have changed little over time, (2) despite the scientific evidence that continues to solidify the theory of evolution, the creationist remained unmoved and finally (3) that scientists have consistently suggested that better education as the solution to the debate while all evidence to the date does not support that position. (Strauss, p. 93)

A New Approach: Teach the Controversy

Evolution education has weathered many attempts by religious groups to decrease the teaching of the topic in the United States including creation science, balanced treatment, academic freedom, and intelligent design. Each strategy gains momentum and eventually a local school board pushes the envelope. New court cases are created and mold the law. After the ruling in Dover and Cobb County, there is a new strategy. The new strategy suggests that science teachers "teach the controversy" and question scientific theory (Scott, 2007). Several states are beginning to test this new approach.

Louisiana passed the Louisiana Science Education Act in 2008. The law specifically noted that global warming, biological evolution, human cloning, and chemical origins of life are explicitly mentioned as scientific theories that deserve scrutiny by students (Scott, 2009b). Scott noted the real issue is there is no controversy with the theory of evolution in the scientific community. She conceded that teaching the controversy was a great approach to areas in science that are controversial such as the origin of the moon. She even noted that teaching controversies

in evolution are good approaches to teach students critical thinking about evolution. She specifically noted the relationship of Neanderthals to modern humans and the relationship of dinosaurs to birds. Teaching the controversy was an attempt to suggest that evolution is a weak scientific theory with scant support or evidence. The drums are beating again with a new beat and a local school board will attempt to push the envelope again with “teach the controversy.”

Summary for Section Two

The Scopes trial 85 years ago set the stage for the continuing debate on the teaching of evolution in the public schools. Since that case, the courts have overwhelmingly ruled for evolution to be taught in the public schools due to laws revolving around the separation of church and state. The American public continues to question the validity of the theory of evolution and treat it more as a hypothesis than a scientific theory. Public sentiment against the teaching of evolution, creationism, and intelligent design remains even though the courts have ruled for teaching evolution without the influence of religion in science classrooms. According to survey data, science teachers are teaching more evolution and textbooks reflect the increase in the teaching of the theory. However, there are teachers who do not adhere to the laws and teach what they want behind the closed doors of their respective classrooms. The science classroom is part of something that is uniquely American: it is historically decentralized. Even though the federal government gives much money to the states for education, the states and local school districts approve the budgets, rules, regulations, and, often, the curricula.

Section Three

Introduction to the State Science Standards

In 1993, the Benchmarks for Science Literacy were released by the American Association for the Advancement of Science (Rutherford, 1993). The purpose was to help states establish science curricula that would be strong and appropriate for the 21st century. The exhaustive effort examined four different groupings of students and noted what they should know about science by the end of their second, fifth, eighth, and 12th grade years. The benchmarks were clearly stated and evolution was included in each grouping. The evolution benchmarks were detailed and pervasive. Human evolution was discussed by the fifth grade, and the eighth grade standard noted, “Fossil evidence is consistent with the idea that human beings evolved from earlier species” (Rutherford, p. 129). In 1996, the National Science Education Standards were released and they paralleled the Benchmarks with respect to evolution (Aldridge, 1996). Accountability for teaching became more and more important as legislation was enacted to hold teachers more accountable for what they taught. State testing would be the vehicle for that accountability. States would individually create their own standards. The Benchmarks and the National Standards would serve as a model but the decentralization policies of the American education would allow states to add or omit as they deemed necessary. The early 21st century would enable states to create and modify their curricula. Outside agencies would rate individual state’s curricula as there was no consistency established between states. The Federal Government did not oversee consistency to the curricula between the states and its only power was manifested with the threat of withholding funds for states whose students did not perform well on state tests. By the close of the first decade of the 21st century, many voices were calling for a common core curriculum that would be taught in all states.

National Studies on Science Standards and Evolution

In 2001, Dr. Lawrence Lerner developed a report card for the states regarding the teaching of evolution according to the state standards (Applegate, 2001; Braden, Finn, & Lerner, 2001). The states' curricula were graded by eight criterion designed by the California State professor: (1) use of the word evolution, (2) treatment of human evolution, (3) treatment of geological evolution, (4) treatment of cosmology, (5) connections among the historical sciences, (6) creationist jargon, (7) treatment of biological evolution, and (8) the use of disclaimers. Alabama, Mississippi, Tennessee, Florida, and Georgia all received a grade of "F." If one were to make a map of the grades, it would be obvious the South as a whole received low grades, with the exception of the Carolinas. Kansas received an "F" because the state board decided to take evolution content out of state mandated testing. Because state testing was important, teachers could legitimately give short shrift to the teaching of evolution (Anderson, 2000). By taking evolution out of the state biology assessment,

Kansas creationists hoped to accomplish that which their brethren have failed to accomplish: without referring to the religious nature of creationism, without actively downplaying one or the other, and without requiring overt statements of approval or disapproval, they have managed to take evolution out of the classroom. (Anderson, p. 399)

After a 2001 re-election, the new Kansas state board reversed the decision on testing.

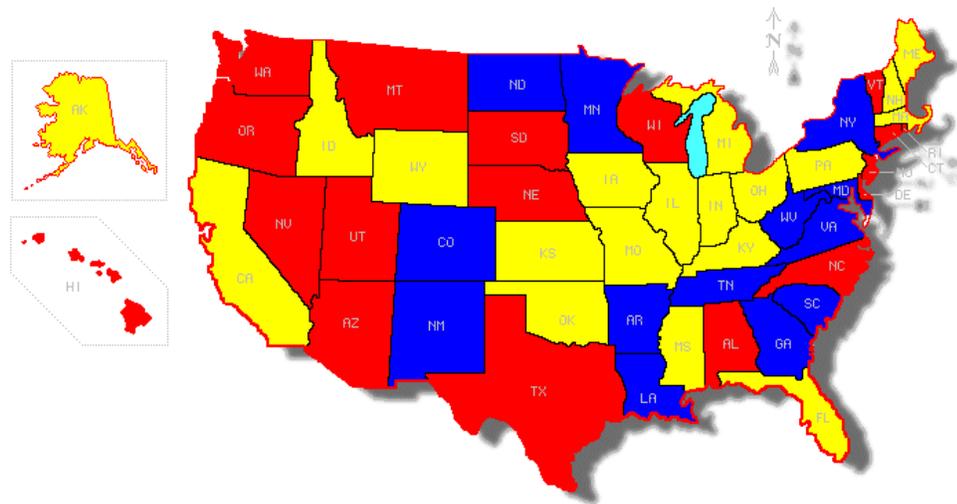
In 2002, 884 students participated in a Likert-type survey on evolution at the University of Minnesota (Moore, 2004). The survey was designed to see how many of the students had been taught evolution in high school and to what extent. The survey was prompted by a professor, Dr. Randy Moore, after he had read Dr. Lerner's work. Minnesota received a grade of "B" on their report card; therefore, he wanted to explore how well students had been taught the theory in a state that received a good rating on their report card. The results were surprising to

Dr. Moore. He found that “the state standards for evolution education are largely irrelevant to the teaching of evolution in biology classrooms of public schools” (Moore, p. 43). It was surprising to Moore that 15% of biology teachers in Minnesota included creationism in their biology classes. In a related study, it was found that 40% of the Minnesota educators spent little or no time on evolution in direct violation of the state standards (Hessler, 2000). In Indiana, a state that received an “A” rating, 33% of the biology teachers reported they spent less than 3 days on evolution (Rutledge, 2000). A 1999 study in Pennsylvania revealed that 33% percent of their teachers believed that evolution was not central to biology (Weld, 1999).

In 2006, the Thomas Fordham Foundation released its study on “The State of the State’s Standards” (Gross, Goodenough, Haack, Lerner, & Schwartz, 2005). The research examined the standards in history, science, math and English in all states and then compared them to an original study in 2000. Georgia was rated in the first quartile for all subjects. With respect to the science standards, Georgia showed a large increase and received a grade of “B” primarily due to the implementation of the Georgia Performance Standards. Most Southern states, except North Carolina and Alabama, experienced a stable or increased grade in their respective standards. The map below (Figure 2) depicts the trends in grades on the state science standards from 2000 to 2005.

Trends in Grades

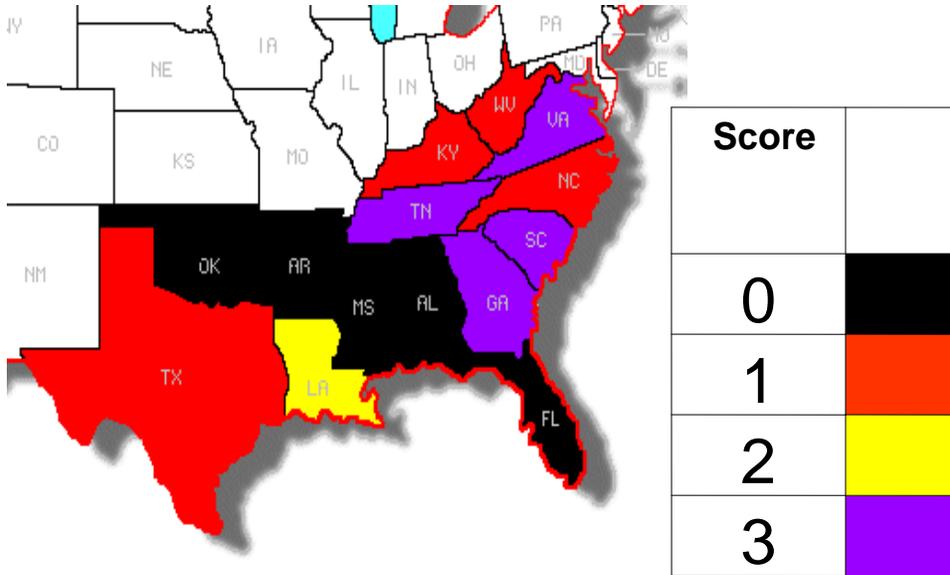
- - No Change
- - Improved
- - Declined



1-1-07

Figure 2. Trends in grades on the state science standard from 2000-2005.

The 2005 Fordham study disaggregated the data and three questions were specifically aimed at the standards revolving around evolution. The South as a region improved but did not rank high. However, Georgia's curriculum on evolution was one of the best in the region. The Fordham study ranked the evolution standards from 0 to a high of 3. Georgia, Tennessee, South Carolina, and Virginia all received a score of 3. Two maps (Figure 3 and Figure 4) illustrate the treatment of evolution in 2005. The first map includes the entire nation, and the second map focuses on the Southeastern region of the country.



Source: Fordham Science 2005

Figure 4. Evolution curriculum scores for southern states.

In 2009, Mead and Mates repeated Dr. Learner’s research on the state standards. There was an increase in the amount of evolution content in the standards as a whole. The South had mixed results. Alabama, Kentucky, Oklahoma, South Carolina, and West Virginia’s scores remained the same. Arkansas, Florida, Georgia, Mississippi, Tennessee, and Virginia all increased their scores on evolution. Georgia’s score increased but the lack of human evolution, except in anatomy and physiology courses, kept their scores at a “C.” Florida and Mississippi both had failed in the original study and their scores improved to “A” and “B,” respectively. However, Louisiana, North Carolina, and Texas received lower scores because creationist jargon or euphemisms for evolution crept back into their standards. The region still has a way to go in that the following states received a grade of “D” or “F”: Alabama, Kentucky, Louisiana,

Oklahoma, Texas, Tennessee, and West Virginia. These Southern states received “A’s” or “B’s” in the study: Florida, Mississippi, North Carolina, and South Carolina.

The Georgia Performance Standards Regarding Evolution

In the school year 2004-2005, teachers in Grades 6 through 12 in the state of Georgia were trained on the Georgia Science Performance Standards. The Performance Standards had set off a firestorm of controversy in regard to teaching evolution. Georgia had not used the term evolution in their standards in the past. The seventh grade life science curriculum and high school biology and geology curriculums are laden with evolutionary terms. This is in direct opposition to the QCC that awarded the state a grade of “F,” by Dr. Lerner’s report in 2001 (Applegate, 2001). Table 2 summarizes the Georgia Performance Standards for Evolution.

Table 2

7th Grade Life Science Performance Objectives on Evolution

7th Grade Life Science Performance Objectives on Evolution
Students will examine the evolution of living organisms through inherited characteristics that promote survival of organisms and the survival of successive generations of their offspring.
A. Explain how physical characteristics of organisms have changed over successive generations(Ex. Darwin’s finches and peppered moths of Manchester).
B. Describe ways in which species on earth have evolved due to natural selection
C. Trace evidence that the fossil record found in sedimentary rock provides evidence for the history of changing life forms.
High School Biology Science Performance Objectives on Evolution
Students will evaluate the role of natural selection in the development of the theory of evolution.
A. Trace the history of the theory.
B. Explain the history of life in terms of biodiversity, ancestry, and the rates of evolution.
C. Explain how the fossil record and biochemical evidence support the theory.
D. Relate natural selection to changes in organisms.
E. Recognize the role of evolution to biological resistance (pesticide and Antibiotic resistance).

Georgia Science Performance Standards (2004)

On June 28, 2006, a New York Times article was written about a Lumpkin County, Georgia teacher who had experienced angry parents, students, coworkers, and principals for teaching the Georgia Performance Standards on evolution to her students. At one point, her principal pushed the issue,

On April 25, 2005, during a meeting about parent complaints with her principal, Rick Conner, she recalled: He took a Bible off the bookshelf behind him and said, "Patty I believe in everything in this book, do you?" I told him, "I really feel uncomfortable about your asking that question." He wouldn't let it go. The next day, she said, in the lunchroom, "he reached across the table, took my hand and said: I accept evolution in most things but if they ever say God wasn't involved I couldn't accept that. I want you to say that, Pat." (Winerip, 2006, n.p.)

The teacher filed a complaint to initiate a grievance that she was being harassed and threatened in May of 2005. She gave the superintendent and school board a 24-hour ultimatum to support her for teaching the GPS standards on evolution. If they complied she noted she would terminate the complaint. The superintendent and Board agreed she was teaching the GPS and sent her a vote of confidence to continue teaching the standards. This event set the stage for parents considering witch hunts on teachers who were teaching the Georgia Standards on evolution. Evolution standards "provide a shield for teachers to place themselves and those opposing the teaching of evolution--Which may include parents, students, and, unfortunately, even administrators" (Scott, 2009a, p. 538).

There is a current move for there to be more standard curricula for American students that supersedes the state standards. In 2010, The National Governor's Association for Best Practices has 48 of the 50 governors initially signed on to create nationalized standards for math and language with future discussions regarding science. This movement is commonly termed the "common core." The common core is the first major attempt at a National Curriculum for students in the United States.

Summary of Section Three

In the 1990s, educational leaders started pushing for a change in American education. They wanted students and teachers to be more accountable and individual states began to create their standards. The standards could be used to primarily measure student performance often on high stakes tests for Adequate Yearly Progress monitoring. Teacher performance has also been inferred from student performance in some states. Georgia was one of the last states to roll out its curriculum, the GPS. The GPS in middle school life science and high school biology received average to above average grades on the treatment of evolution according to independent researchers. In the latter part of the first decade of the 21st century, there has been talk about a more nationalized curriculum based on common standards.

Section Four

A Gap in the Literature

The academic literature on evolution and the public school is targeted at teachers and students. Teachers in the United States often walk on eggshells regarding evolution. They must decide to teach or not to teach and suffer the consequences of their choice. Teachers avoid the topic for many reasons. Some teachers are afraid to teach the topic because they feel their content knowledge is lacking (Kraemer, 1995; Moore, 2002; Moore & Kraemer, 2005; Potter, 2004; Rutledge & Mitchell, 2002; Winslow 2008). Teachers must decide to teach creationism, intelligent design, or evolution based on pressures of parents, community, or administrators (Cavanaugh, 2005; Moore, 2002, 2004; Moore & Kraemer 2005; Plank 2006). Many teachers have no concept of the laws that determine what can or cannot be taught regarding evolution (Moore, 2004). Other teachers realize there is a lack of consequences for teaching creationism

based on their community values and teach it even though it is against the law (Moore, 2004, 2007). Some teachers allow their personal religious views to enter into the equation whether they teach evolution or not (Moore & Kraemer, 2005; Trani, 2004; Wylie 2003). These difficult decisions are faced by American teachers every day. It is the responsibility of their administrators to ensure the laws are followed and teachers are supported.

There are published studies on teachers' knowledge of the law, knowledge of evolution, views on teaching evolution, willingness to teach evolution, and fears of teaching evolution. These studies focused on what, when, and how much evolution was taught in their classrooms. However, there are no studies that discuss secondary administrators' knowledge of the teaching of evolution. Studies imply that teachers fear their administrators if they teach the topic, but little is written to validate teacher concerns. Therefore, this study explored administrators' knowledge of the laws that govern the teaching of evolution in the state of Georgia and their clinical experiences.

Chapter Summary

Darwin's theory was accepted by the vast majority of scientists in a matter of a few decades past its introduction. The harmonious balance between science and religion was shattered in the early 20th century. Scientific studies in the life sciences and geology have only strengthened the theory in the modern era. The debates no longer revolved around religion and the theory of evolution but the teaching of the subject in the early 20th century.

The history of teaching evolution in the United States has been an 85-year struggle. The courts have used the First and Fourteenth Amendments to decide the validity of the cases. The Monkey Trial set the stage for 30 years by squelching the teaching of evolution in the rural

South. The evolutionists seemed to get the upper hand in the timeframe from 1950 to 1985. With the rise of evangelical Christians and the moral majority movements, the pendulum began to swing back in the other direction. Evolution in America is a very tense and terse topic today. Both sides are very passionate about their convictions and both think they are totally right in their thinking. Two quotes demonstrate the polarization of each argument. Pastor Fox, of the largest southern Baptist church in the Midwest with 6,000 worshipers a week, said to his congregation of Fundamentalist Christians:

The strategy this time is not to go for the whole enchilada. We are trying to be a little more subtle. The fight to teach God's role in creation is becoming the essential front in America's cultural war. The issue is on the agenda at every meeting of pastors he attends. If evolution's boosters can be forced to back down, he said, the Christian Rights Agenda will advance. If you believe God created that baby, it makes it a whole lot harder to get rid of that baby. If you can cause enough doubt on evolution, liberalism will die. (Slevin, 2005, n.p.)

In a November 10th letter to the editor of the Atlanta Journal-Constitution, microbiologist David L. Cox wrote,

Some Georgians still don't know that a theory is a set of facts, propositions or principles analyzed in their relation to one another and used, especially in science, to explain phenomena. Too many people get "theory" confused with "hypothesis," which is unproven and has little data to back it up. Evolution has reams of data to support it. All one has to do is look at the emergence of antibiotic-resistant bacteria in the past 50 years to see mini-"evolution" in action and in our lifetimes. And where is it written that evolution couldn't be God's work? The Bible says God created the Earth in six days, but I think Old Testament stories were simple explanations for simple-minded people. Thousands of years ago, who could have comprehended genes, DNA or the atom? Even today, many people still don't understand them; some parents in Cobb County are living proof. (American Geological Institute, 2005, n.p.)

Cynthia Tucker, editorial page editor for the Atlanta Journal Constitution, wrote an article entitled, "Until We Grasp Science, Future Will Elude Us" in January of 2005. She was troubled by the Cobb County sticker disclaimers and intelligent design being taught in Dover, Pennsylvania. She noted, "You would have thought the old controversies between science and

religion would have passed long ago. After all, we live in an age of rapid fire scientific and technological development” (Tucker, 2005, p. A14). Ms. Tucker calls for some commonsense from citizens in a modern age if we are to progress and keep our competitive edge.

The evolutionist and creationist are very exuberant about their causes. They are unyielding to each other and have blinders on, leaving those in the middle often trampled by their rigid dogma. They attempt to force citizens to agree with them and pump millions of dollars into their cause. The courts are left to mediate and the teachers shiver in fear from retaliation from both sides. Science administrators have the duty to see their teachers are empowered to teach evolution according to the laws. Even though the Georgia Performance Standards are based on the National Science Standards, the curriculum has placed a greater emphasis on evolution and fueled the fires of dissention between the groups.

CHAPTER 3

METHODOLOGY

The study examined secondary principals' knowledge of evolution as it was related to school law and the Georgia Performance Standards, and explored their experiences and views on the topic. This chapter deals with subjects, materials, data collection, and the methods of analysis. This study was designed using mixed methods. The first part of the study involved quantitative statistical analysis to determine the initial knowledge of middle and high school administrators, and central office staff administering science curriculum using a 43-item survey. A qualitative interview protocol was used to explore principals' understandings on the topic of evolution relating to school law from administrators' differing points of view and experience. The details associated with the methodology of the quantitative portion will be discussed first followed by the methods of the qualitative part of the study.

Quantitative Subjects

All of the subjects in this study were adults from the three northernmost RESAs in Georgia: Northwest RESA, North Georgia RESA, and Pioneer RESA. There are 36 school districts located in these three RESAs. The subjects consisted of two groups. The first group was composed of central office administrators that deal with secondary science education. There were 36 central office staff that met this criterion and each was sent a quantitative survey. The second group was composed of 455 middle and high school assistant principals and principals. All 36 systems were sent surveys for a combined total of 491 mailed surveys. Eight districts

were city school systems: Bremen, Calhoun, Cartersville, Chickamauga, Dalton, Gainesville, Rome, and Trion. Twenty-eight systems were county school districts: Banks, Bartow, Catoosa, Chattooga, Cherokee, Dade, Dawson, Fannin, Floyd, Franklin, Gilmer, Gordon, Habersham, Hall, Haralson, Hart, Lumpkin, Murray, Paulding, Pickens, Polk, Rabun, Stephens, Towns, Union, Walker, White and Whitfield.

Each district in the state of Georgia is part of a RESA. In this study, the three Northernmost RESAs were selected and a map displaying the region is in Figure 5. The Northwest Georgia RESA is comprised of the following 16 school districts: Bartow County, Bremen City, Calhoun City, Cartersville City, Catoosa County, Chattooga County, Chickamauga City, Dade County, Floyd County, Gordon County, Haralson County, Paulding County, Polk County, Rome City, Trion City and Walker County. The North Georgia RESA is made up of the following seven districts: Cherokee County, Dalton City, Fannin County, Gilmer County, Murray County, Pickens County, and Whitfield County. The Pioneer RESA is composed of the following 13 school districts: Banks County, Dawson County, Franklin County, Gainesville City, Habersham County, Hall County, Hart County, Lumpkin County, Rabun County, Stephens County, Towns County, Union County and White County.



Figure 5. Three regional education service areas in the study.

- North Georgia RESA:** Cherokee, Fannin, Gilmer, Murray, Pickens, Whitfield and Dalton City
- Northwest Georgia RESA:** Bartow, Catoosa, Chattooga, Dade, Floyd, Gordon, Haralson, Paulding, Polk, Walker, Bremen City, Calhoun City, Cartersville City, Chickamauga City, Rome City and Trion City
- Pioneer RESA:** Banks, Dawson, Forsyth, Franklin, Habersham, Hall, Hart, Lumpkin, Rabun, Stephens, Towns, Union, White and Gainesville City

A demographic chart in Appendix A provides more detailed information about the individual school districts. The information was gleaned from the Georgia Department of Education from the Full-Time Equivalent Report and the 2009-2010 Report Card from the Governor’s Office of Student Achievement (<http://www.gaosa.org/index.aspx>). The categories presented in the table were determined by the state of Georgia and their descriptions are included in Appendix A. The 36 districts had approximately 258,443 students comprising 15.9% of the total student population in Georgia. The study area had only seven systems that were below the

state average of 49% for free and reduced lunch. The districts ranged from 26% to 77% reduced and free lunch. Generally, the systems closer to Metro-Atlanta and Metro-Chattanooga had lower free and reduced numbers. Racially the study area was much more White and Hispanic and less Black compared to the rest of Georgia. Two districts were Hispanic majority systems with 55% and 66%, respectively. Fourteen of the districts had a larger percentage of Hispanics than the state average of 11%. Thirty-three of the 36 systems had a greater White percentage than the state average of 45%. Twenty-two of the districts had more than 79% of their districts composed of White students. All 36 school districts have a lower percentage than the state average of 36% Black population. The RESAs have a larger percentage of students with disabilities than the state average of 10%. Twenty-five of the 36 school systems in the study area had a larger percentage of students with disabilities than the state average. Thirteen school districts had more English Language Learners students than the state average. These 13 districts were accompanied by large Hispanic populations, compared to the rest of the state.

The 36 school districts were broken into three groups based on population size for disaggregation of the data. The large systems had student populations from 13,000 to 39,000 and included five districts: Bartow, Cherokee, Hall, Paulding, and Whitfield Counties. The medium group included 12 school districts with student populations between 4,171 to 10,533 and included Catoosa County, Dalton City, Floyd, Gainesville City, Gilmer County, Gordon County, Habersham County, Murray County, Pickens County, Polk County, Rome City and Walker County. The small group included schools with populations between 1,128 to 4,004 and included the following 14 districts: Banks County, Bremen City, Calhoun City, Cartersville City, Chattooga County, Chickamauga City, Dade County, Dawson County, Fannin County, Franklin County, Haralson County, Hart County, Lumpkin County, Rabun County, Stephens

County, Towns County, Trion City, Union County, and White County. Small districts may have only had one middle school and one high school. Large school districts may have had 5-10 schools at each respective level. Surveys were mailed in early January 2011 to all assistant principals and principals in these 36 districts. One survey in each of the respective districts was sent to the central office for the person that oversees science instruction. In the largest districts, there may be a person who is solely responsible for science, yet in a small district there may be a director of curriculum that covers all subject areas. All subjects were volunteers and there were no incentives offered for taking the survey. There were 491 surveys mailed and 175 were returned. This gave a return rate of 35.6%. Twenty-one of the returned surveys were non-scoreable due to missing or incomplete data. The statistical analysis was based on the 154 scoreable surveys, which represented 31.4% of the mailed surveys.

Qualitative Subjects

The qualitative portion of the study was limited to 12 interviews. Five central level administrators were interviewed. At least one interviewee was interviewed from each of the three population categories. Seven school level administrators were selected for interviews. At least two interviewees represented each population category. Persons interviewed were based on their willingness to take part in the qualitative interview protocol survey. The subjects were selected at random in the following manner. Three boxes representing the three RESAs in the study contained the names of each of their respective districts folded into a wad in the box. Four wads of paper were selected at random from each of the three boxes. These districts were the ones selected to take part in the interviews. There had to be a representative of each population category from each box: small, medium, and large. In two instances a system had to be thrown

out and another system drawn to achieve at least one small, one medium, and one large district in each RESA. Names were selected at random to call from each school district to interview. The interviewees were called to determine if they were willing to take part in the interview. Twenty-two administrators had to be contacted because 10 declined to take part in the interview process. All 12 were from different school districts from the three northernmost RESAs in Georgia. The 12 interviewees had a very broad spectrum of educational experiences. Due to maintaining the confidentiality and anonymity of the individuals as prescribed in the IRB, individuals' experiences were not described. Therefore, the experiences of the administrators were separated into two groups: 1) middle and high school administrators and 2) district level administrators.

There were seven school level administrators interviewed. Three were middle school principals and four were high school principals. The group had a range of 3 to over 20 years of experience. The group had administrative experiences that were varied and included assistant principal and principal at elementary, middle, and high school levels, private school administrator, administrator of an alternative school, State Department of Education, and district administrator. The past teaching experiences of the group were diverse and the group served in the following capacities: elementary teacher, career and technical instructor, academic coach, health and physical education teacher, math teacher, English teacher, science teacher, and college professor. Several had clinical experience outside of Georgia and the group had taught in rural, suburban, and inner-city schools. The group had taught in an upper-class private school to poor minority majority schools. While the sample size was small, there was much diversity in the pool of interviewees.

There were five district level administrators who participated in the interview process. The interviewees had a range from 20 to over 35 years experience in education. The group

consisted of curriculum directors/coordinators or assistant superintendents. The teaching experience of the group was narrowly focused in three areas: science, math, and elementary education. The group had other experiences such as science coordinator, math specialist, curriculum specialist, math coordinator, principal, assistant principal, department chair, and State Department of Education. The group had been administrators in poor and wealthy districts as well as minority majority system. Most of the interviews were taped but one subject refused and notes were taken. Most of the interviews were done in person; however, weather conditions made it necessary to complete some interviews over the phone. Interviewees signed the IRB and noted their willingness to audio tape, with one exception to the taping. The interviews were completed in December of 2010. In an effort to maintain the interviewees' anonymity, the 12 districts taking part in the qualitative interview process were not revealed.

Quantitative Materials

The materials used in this study were the quantitative survey instrument consisting of 43 questions (see Appendix B). All groups were administered the same quantitative survey that Dr. Randy Moore of the University of Minnesota originally created and delivered to Minnesota teachers in 2004. Dr. Moore's original survey is included in Appendix C. He granted permission to use the survey. Dr. Moore completed the original validity and reliability studies on his instrument. The author, to make the survey more appropriate to Georgia, modified the original survey.

The changes in the quantitative survey were primarily due to questions regarding the GPS on the teaching of evolution. Ten professors from Dalton State College and West Georgia University reviewed the modified instrument to ensure validity in 2010. The professors were

sent the survey and came in groups of two to three to discuss the instrument. The following items were addressed by the group: (1) wording of the instrument for clarity, (2) content understanding in the instrument, (3) survey instrument applicable to Georgia, (4) items needing reworked, (5) any needed questions not addressed in the survey, (6) grouping/sub-scaling items, and (7) Likert-type responses. Each item was sequentially discussed by the professors and suggested changes were made based on comments. In addition, three high school biology teachers reviewed the survey instrument for input after the changes were made by the professors' input. No changes were made by the biology teachers, based on their responses due to the clarity of the instrument.

Questions 1-7 were related to information regarding a subject's role, content area strength, gender, and educational experience. Questions 8 and 9 regarded professional development and coursework of administrators relating to evolution. Questions 10 and 11 dealt with subjects' religious and political affiliations. Questions 12 and 13 revolved around a principal's experience with parent and teacher anxiety about the teaching of evolution or creationism. Question 14 dealt with an administrator's personal religious views about the Theory of Evolution. Items 15-21 on the quantitative survey were related to the teaching of evolution with regard to the Georgia Performance Standards. Items 22 and 23 concerned disclaimers in textbooks in Georgia. The 24th and 25th questions concerned the legality of teaching creationism. The 26th item concerned the legality of teaching human evolution. The 27th item dealt with a student's right to religious freedom from the teaching of evolution. Questions 28-30 addressed government monies used to fund the teaching of evolution. Questions 31-38 dealt with the evolutionary issues revolving around the First and Fourteenth

Amendments of the U.S. Constitution. Questions 39-43 dealt with specific questions regarding landmark cases in evolution.

Qualitative Materials

The interview protocol was designed by the researcher with assistance from the dissertation chair. The instrument was reviewed by six principals, two college professors, and central office staff. Most of the reviewers were retired educators. Each reviewer was individually interviewed about the interview protocol in the sequential order of the questions. Comments were made and changes were made based on responses. In addition three high school biology teachers reviewed the survey instrument for input. The changes were submitted to the dissertation chair for review.

The qualitative interview consisted of 25 questions and a copy of the instrument is located in Appendix D. Twelve administrators took part in the qualitative component of the study. The 12 interviewees had to sign the IRB University of Alabama Human Research Protection Program Consent Form for Nonmedical Interview Study and consent to having their interview taped. The interview protocol was administered in late December of 2010. The qualitative data were transcribed verbatim.

The first question asked about a principal's experience as an administrator and a teacher. The second item probed administrators on their knowledge of the Georgia Performance Standards on evolution. Questions 4-6 revolved around issues that principals had experienced with students, teachers, and parents regarding evolution, creationism, or intelligent design. The seventh question probed administrators past training regarding evolution, creationism, or intelligent design. Questions 8 and 9 asked for principals' opinions on whether teaching

evolution and/or intelligent design should be included in the curriculum. Question 10 revolved around the amount of professional development administrators had germane to the topic. Question 11 asked principals to describe their knowledge about the laws that govern the teaching of evolution. Questions 12-13 and 19 were hypothetical situations asking for a principal's reaction to teachers who refused to teach evolution or intelligent design. Question 14 asked principals to cite instances when their superintendant discussed evolution with administrators or teachers. Question 15 asked about a principal's knowledge of the Theory of Evolution. Question 16 asked the principals how they knew the Georgia Performance Standards on Evolution were being taught in their schools. Question 17 asked if the clergy and the community had expressed concern over evolution being taught in their schools. Question 18 examined the need for future professional development needs relevant to the topic. Question 20 investigated principals' knowledge on the scientific definition of the word "theory." Question 21 checked to see if a principal believed his science chair/lead teacher was knowledgeable about the laws regarding the teaching of evolution, creationism, and intelligent design. Question 22 asked principals to expose their greatest fear, if any, regarding the teaching of evolution. Question 23 investigated the principal's knowledge on the court's ruling that teaching evolution was not teaching religion. The final two questions asked principals to explain their own personal beliefs regarding evolution. The interview protocol was created to get a better picture regarding the feelings of administrators about the laws governing the teaching of evolution.

Quantitative Data Collection

Thirty-six school systems' middle and high school administrative personnel, as well as pertinent central office staff, were sent a survey and asked to respond in 2 weeks time. The

survey instrument was sent by United States Post Office mail. The 491 mailed surveys included a cover letter, the survey instrument, and a return envelope including postage. Large systems were sent gray-colored surveys, middle sized systems were sent cream-colored surveys, and small systems were sent white-colored surveys. The data were initially categorized based on size of system for analysis. The data were transcribed into a spreadsheet for analysis. Administrators returned 175 surveys and 154 were scoreable.

Qualitative Data Collection

Administrators in the qualitative portion were selected and interviews were completed in December of 2010. A minimum of three principals, one in each size category, were interviewed as well as one central office person per category to glean a more in-depth understanding of the teaching of evolution in Georgia middle and high schools. Three additional administrators were interviewed. Participants signed the IRB to take part in the study. Eleven interviews were taped and one interviewee did not want to be recorded. Notes were taken with all participants using the interview protocol. The 11 interviews were transcribed verbatim.

Research Questions

Question 1: What is the current knowledge level of middle and high school principals and assistant principals in 36 North Georgia public school districts regarding the laws that govern the teaching of evolution?

Question 2: What is the current knowledge level of district level administrators who are responsible for science curriculum in 36 of North Georgia school systems regarding the laws that govern the teaching of evolution?

Question 3: Do school administrators have a strong working knowledge of the Georgia Performance Standards regarding evolution and the topic of evolution in general?

Question 4: What building level issues have administrators faced in their clinical experience regarding evolution, creationism, and intelligent design?

Question 5: What district level issues have administrators experienced with evolution, creationism, and intelligent design in their respective school systems?

Question 6: What is the level of initial and ongoing training regarding evolutionary law experienced by administrators?

Question 7: What are the beliefs of administrators regarding the teaching of evolution in public schools of north Georgia?

Quantitative Data Analysis

The survey data were analyzed using several statistical measures. The original survey created and delivered by Dr. Moore at the University of Minnesota in 2005 had two responses: *yes* or *no*. Based on concerns from the prospectus committee, subjects were offered five responses instead of two on the modified survey instrument. The concern was based on a 50% chance of getting any item correct due to only having two choices on the original survey. The modified survey instrument was used to test all subjects in the Georgia survey. Answer choices were (1) *strongly agree*, (2) *agree*, (3) *don't know*, (4) *disagree*, and (5) *strongly disagree*. The data were analyzed twice.

The first analysis of the marked responses were graded and assigned an overall exam score based on questions 15-42 on the survey. The only answers that were considered correct were either *strongly agree* or *strongly disagree*. For example, if the correct response was

strongly agree, then all other answers were categorized as incorrect responses. Likewise, if a correct answer was *strongly disagree*, then the remaining answers were deemed incorrect.

The second analysis of the marked responses were graded and assigned an overall exam score based on questions 15-42 on the survey. The only answers that were considered correct were either *strongly agree* and *agree* or *disagree* and *strongly disagree*. For example, if the correct response was *strongly agree* or *agree*, then all other three answers were categorized as incorrect responses. Likewise, if a correct answer was *strongly disagree* or *disagree*, then the remaining three answers were deemed incorrect. This method was a means of generating binomial data from questions with multiple responses.

The mean score for both analyses were compared to determine an administrator's degree of true knowledge versus hunch knowledge. Hunch knowledge would be based on answers that were *agree* or *disagree* where the administrator had a hunch they knew the correct answer. This method of analysis provided insight in determining the measure of an administrator's degree of truly understanding the law versus those who think they know the laws governing the teaching of evolution in Georgia. A Pareto analysis on the exam questions were provided in both analyses to create a bar graph sorting the questions by those most frequently missed to those that were missed least frequently. An additional graph was created that superimposed the hunch data on top of the true knowledge Pareto data. The statistical software package was used was Minitab 16 (<http://www.minitab.com/en-US/default.aspx>).

Questions 1 through 14 were categorical inquiries that were correlated to exam scores in analyses one and two using the chi-square method. The initial assumption was that the proportions would be equal in all responses. Each categorical question was analyzed and results were reported using a bar graph to determine the dependence among the data and its differing

variables. The X-axes were the categorical questions and the Y-axes were the generated binomial data in the form of an exam score. The statistical significance was determined using an alpha risk of 5%.

Qualitative Data Analysis

The 12 administrators taking part in the qualitative interview process had a wide variety of work experiences. Due to confidentiality and maintaining anonymity of subjects, some detailed job descriptions of the interviewees were omitted. The transcribed qualitative interview data were examined for similar concepts and themes based on the phenomenon of administrative experiences with teaching evolution in the state of Georgia. The interviews were individually re-examined to clarify concepts and themes, and to synthesize them into clusters of meaning (Creswell, 1998; Moustakas, 1994). The data gleaned from the process were merged to create a description of the phenomenon. Textural descriptions of “what was experienced” and structural descriptions of “how it was experienced” were emphasized. Descriptions on principals’ knowledge about the theory of evolution, the laws regarding the teaching of the theory, personal beliefs about the teaching of the theory, and clinical experiences with students, parents, and the community regarding the teaching of evolution were documented.

Each transcribed interview was printed on 1 of 12 different colored sheets of paper. Once the themes were established, questions in the interview protocol were correlated to the themes. The five themes that emerged in the coding process were as follows: (1) Graduate level coursework and professional development on evolution for administrators is a rarity. (2) Evolution is not a major controversial issue in schools in the study area. (3) The Georgia Performance Standards concerning evolution ensure that no laws are broken as long as the

standards are being taught as written. (4) Religious modes and mores were evident in the school climate with respect to evolution in the schools. (5) There is variance in the understandings of the term scientific theory and evolution expressed by administrators. Five large sheets of paper were titled with each of the five themes established in the coding process. Interviewees' responses on all the correlated questions were affixed to the large sheets of paper. A table is located in Appendix E correlating the themes to the interview questions. This process afforded the researcher to easily determine comments made by each interviewee according to interview question and theme. Pseudonyms were assigned to interviewees according to their paper color such as Mr. Blue, Mrs. Goldenrod, or Ms. Magenta. The colored qualitative transcriptions were printed again. However, this time seven large sheets of paper were used that had one of each of the seven research questions as its heading. Each qualitative interview questions was correlated to one of the seven research questions. A table in Appendix F represents the correlation of the qualitative interview questions to the seven study research questions. Each of the 12 transcriptions were cut apart by qualitative question and affixed on a large piece of paper titled with the corresponding research questions it best answered. In this manner, the researcher could again easily determine the interviewee, qualitative interview question, and research question. The interviews fostered a greater understanding of the quantitative data.

Research Positionality

As the researcher that conducted this study, I have had a variety of educational positions. For 10 years I served as a high school chemistry, physical science, biology, earth science, geology, ecology, and anatomy teacher in an inner-city school with approximately 1,200 students. I simultaneously served as an evening high school science instructor for 10 years.

During this time I was awarded the Tennessee Earth Science Teacher of the Year award and the Tennessee Science Teacher of the Year award. I moved to Georgia and taught chemistry, biology, and earth science at a suburban high school with approximately 1,300 students for 4 years. I then moved to a charter school and taught 1 year as a half-time chemistry teacher and half-time district science supervisor. In this 5-year period, I was named the Georgia Earth Science Teacher of the Year, and was a finalist for the Georgia Teacher of the Year for all subject areas. The last 5 years I have served as a Director of Teaching and Learning for a district of nearly 14,000 students. My experience as a successful science teacher affords me the opportunity to be a respected administrator in the eyes of teachers I serve due to my teaching reputation. High quality science teaching, focusing on modern methods and standards, are paramount from my perspective.

I have experience working in two school districts in the South. The first school district had approximately 60,000 students and the second had 14,000 students. In the large school district, evolution was a topic that was openly discussed as part of the curriculum and there was a definite boundary between church and state. Evolution was addressed at the district level by the science supervisor and on several occasions staff were reprimanded for teaching creationism in their science classrooms. In the smaller school district, the topic was not initially emphasized and was often “tip-toed” around or avoided by staff. The boundary between church and state was blurred. When the Georgia Performance Standards were rolled out in 2005, 1/5 of the standards revolved around evolution. Yet, professional content development on the topic was not offered even though there was great controversy that was played out nationally as the State Education Superintendant was chastised for her position by late night comics. Even Georgia’s governor and former President Carter entered the fray defending the teaching of evolution.

The differences experienced in the two systems and the lack of professional development on the topic of evolution have been a concern to me. While I attempted to stay neutral, my deep seated concern revolved around potential litigation on the topic of evolution across the state of Georgia. My clinical experiences as a teacher/administrator and discussions with science supervisors across the state heightened my sense of awareness that administrators may need to be more cognizant of laws to avoid future litigation. As a former science teacher and Sunday school teacher, I feel that it is important for all children to be taught the scientific theory of evolution and that creationism/intelligent design should be taught outside the science classroom. This study helped to determine the need for professional development on this topic to administrators and gauge the level of urgency related to the topic.

CHAPTER 4

RESULTS OF THE STUDY

Introduction

This study sought to determine public school administrators' knowledge and perceptions regarding the laws that govern the teaching of evolution in the three Northernmost Regional Educational Service Agencies in Georgia. Perceptions, personal feelings, and clinical experiences concerning the teaching of evolution were explored among central office staffs that oversee science curricula as well as secondary principals. A mixed method approach was used to best acquire data to understand the issues administrators face with respect to teaching evolution in the public schools.

Study Participants

Chapter 4 is broken into two distinct sections. The first section is composed of the findings in the quantitative analysis. To explore principals' and central office staffs' knowledge of the laws that govern the teaching of evolution, a quantitative survey was mailed to 491 administrators in the study area. Every middle and high school principal in one of the 36 districts that make up Northwest Georgia RESA, North Georgia RESA, and Pioneer RESA was mailed a survey. A total of 455 surveys were sent to principals. In addition, 36 surveys were sent to the person overseeing science curriculum in the study area. A total of 175 surveys were returned. Only 154 were scoreable and 21 were discarded due to incomplete information. This gave a return rate of 35.6% with 31.4% scoreable and 4.3% discarded. Traditionally surveys on

evolution have low response rates (Ellis, 1983; Moore, 2004a; Riddle et al. 1942; Tatina, 1989; Wendell, 2006; Zimmerman, 1987). This study is based on administrators self-reporting on survey items describing their knowledge about the laws that govern the teaching of evolution and the GPS in the state of Georgia. Quantitative research methods using *Minitab 16* (Minitab 16, 2010) provided the results of the data analysis along with descriptive data. A table (see Appendix (A)) presents the demographic characteristics of the quantitative respondents. Data from a Pareto chart will also be addressed in this section.

The second section is comprised of the qualitative analysis. To explore administrators' perceptions, personal feelings, and clinical experiences concerning the teaching of evolution, a qualitative interview protocol instrument was created. Twelve administrators in the study area were interviewed and the transcriptions were used to develop themes. Seven principals and five district-level administrators from the three different RESAs were randomly selected to take part in the interview process. The interviewees were from 12 different systems and were from small, medium, and large districts.

Results of Quantitative Data Analysis

This section presents the results of the data analysis for each of the seven research questions. For each research question, raw data and applicable Pearson's Chi-Square were reported. After the presentation of the quantitative data, the research findings are summarized in narrative form. The raw survey data are organized in tabular form for analysis. The results of this survey data gave insight into the study's research questions. Secondly, the researcher examined two dependent variables (true exam score and hunch exam score) based on the independent variables of size of school system, current role of the respondent, respondent's area

of content strength, type of school, gender, education experience, administrative experience, type of college attended, professional development received, administrative coursework, religious affiliation, political ideology, parents calls with concerns about evolution, teacher concerns about teaching evolution, and religious views that conflict with the theory of evolution. Each of the 15 demographic questions was analyzed twice. The first analysis for each demographic variable was termed “true answer.” All of the answers of the test were either *strongly agree* or *strongly disagree*. For example, if the correct response was *strongly agree*, then all the other answers were categorized as incorrect responses. Likewise, if a correct answer was *strongly disagree*, then the remaining answers were deemed incorrect. The second analysis of the marked responses were graded and assigned an overall exam score based on questions 15-42 on the survey. The only answers that were considered correct were either *strongly agree* and *agree* or *disagree* and *strongly disagree*. For example, if the correct response was *strongly agree* or *agree*, then the other three answers were categorized as incorrect responses. Likewise, if a correct answer was *strongly disagree* or *disagree*, then the remaining three answers were deemed incorrect. This method was a means of generating binomial data from questions with multiple responses. The mean score for both analyses were compared to determine an administrator’s degree of true knowledge versus hunch knowledge. Hunch knowledge would be based on answers that were *agree* or *disagree* where the administrator had a hunch they knew the correct answer, but not enough to mark *strongly agree* or *strongly disagree*. The detailed analyses of all 15 independent variables are located in Appendix (G)

Research Questions 1 and 2

1. What is the current knowledge level of middle and high school principals and assistant principals in 36 North Georgia public school districts in this study regarding the laws that govern the teaching of evolution?

2. What is the current knowledge level of district level administrators who are responsible for science curriculum in 36 of North Georgia public school systems in this study regarding the laws that govern the teaching of evolution?

These two research questions were very similar and only varied by the role of the administrator; therefore, these questions were analyzed simultaneously. Survey questions that relate to Research Questions 1 and 2 are questions 1, 4, and 6. Table 3 shows the organization of the responses to these questions. The role of the administrator was divided into six categories and given the following abbreviations: Assistant Principal of a Middle School (APMS), Assistant Principal High School (APHS), District Level Administrators (DLA), District Level Science Administrators (DLSA), Principal of a High School (PHS), and Principal of a Middle School (PMS).

Table 3

Survey Data for Administrators Relating to Research Questions 1 and 2

Role of the administrator	Number of administrators	Percentage of administrators
APMS	49	31.8%
APHS	36	23.4%
DLA	8	5.2%
DLSA	2	1.3%
PHS	33	21.4%
PMS	26	16.9%
Total	154	100.0%

(table continues)

Gender of the administrator	Number of administrators	Percentage of administrators
Female	57	63.0%
Male	97	37.0%
Total	154	100.0%
Years of Adm. Experience		
0-4 years	32	20.8%
5-10 years	70	45.5%
11-15 years	27	41.5%
16-20 years	12	7.8%
21 or more years	13	8.4%
Total	154	100.0%

Chi-Square Test for the Role of the Administrator

To determine if there was a statistically significant difference in the current knowledge level between the three types of administrators, a Pearson Chi-square analysis was performed for each of the dependent variables (true law score and hunch law score) since they are classified as binomial data. The administrators were condensed into three groups based on their roles and collapsed from six groups into three. The independent variable studied was the current type of administrator, where each respondent was assigned the following abbreviations: District Level Administrators (DL), High School Administrators (HS), and Middle School Administrators (MS). The null and alternative hypotheses for this analysis are given as follows:

H_0 : The true law score [or hunch law score] is independent of the type of administrator
(or the DL true law score = HS true law score = MS true law score)

H_a : The true law score [or hunch law score] is dependent upon the type of administrator
(or at least one is different)

Both Pearson's Chi-Square tests provided a p -value of 0.000, which is less than the alpha risk of 0.05. Therefore, the H_0 was rejected, and it was concluded with 95% confidence that the true law score and the hunch law score were both dependent upon the type of administrator. In

other words, there was a significant difference in scores among the types of administrators. Table 4 shows the current knowledge level, defined as the true law score and the hunch law score, regarding the laws that govern the teaching of evolution for each type of administrator.

Table 4

Current Knowledge Level of Administrators Regarding the Laws that Govern the Teaching of Evolution in Georgia Public School Districts

Type of administrator	True law score	Hunch law score
District Level Administrators	45.9% correct	64.6% correct
High School Administrators	11.9% correct	37.0% correct
Middle School Administrators	11.0% correct	37.8% correct
	Pearson Chi-Square = 206.3 <i>p</i> value = 0.000	Pearson Chi-Square = 64.292 <i>p</i> value = 0.000

Chi-Square Test for Gender

To determine if there was a statistically significant difference in the gender and exam scores, A Pearson’s Chi-Square analysis was performed for each of the dependent variables (true exam score and hunch exam score) because they are classified as binomial data. The independent variable studied was the gender of either male or female. The null and alternative hypotheses for this analysis are given as follows:

Ho: The true exam score [and hunch exam score] is independent of gender (not related) or the proportion of questions missed for male = the proportion of questions missed for female

Ha: The true exam score [and hunch exam score] is dependent upon gender (related) or the proportion of questions missed for male is not equal to the proportion of questions missed for female

Both Chi-Square analyses provided a p -value of 0.000, which is less than the alpha risk of 0.05; therefore, we can reject the H_0 and conclude with 95% certainty that the true exam score and true hunch score are *dependent* upon gender. In other words, there is a *significant difference* in the true and hunch exam scores among males and females. Table 5 shows the data for gender in administrators.

Table 5

Administrator Gender

Administrator gender	True exam score	Hunch exam score
Male	17.3% correct	41.56% correct
Female	10.5% correct	36.10% correct
	Pearson's Chi-Square = 37.673 $p = 0.000$	Pearson's Chi-Square = 12.893 $p = 0.000$

Chi-Square Test for Years of Administrative Experience

To determine if there was a statistically significant difference in the number of years of administrative experience and exam scores, a Pearson's Chi-Square analysis was performed for each of the dependent variables (true exam score and hunch exam score) because they are classified as binomial data. The independent variable studied was the number of years of administrative experience. The categories of experience were 0-4 years, 5-10 years, 11-15 years, 16-20 years, and 21 years or greater. The null and alternative hypotheses for this analysis are given as follows:

H_0 : The true exam score [and hunch score] is independent of administrative experience (not related) or The proportion questions missed with 0-4 years administrative experience = the proportion questions missed with 5-10 years administrative

experience = the proportion questions missed with 11-15 years administrative
 experience = the proportion questions missed with 16-20 years administrative
 experience = the proportion questions missed with 21 or more years administrative
 experience

H_a: The true exam score [and hunch score] is dependent upon administrative experience
 (related) or at least one of the proportions is different.

Both Chi-Square analyses provided a *p*-value of 0.000, which is less than the alpha risk of 0.05; therefore, we reject the H₀ and conclude with 95% certainty that the true exam score and true hunch score are *dependent* upon years of administrative experience. In other words, there is a *significant difference* in the true and hunch exam scores among administrators with varying years of experience. Table 6 shows the data for administrative years of experience.

Table 6

Administrative Years of Experience

Years of administrative experience	True exam score	Hunch exam score
0-4 years	14.4% correct	41.0% correct
5-10 years	14.3% correct	37.3% correct
11-15 years	8.1% correct	37.9% correct
16-20 years	17.0% correct	40.2% correct
21 or more years	30.2% correct	50.9% correct
	Pearson's Chi-Square = 101.512 <i>p</i> = 0.000	Pearson's Chi-Square = 26.436 <i>p</i> = 0.000

Research Questions 1 and 2: Discussion of Findings

The quantitative findings relating to study Research Questions 1 and 2 revealed that 36 assistant middle school principals, 26 middle school principals, 49 assistant high school

principals, 33 high school principals, 8 district level administrators, and 2 district level science administrators participated in the survey. The group was composed of 37% females and 63% males. The group had a wide range of years of experience; however, 67% of the group had been an administrator for less than 11 years. Only 13.7% had been an administrator for more than 21 years. In the statistical analysis, the six types of administrators were collapsed into three groups: middle school principals, high school principals, and district level administrators. Statistically, the role of the administrator was compared to the exam score, which was the percentage of correct answers for questions 22-43 on the survey. The data in Table 4 suggest that the district level administrators had a greater knowledge level of the laws that govern the teaching of evolution than either middle or high school administrators. The Pearson's Chi-Square test noted there was a significant difference between the groups in both the hunch and true scores. The true law score for district level administrators was 45.9% correct compared to 11.9% and 10.0% for principals. The hunch law score had similar differences in the data between the groups. The district level administrators scored 64.6% on the hunch score while principals scored 37.0% and 38.8% correct. This data suggest that administrators in the region are lacking knowledge about the laws that govern the teaching of evolution. The highest score of 64.6% correct would be a failing exam score in any Georgia classroom. In the Chi-Square test for gender, males significantly out-performed females on both the true and hunch test scores. The data in Table 5 indicate that there is a significant difference between the scores of males and females; however, neither of the scores was high, indicating that neither male nor female administrators know the laws governing the teaching of evolution. In the Chi-Square test for years of administrative experience, the older administrators with more than 21 years of experience scored significantly higher on the true exam and hunch exam scores earning 30.2% and 50.9%, more than all four

other groups. However, the highest score of 50.9% was still an indicator that none of the groups really knew the laws governing the teaching of evolution. It is interesting to note, that the scores for the two district level science administrators earned a true exam score of 82.8% correct and a hunch exam score of 91.4% correct. These two administrators were from large school districts where they have more monies to hire central level support staff and can hire administrators specifically to supervise the science curriculum. Obviously, while this group was small, it was the only group that truly understood the laws governing the teaching of evolution.

Research Question 3

Do school administrators have a strong working knowledge of the Georgia Performance Standards regarding evolution and the topic of evolution in general?

Two pieces of data were examined to determine the knowledge level of administrators concerning the GPS. The first was to determine an exam score based on the questions on the survey that only examined the GPS. Three categorical groups were created: middle school principals, high school principals, and district level administrators. Each group's hunch and true exam scores were determined. The second data examined were to examine administrators' content knowledge strength compared to their hunch and exam score.

Chi-Square Test for Working Knowledge of the GPS

To determine if there was a statistically significant difference in the area of working knowledge of the GPS and the exam scores, a Pearson's Chi-Square analysis was performed for each of the dependent variables (true GPS score and hunch GPS score) because they are classified as binomial data. The independent variable studied was the area of working

knowledge of the GPS. The scores were based on their answers to survey questions 15-21 as those questions pertained to their knowledge of the Georgia Performance Standards. The null and alternative hypotheses for this analysis are given as:

H_0 : The true GPS score [and the hunch GPS score] is independent of the group of the respondent (not related) or the proportion questions missed for MS = the proportion questions missed for HS = proportion questions missed for DL.

H_a : The true GPS score [and the hunch GPS score] is dependent upon the group of the respondent (related) or at least one of the proportions is different.

Both Pearson's Chi-Square tests provided a p -value of 0.000, which is less than the alpha risk of 0.05. Therefore, the H_0 was rejected, and it was concluded with 95% confidence that the true exam score and the hunch exam score were both dependent upon the working knowledge of the GPS. In other words, there was a significant difference in scores among the working knowledge of the GPS among administrators. Table 7 shows the area of knowledge of the GPS as related to the true exam score and the hunch exam score.

Table 7

Administrators' Working Knowledge of the GPS Regarding the Topic of Evolution

	True exam score	Hunch exam score
District Level Administrators	42.9% correct	65.7% correct
High School Administrators	16.9% correct	42.2% correct
Middle School Administrators	15.7% correct	35.5% correct
	Pearson's Chi-Square = 31.247 $p = 0.000$	Pearson's Chi-Square = 23.453 $p = 0.000$

Survey question 2 asked the respondent to mark their area of content strength. The choices given were elementary education (EE), fine arts (FA), foreign language (FL), guidance (G), language arts (LA), math (M), physical education and health (PE), science (S), social studies (SS), special education (SE), vocational (V), and other (O). Table 8 shows the organization of the responses to this question on area of content strength.

Table 8

Survey Data for Administrators' Area of Content Strength

Area of content strength	Number of administrators	Percentage of administrators
Elementary Education	10	6.5%
Fine Arts	1	0.7%
Foreign Language	2	1.3%
Guidance	1	0.7%
Language Arts	23	14.9%
Math	23	14.9%
Physical Education	29	18.8%
Science	23	14.9%
Special Education	8	5.2%
Social Studies	20	13.0%
Vocational	8	5.2%
Other	6	3.9%

Chi-Square Test for Administrators' Area of Content Strength

To determine if there was a statistically significant difference in the area of content strength and the exam scores, a Pearson's Chi-Square analysis was performed for each of the dependent variables (true exam score and hunch exam score) because they are classified as binomial data. The independent variable studied was the area of content strength of the administrator. The choices given were elementary education (EE), fine arts (FA), foreign language (FL), guidance (G), language arts (LA), math (M), physical education and health (PE),

science (S), social studies (SS), special education (SE), vocational (V), and other (O). The null and alternative hypotheses for this analysis are given as follows:

H₀: The true exam score [and the hunch score] is independent of the subject area of content strength (not related) or the proportion of questions missed for elementary education = the proportion of questions missed for fine arts = proportion of questions missed for foreign language = etc.

H_a: The true exam score [and the hunch score] is dependent upon the subject area of content strength (related) or at least one of the proportions is different.

Both Pearson's Chi-Square tests provided a *p*-value of 0.000, which is less than the alpha risk of 0.05. Therefore, the H₀ was rejected, and it was concluded with 95% confidence that the true exam score and the hunch exam score were both dependent upon the type of administrator. In other words, there was a significant difference in scores among the areas of content strength among administrators. Table 9 shows the area of content strength as related to the true exam score and the hunch exam score.

Table 9

Administrators' Area of Content Strength

Area of content strength	True exam score	Hunch exam score
EE	17.6% correct	39.0% correct
FA *	0.0% correct	0.0% correct
FL	0.0% correct	34.5% correct
G *	44.8% correct	58.6% correct
LA	15.0% correct	43.5% correct
M	4.7% correct	32.1% correct
PE	9.27% correct	32.0% correct
S	30.1% correct	54.3% correct
SE	9.1% correct	34.1% correct

(table continues)

Area of content strength	True exam score	Hunch exam score
SS	15.3% correct	42.4% correct
V	15.1% correct	34.9% correct
O	23.6% correct	43.1% correct
	Pearson's Chi-Square = 254.060 $p = 0.000$	Pearson's Chi-Square = 132.443 $p = 0.000$

**Note.* Two cells had expected counts of less than five.

The Chi-Square test wanted a minimum of 5 for each of the expected cell counts. There was only one respondent in Fine Arts, with an expected count of 4.3. There was only one respondent from Guidance, with an expected count of 4.3. More surveys needed to be gathered from both of these groups for added certainty.

Research Question 3: Discussion of Findings

Questions 15-21 concerned the GPS on the survey. Three groups of administrators' scores on these questions were compared for statistical analysis. District level administrators scored 42.9% correct and 65.7% correct on the true GPS score and the hunch GPS score, which still suggested they did not have enough knowledge concerning the GPS. Middle school and high school principals' scores on the GPS segment of the exam were significantly lower than the district administrators' exam scores. Principals at the middle and high school level have a poor understanding of the GPS that deal with evolution. Part of the study was to determine if certain content areas, particularly science, had any effect on the knowledge level of principals regarding the GPS. The quantitative findings relating to study Research Question 3 revealed that the largest number of returned surveys came from language arts (23), math (23), physical education (29), science (23), and social studies (20). Two areas, fine arts and guidance, had only one

respondent, which questioned the certainty of their analyses in the Chi-Square tests and were therefore not included in the final analysis. Administrators from a science background scored the highest on the true and hunch exam scores with a 30.1% and 54.3% correct, respectively. These scores were significantly higher than the scores of all remaining subject areas. Nine other areas scored less than 20% on the true exam scores. The science teachers' scores were still low enough to suggest even they were not confident in their working knowledge of the GPS regarding the standards on evolution.

Research Question 4

What building level issues have administrators faced in their clinical experience regarding evolution, creationism, and intelligent design?

In the quantitative survey, several questions could offer some insight on building level issues faced by middle and high school principals. Question 12 examined phone call data and question 13 examined teacher fears and concerns regarding teaching evolution in their science classrooms. The raw data were tallied and percentages were calculated for each category. There were 144 building level administrators who responded to the survey. They were asked to mark the categorical range that best matched the number of parent calls they had received in their administrative career. The following categorical ranges were 0-5 parent calls, 6-10 parent calls, 11-20 parent calls, or 21 or more parent calls. Table 10 shows the tally of their responses.

Table 10

Number of Building-Level Issues Reported to Building-Level Administrators

Number of calls received	Number of administrators	Percentage of administrators
0-5 parent calls	135	93.8%
6-10 parent calls	5	3.5%
11-20 parent calls	2	1.4%
21 or more parent calls	2	1.4%

The 144 building level administrators were asked how many times teachers have voiced their fears or concerns regarding the teaching of evolution in their science classrooms. They were asked to mark the categorical range that best matched the number of teacher fears/concerns they had received in their administrative career. The following categorical ranges were 0-5 teacher concerns, 6-10 teacher concerns, 11-20 teacher concerns, or 21 or more teacher concerns. Table 11 shows the tally of their responses.

Table 11

Number of Teacher Fears/Concerns Reported to Building-Level Administrators

Number of teacher concerns	Number of administrators	Percentage of administrators
0-5 concerns	135	93.8%
6-10 concerns	7	4.9%
11-20 concerns	0	0.0%
21 or more concerns	2	1.4%

Research Question 4: Discussion of Findings

From the examination of the data in Table 10, 93.8% of the building level administrators reported they had received 0-5 calls concerning evolution being taught in the science classroom

during their careers. The data in Table 11 reported that 93.8% of the building level administrators had dealt with 0-5 teacher fears and/or concerns regarding evolution.

The data suggested that principals at the secondary level had very few issues from parent phone calls and teacher fears and concerns. The qualitative data will offer more insight on this research question.

Research Question 5

What district level issues have administrators experienced with evolution, creationism, and intelligent design in their respective school systems?

In the quantitative survey, several questions could offer some insight on district level issues faced by curriculum directors and science supervisors. Question 12 examined phone call data and question 13 examined teacher fears and concerns regarding teaching evolution in their science classrooms. The raw data were tallied and percentages were calculated for each category. There were 10 district level administrators who responded to the survey. They were asked to mark the categorical range that best matched the number of parent calls they had received in their administrative career. The following categorical ranges were 0-5 parent calls, 6-10 parent calls, 11-20 parent calls, or 21 or more parent calls. Table 12 shows the tally of their responses.

Table 12

Number of Parent Calls Reported to District-Level Administrators

Number of parent calls	Number of DLA	Percentage of DLA
0-5 concerns	10	100.0%
6-10 concerns	0	0.0%
11-20 concerns	0	0.0%
21 or more concerns	0	0.0%

The 10 district level administrators were asked how many times teachers have voiced their fears or concerns regarding the teaching of evolution in their science classrooms. They were asked to mark the categorical range that best matched the number of teacher fears/concerns they had received in their administrative career. The following categorical ranges were 0-5 teacher concerns, 6-10 teacher concerns, 11-20 teacher concerns, or 21 or more teacher concerns. Table 13 shows the tally of their responses.

Table 13

Number of Teacher Fears/Concerns Reported to District-Level Administrators

Number of teacher concerns	Number of DLA	Percentage of DLA
0-5 concerns	10	100.0%
6-10 concerns	0	0.0%
11-20 concerns	0	0.0%
21 or more concerns	0	0.0%

Research Question 5: Discussion of Findings

Only 28% of the 36 districts had their district level administrator respond to the survey. The number of parent calls expressing concern about evolution was very minimal. All respondents reported the lowest category of 0-5 calls in their administrative career. From the examination of the data in Table 12, 100% of the district level administrators reported they had received 0-5 calls concerning evolution being taught in the science classroom during their careers. From the examination of the data in Table 13, 100% of the building level administrators reported they had received 0-5 teacher fears/concerns in their administrative career. The raw data on teacher concerns and fears were exactly the same as the data on parent calls. The

quantitative data suggested that evolution issues are not a major concern in the reporting districts. The qualitative data will provide more insight on Research Question 5.

Research Question 6

What is the level of initial and ongoing training regarding evolutionary law experienced by administrators?

To answer Research Question 6, the raw percentage data and Pearson's Chi-Square data are used to offer insight on administrators' training on evolutionary law. Questions 7, 8, and 9 on the quantitative survey provided information pertaining to administrators' training on evolutionary law. The raw data was examined first. Question 7 provided insight on the initial college attended by the administrator. The choices of colleges attended were Public College (PC), Private Non-Religious College or University (PNR), Public University (PU), or Religious Affiliated College or University (RA). Table 14 summarizes this data.

Table 14

Type of Colleges and Universities Attended by Administrators

Type of college attended	Number of administrators	Percentage of administrators
PC	78	50.7%
PNR	12	7.8%
PU	33	21.4%
RA	31	20.1%

Question 8 asked administrators if they had received professional development regarding controversial issues about teaching evolution. The answer choices were a simple *yes* or *no* and are reported in Table 15.

Table 15

Professional Development Provided

Professional development provided	Number of administrators	Percentage of administrators
No	127	82.50%
Yes	27	17.50%

Question 9 asked administrators if they had received any instruction during their administrative coursework about the laws regarding the teaching of evolution. A *yes* or *no* answer choice was provided. Table 16 shows how many answered *yes* or *no*.

Table 16

Administrative Coursework on Evolutionary Laws

Administrative coursework on evolutionary law	Number of administrators	Percentage of administrators
No	95	61.70%
Yes	59	38.30%

Chi-Square Test for Types of Colleges and Universities Attended by Administrators

To determine if there was a statistically significant difference in the types of colleges and universities attended by administrators, a Pearson’s Chi-Square analysis was performed for each of the dependent variables (true exam score and hunch exam score) because they are classified as binomial data. The independent variable studied was the types of colleges and universities attended by administrators. The choices of colleges attended were Public College (PC), Private Non-Religious College or University (PNR), Public University (PU), or Religious Affiliated College or University (RA). The null and alternative hypotheses for this analysis are given as follows:

H₀: The true exam score [and hunch score] is independent of administrative experience (not related) or The proportion questions missed with 0-4 years administrative experience = the proportion questions missed with 5-10 years administrative experience = the proportion questions missed with 11-15 years administrative experience = the proportion questions missed with 16-20 years administrative experience = the proportion questions missed with 21 or more years administrative experience

H_a: The true exam score [and hunch score] is dependent upon administrative experience (related) or at least one of the proportions is different.

Both Chi-Square analyses provided a *p*-value of 0.000, which is less than the alpha risk of 0.05; therefore, we reject the H₀ and conclude with 95% certainty that the true exam score and true hunch score are *dependent* upon the types of colleges and universities attended by administrators. In other words, there is a *significant difference* in the true and hunch exam scores among administrators who attended various colleges and universities. Table 17 shows the data for types of colleges and universities attended by administrators.

Table 17

Colleges and Universities Attended by Administrators

Colleges and universities	True exam score	Hunch exam score
PC	13.1% correct	36.8% correct
PNR	16.1% correct	35.9% correct
PU	18.1% correct	44.8% correct
RA	8.1% correct	30.9% correct

Chi-Square Test for Professional Development Received by Administrators

To determine if there was a statistically significant difference in the professional development received by administrators, a Pearson's Chi-Square analysis was performed for each of the dependent variables (true exam score and hunch exam score) because they are classified as binomial data. The independent variable studied was the professional development received by administrators regarding controversial issues regarding the teaching of evolution.

The null and alternative hypotheses for this analysis are given as follows:

H_0 : The true exam score [and the hunch score] is independent of received professional development (not related) or the proportion questions missed from those who received professional development = the proportion questions missed from those who did not receive professional development.

H_a : The true exam score [and the hunch score] is dependent upon received professional development (related) or the proportion questions missed from those who received professional development is not equal to the proportion questions missed from those who did not receive professional development.

Since the Chi-Square analyses gave a p -value of 0.000, which is less than the alpha risk of 0.05, we reject the H_0 and conclude that the true exam score is *dependent* upon professional development. In other words, the true exam score for those who had professional development is *significantly different* from the true exam score for those who did not have professional development. Table 18 shows the exam scores for administrators.

Table 18

Administrative Professional Development

Administrative professional development	True exam score	Hunch exam score
Yes	26.4% correct	49.4% correct
No	12.3% correct	37.4% correct
	Pearson's Chi-Square = 102.467 $p = 0.000$	Pearson's Chi-Square = 38784 $p = 0.000$

Chi-Square Test for Administrative Coursework on Evolutionary Law

To determine if there was a statistically significant difference in the coursework on evolutionary law received by administrators, a Pearson's Chi-Square analysis was performed for each of the dependent variables (true exam score and hunch exam score) because they are classified as binomial data. The independent variable studied was the administrative coursework received by administrators on evolutionary law. The null and alternative hypotheses for this analysis are given as follows:

H_0 : The true exam score [and hunch exam score] is independent of administrative coursework (not related) or the proportion questions missed from those who received instruction in administrative coursework about the laws regarding the teaching of evolution = proportion of questions missed from those who did not receive instruction in administrative coursework about the laws regarding the teaching of evolution.

H_a : The true exam score [and the hunch score] is dependent upon administrative coursework (related) or the proportion of questions missed from those who received instruction in administrative coursework about the laws regarding the teaching of evolution is not equal to the proportion of questions missed from those who did not

receive instruction in administrative coursework about the laws regarding the teaching of evolution.

The Chi-Square analyses gave p -values of 0.029 and 0.004, which are less than the alpha risk of 0.05; we can reject the H_0 and conclude that the true exam score is *dependent* upon administrative coursework. In other words, the true exam score for those who had administrative coursework on evolutionary law is *significantly different* from the true exam score for those who did not have administrative coursework on evolutionary law. Table 19 displays this data.

Table 19

Administrative Coursework Received on Evolutionary Law

Received administrative coursework on evolutionary law	True exam score	Hunch exam score
Yes	16.3% correct	42.2% correct
No	13.9% correct	37.9% correct
	Pearson's Chi-Square = 4.756 $p = 0.029$	Pearson's Chi-Square = 8.174 $p = 0.004$

Research Question 6: Discussion of Findings

Twenty percent of the administrators attended a religious institution, while 80% attended non-religious college or universities. The percentage of administrators who had received training about the laws governing the teaching of evolution was 38.30%; 17.5% reported they had received training in professional development on controversial issues regarding the teaching of evolution. The analysis noted the exam scores for administrators attending religious affiliated colleges and universities scored the lowest on both their hunch and true exam scores.

Administrators who had attended public universities scored the highest in both true and hunch

scores. The public universities hunch score was 14.9% higher than the religious affiliated college and university trained administrators. Respondents who attended public universities answered the most questions correctly, at 18.1%. Respondents from religious affiliated colleges or universities scored the lowest number of correct answers at 8.1%. Administrators who attend public universities scored a significantly higher exam score than ones attending a religiously affiliated college. Administrators who received professional development scored significantly higher than those who received no training. They received true scores of 26.4% correct and 49.4% correct in the hunch scores. Administrators who had coursework on evolution scored significantly higher with 16.3% correct and 37.9% correct than those who had no coursework with scores of 13.9% correct and 42.2% correct. Although the data still indicates that administrators attending a public university and receiving evolutionary law in either their coursework or in professional development scored significantly higher than their counterparts, their scores were very low and still suggest that administrators do not know the laws governing the teaching of evolution.

Research Question 7

What are the beliefs of administrators regarding the teaching of evolution in public schools of north Georgia?

To answer Research Question 7, the raw percentage data and Pearson's Chi-Square data is used to offer insight into administrators' beliefs regarding the teaching of evolution in the public schools of north Georgia. Survey questions that related to Research Question 7 were questions 10, 11, and 14. The raw data was examined first. Survey question 10 asked respondents to mark the category that best described their religious affiliation. The religious

groups were Agnostic (A), Catholic (C), Jewish (J), Protestant (P), and Other (O). Table 20 summarizes this data.

Table 20

Administrators' Religious Affiliations

Religious affiliation	Number of administrators	Percentage of administrators
Agnostic	2	1.30%
Catholic	13	8.40%
Jewish	1	0.70%
Protestant	123	79.90%
Other	15	9.70%

Survey question 11 asked respondents to mark the category that best described their political ideology. The political ideologies were Conservative (C), Far Right (FR), Liberal (L), Middle of the Road (MR), and Far Left (FL). Table 21 summarizes this data.

Table 21

Administrators' Political Ideologies

Political ideologies	Number of administrators	Percentage of administrators
C	78	50.60%
FR	3	1.90%
L	17	11.10%
MR	56	36.40%
FL*	None	None

*Note: There were no respondents in the Far Left Political Ideology Group.

Survey question 14 asked administrators to *agree* or *disagree* with the following statement: “My personal religious views do not conflict with my understanding of the theory of evolution.” Table 22 summarizes the data for this question.

Table 22

Administrators' Understanding of the Theory of Evolution and Their Religious Views

Religious views on evolution	Number of administrators	Percentage of administrators
Agree	111	72.10%
Disagree	43	27.90%

Chi-Square Test for Administrators' Religious Affiliations

To determine if there was a statistically significant difference in the religious affiliation of administrators and the exam scores, a Pearson's Chi-Square analysis was performed for each of the dependent variables (true exam score and hunch exam score) because they are classified as binomial data. The independent variable studied was the area of religious affiliation of the administrator. The religious groups were Agnostic (A), Catholic (C), Jewish (J), Protestant (P), and Other (O). The null and alternative hypotheses for this analysis are given as follows:

H_0 : The true exam score [and the hunch score] is independent of religious affiliation (not related) or the proportion of questions missed from those who are non-religious affiliated = proportion of questions missed from those who are Agnostic = proportion of questions missed from those who are Catholic = proportion of questions missed from those who are Protestant = proportion of questions missed from those who are Jewish = proportion of questions missed from those who are Other.

H_a : The true exam score [and the hunch score] is dependent upon religious affiliation (related) or at least one of the proportions is different.

Both Chi-Square analyses provided a p -value of 0.000, which is less than the alpha risk of 0.05; therefore, we can reject the H_0 and conclude with 95% certainty that the true exam score and true hunch score are *dependent* upon the religious affiliations of administrators. In other

words, there is a *significant difference* in the true and hunch exam scores among administrators with varying religious affiliations. Table 23 shows the data for the various religious affiliations of administrators.

Table 23

Administrators' Religious Affiliations

Religious affiliations	True exam score	Hunch exam score
A	32.8% correct	58.6% correct
C	14.1% correct	39.3% correct
J *	72.4% correct	75.9% correct
P	8.3% correct	29.2% correct
O	14.9% correct	40.2% correct
	Pearson's Chi-Square = 106.170 $p = 0.000$	Pearson's Chi-Square = 45.031 $p = 0.000$

Note. -1 cells with expected counts less than 5

The chi-square test wanted a minimum of 5 for each of the expected cell counts. There were only 21 correct answers from Jewish respondents, with an expected count of 4.3. More surveys should be gathered from this group for added certainty.

Chi-Square Test for Administrators' Political Ideologies

To determine if there was a statistically significant difference in the area of administrators' political ideologies and the exam scores, a Pearson's Chi-Square analysis was performed for each of the dependent variables (true exam score and hunch exam score) because they are classified as binomial data. The independent variable studied was the area of political ideology of the administrators. Administrators were asked to best describe their political ideology by selecting from five categories. The political ideologies were Conservative (C), Far

Right (FR), Liberal (L), Middle of the Road (MR), and Far Left (FL). The null and alternative hypotheses for this analysis are given as follows:

H₀: The true exam score [and the hunch score] is independent of political ideology (not related) or the proportion of questions missed from those who are far left = proportion of questions missed from those who are liberal = proportion of questions missed from those who are middle of the road = proportion of questions missed from those who are conservative = proportion of questions missed from those who are far right.

H_a: The true exam score [and the hunch score] is dependent upon political ideology (related) or at least one of the proportions is different.

The Chi-Square analysis for the true exam score provided a *p*-value of 0.000 and for the hunch exam score provided a *p*-value of 0.009, both which are less than the alpha risk of 0.05; therefore, we can reject the H₀ and conclude with 95% certainty that the true exam score and true hunch score are *dependent* upon the political ideology of the administrator. In other words, there is a *significant difference* in the true and hunch exam scores among administrators with differing political ideologies. Table 24 shows the data for administrators' political ideologies.

Table 24

Administrators' Political Ideologies

Political ideologies	True exam score	Hunch exam score
C	13.0% correct	38.0% correct
FR	23.0% correct	46.0% correct
L	20.3% correct	45.6% correct
MR	15.2% correct	39.5% correct
FL	none	none
	Pearson's Chi-Square = 22.745 <i>p</i> = 0.000	Pearson's Chi-Square = 11.495 <i>p</i> = 0.009

Chi-Square Test for Administrators' Personal Religious Views

To determine if there was a statistically significant difference in the area of personal religious views affecting the understanding of the theory of evolution and the exam scores, a Pearson's Chi-Square analysis was performed for each of the dependent variables (true exam score and hunch exam score) because they are classified as binomial data. The independent variable studied was the area of personal religious views. The administrators were asked to *agree* or *disagree* with the following statement: "My personal religious views do not conflict with my understanding of the theory of evolution." The null and alternative hypotheses for this analysis are given as follows:

H₀: The true exam score [and the hunch score] is independent of no conflict (not related) or the proportion of questions missed from those who have no conflict = the proportion of questions missed from those who do have conflict.

H_a: The true exam score [and the hunch score] is dependent upon no conflict (related) or the proportion of questions missed from those who have no conflict is not equal to the proportion of questions missed from those who do have conflict.

Both Chi-Square analyses provided a *p*-value of 0.000, which is less than the alpha risk of 0.05; therefore, we can reject the H₀ and conclude with 95% certainty that the true exam score and true hunch score are *dependent* upon the administrators who agreed their religious views did not conflict with their understanding of the theory of evolution. In other words, there is a *significant difference* in the true and hunch exam scores among administrators who agreed their religious views did not conflict with their understanding of the theory of evolution. Table 25 shows the data for this survey question.

Table 25

Administrators' Religious Views

Religious views/No conflict	True exam score	Hunch exam score
Agree	17.7% correct	42.2% correct
Disagree	7.4% correct	32.7% correct
	Pearson's Chi-Square = 75.236 $p = 0.000$	Pearson's Chi-Square = 33.706 $p = 0.000$

Research Question 7: Discussion of Findings

Protestant was the religious affiliation chosen by 79.9% of administrators. Only one claimed to be Jewish and two claimed to be Agnostic. Eliminating the Jewish group, due to a low number of these respondents, the group with the greatest number of correct answers was the Agnostics and the lowest number of correct answers came from the Other group. A little more than half of the respondents (50.6%) chose their political ideology as Conservative. The next 36.4% chose Middle-of-the-Road as their political ideology. Seventy-two percent of the administrators agreed that their personal religious views did not conflict with their understanding of the theory of evolution; therefore, the majority of the respondents fit the stereotype of a southerner in the Bible belt: Conservative Protestant who can possibly understand the theory of evolution but may not necessarily accept it as a scientific theory with factual evidence as proof. Now let's look at the Chi-square analyses to see how these complete the picture of the respondent.

The Agnostic administrators earned the highest marks on the true and hunch exam scores with 32.8% correct and 58.6% correct, respectively. The largest group of administrators, the Protestants, had the lowest marks in both true and hunch exam scores with 8.3% correct and 29.2% correct, respectively. The Conservatives scored the lowest on both the true and hunch

exam scores. Interestingly the Far Right group scored the highest. The administrators that agreed their religious views did not conflict with their understanding of the theory of evolution earned a score of 17.7% correct on the true exam score and 42.2% correct on the hunch exam score. These data suggest that regardless of their religious affiliation, political ideology, and non-conflicting religious views, they all scored below 58.6% correct, indicating that none of them really knew the laws that govern the teaching of evolution.

Pareto Analysis

The data were given a final analysis through the creation of a series of three Pareto charts. Pareto's Principle, or the 80/20 Rule, states that 80% of the problem is caused by 20% of the issues (Reh, 2011). The Pareto Chart highlights the most frequently missed questions in an effort to allow a researcher to make informed decisions about situations that might need immediate attention. This type of analysis helps a researcher to address the most pressing issues and solve a large majority of the problems first.

On the Pareto charts, the vertical y-axis represents the percentage of administrators who missed a question. The percentage missed is presented by a bar and has the exact percentage annotated at the top of the bar. The horizontal x-axis lists the questions by ordering the most frequently missed question first and then progressing to the least missed question. The horizontal axis contains each of the 29 questions from the survey in descending order from the most missed question to the least missed question ending on the far right side of the chart.

The first Pareto Chart represents the percentage missed based on the true answers of *strongly agree* or *strongly disagree*. The second Pareto Chart represents the percentage missed based on the hunch answers of *strongly agree* and *agree* or *strongly disagree* and *disagree*. The

third Pareto Chart has the hunch answer data superimposed on top of the true answer data for comparison. The third Pareto Chart was used for analysis purposes.

Using Pareto's Principle, the first 20% of the questions missed were questions 19, 17, 23, 32, 38, and 22. Question 19 asked if the GPS requires that students be taught human evolution. The correct answer is no, yet 90.3% said it was a requirement in the GPS for high school biology on the hunch scores. Question 17 asked if the 7th grade Life Science GPS required Darwin's theories be taught. Again the answer was no, yet 89% believed it was a requirement. The misunderstandings of these first two questions can be easily rectified. Thus two problems are easily fixed. Looking at the next six questions (still using Pareto's Principle), questions 23, 32, 38, 22, 36, and 39 are all legal issues. Fixing these issues is not quite so simple, but is a big part of the problem. These questions dealt with administrators believing the following issues were legal or allowable in a public school setting:

- 1) Districts can adopt textbooks that teach intelligent design.
- 2) District courts determined that creationism has scientific merit.
- 3) Science teachers can be required by school administrators to read aloud a disclaimer saying that their teaching of evolution is not meant to dissuade students from accepting creation or intelligent design.
- 4) Georgia school districts can place disclaimers in biology textbooks informing students that evolution is "just a theory."
- 5) The U.S. Supreme Court has endorsed the teaching of "evidence against evolution."
- 6) Science teachers can teach creationism if their school district adopts a course textbook that presents creationism.

All of these six statements are false. Any of these issues could get a system and/or administrator in deep legal trouble for allowing any of the above issues to take place in their system or individual schools. These issues all indicate that administrators and district level staff do not know and understand the laws that govern the teaching of evolution. Answers to the survey questions have spotlighted that administrators are not getting taught about evolutionary laws in their coursework or during any professional development opportunities.

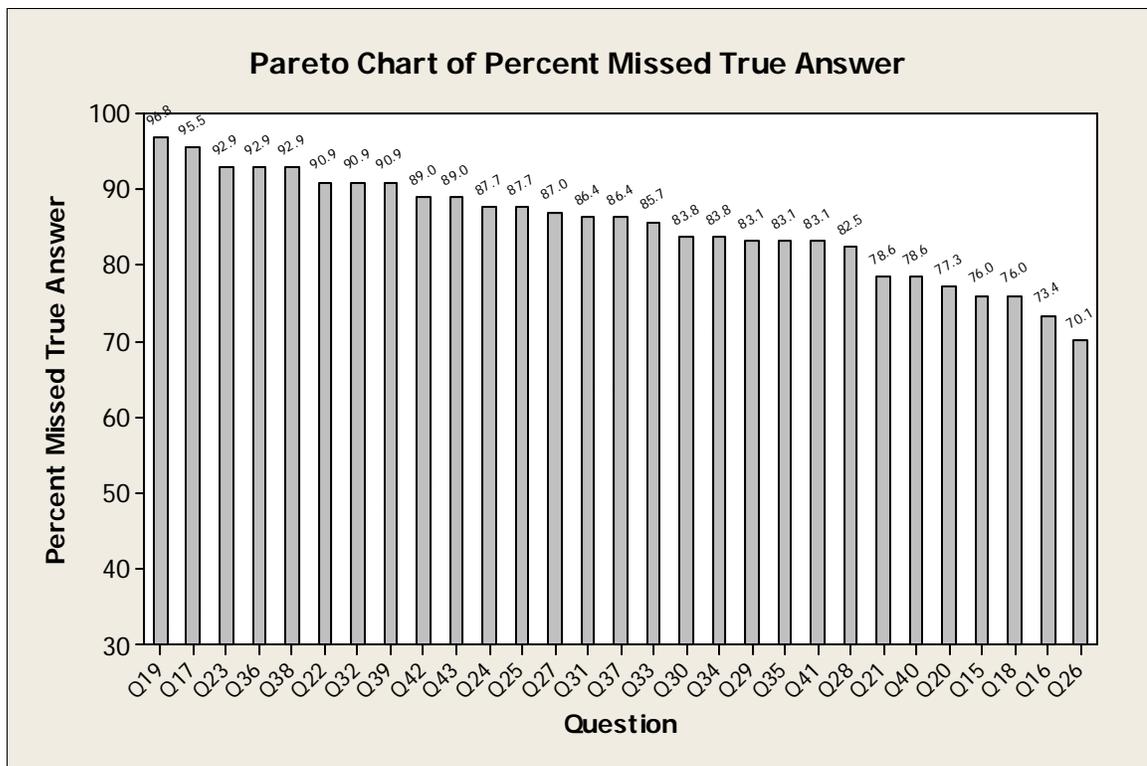


Figure 6. Pareto analysis on the exam questions, sorted by those most frequently missed true answer.

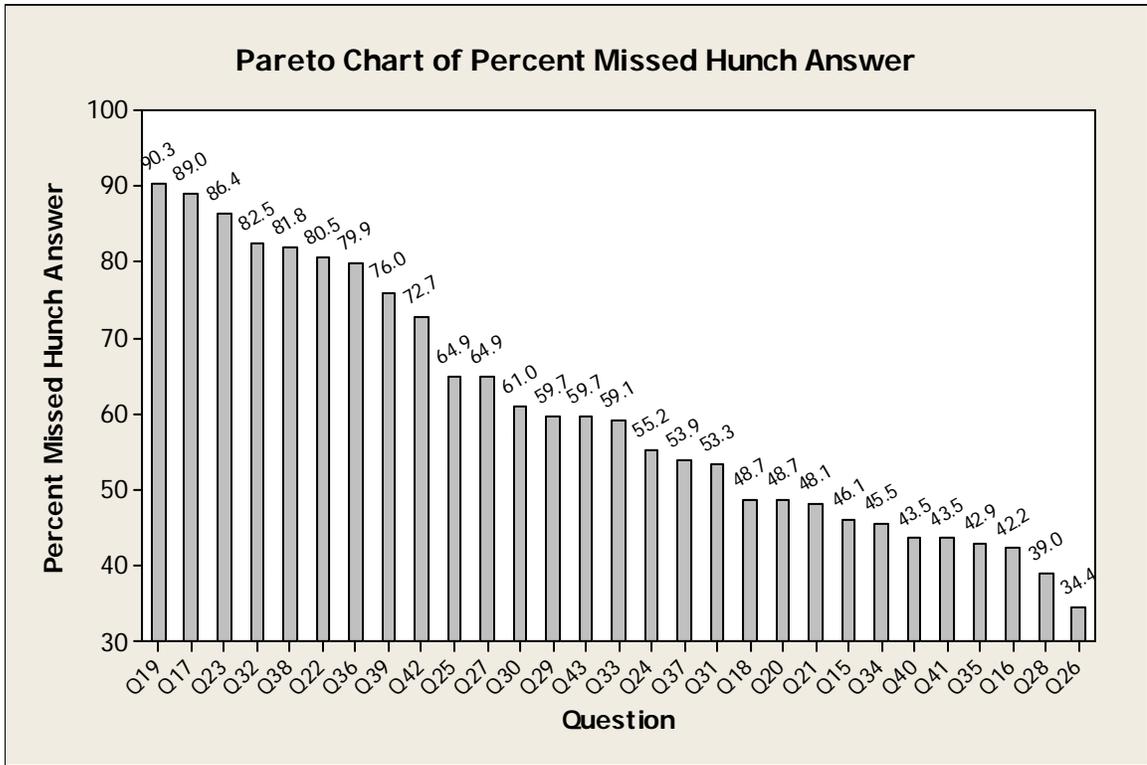


Figure 7. Pareto analysis on the exam questions, sorted by those most frequently missed the hunch answer.

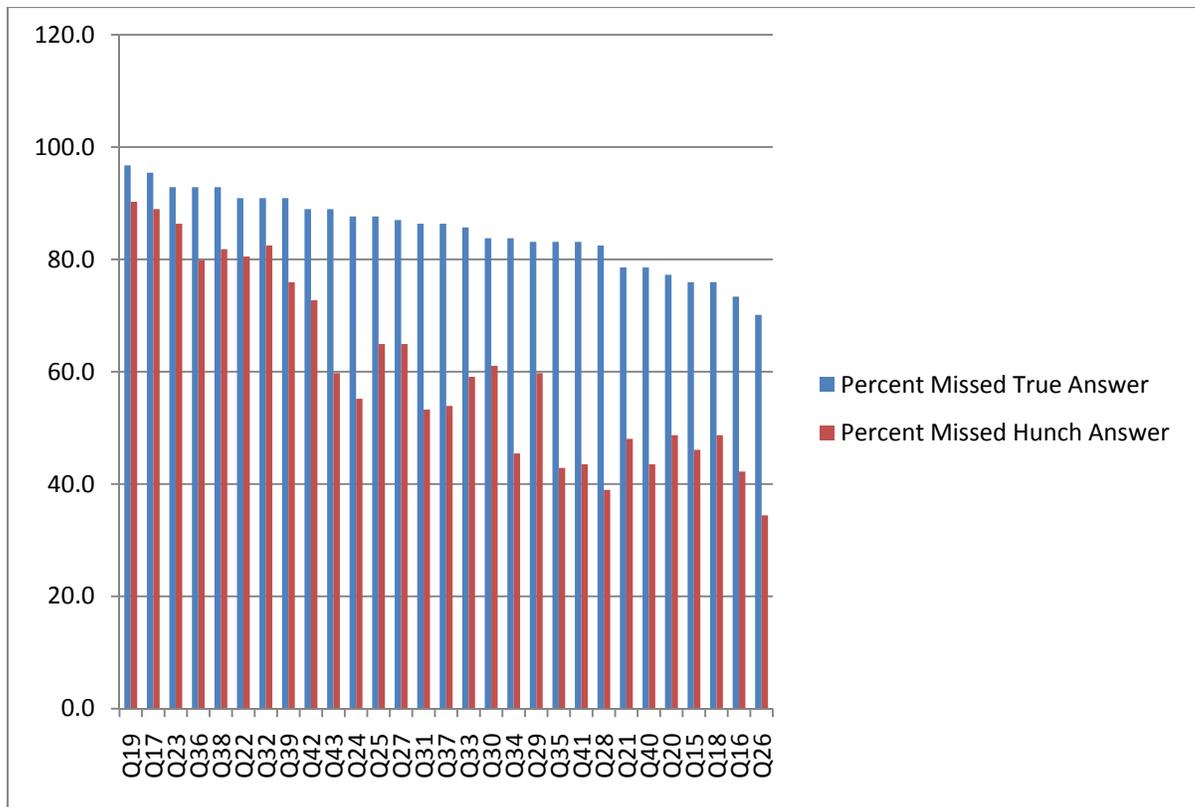


Figure 8. Pareto analysis on the exam questions, sorted by those most frequently missed the hunch answer superimposed on top of the true answer.

Qualitative Analysis

Organization of Qualitative Analysis

The qualitative data analysis of this study was broken down into five main sections. Emerging themes were identified in a coding process, using the transcribed interview data from the 12 administrators taking part in the study. Seven participants were either principals or assistant principals in one of the 36 districts in either Northwest, North, or Pioneer RESA. Five curriculum directors or science directors were participants in the interview process and from the same geographic region. All 12 participants were from different districts.

The five themes were discussed with accompanying quotes from interviewees. The narrative provided by the interviewees supported the validity of the five themes. The five themes are presented sequentially and end with a summary of each theme. The themes that emerged from the qualitative data are (1) graduate level coursework and professional development on evolution for administrators is a rarity, (2) evolution is not a major controversial issue in schools in the study area, (3) the Georgia Performance Standards concerning evolution ensure that no laws are broken as long as the standards are being taught as written, (4) religious mores and mores were evident in the school climate with respect to evolution in the schools, and (5) there is variance in the understandings of the terms “scientific theory” and “evolution” as expressed by administrators.

Theme 1

The first theme that emerged from the coding process was that graduate level coursework and professional development on evolution for administrators was a rarity. Question 7 asked administrators about what they learned in their graduate coursework regarding what could or could not be taught regarding evolution, creationism, and intelligent design. Of the seven school level administrators, only two reported they ever discussed evolution in their graduate level administrative coursework. One principal noted, “In my law classes, evolution was briefly discussed as well as creationism. But that was all the training I received on the topic.” Mr. Pink noted,

I can only remember one course, actually in my master’s coursework on educational law from UAB that discussed evolution. Oddly enough it was from a case study, and we did not discuss what could or could not be taught. We got more into the legal issues dealing with how the school approached parents and gave them information. It really had nothing to do with evolutionary biology.

Two administrators noted they assumed it was covered in their law courses but they could not remember studying the topic. Mrs. Magenta did not remember studying it but she tried to explain what should be known on the topic from an administrator's point of view. "I think you cannot allow creation to be taught because then you would have to allow any other groups to come and teach their origins."

District level administrators had similar experiences in their initial coursework. All five did not remember the topic being discussed in their coursework. Mr. Gray noted, "I never remember it being discussed in my administrative classes. We dealt a lot with the law. We may have looked at the laws that were passed regarding it, but it was no big thing. I don't remember it."

Professional Development

Professional development on the topic of evolution, creationism, and intelligent design was basically nonexistent. No principal had ever received any professional development on the topic. Two district level administrators reported they had been part of conversations on the topic. Mr. Purple noted, "I remember the supervisor of the state having a discussion and a good bit of training on that because of the huge controversy when the GPS was first rolled out in the Atlanta metro area." However, Mr. Purple was not part of that training but had colleagues in the metro area that discussed it with him in an informal conversation. Mrs. Tan noted she had taken part in the GPS training delivered by the State Department of Education. "Even though evolution was included in the GPS, it wasn't part of the DOE design course. I do remember participants discussing it among themselves."

Administrators noted they were willing to attend professional development on the topic of evolution, creationism, and intelligent design. Two middle school administrators did not see the need because it had been a non-issue at their respective schools. High school administrators wanted the training and two preferred to have it delivered in a webinar format. Mr. Green noted, “Society is totally different today than when I started 30 years ago. There are a lot more lawsuits, and any way I can protect our teachers, would benefit them first and then the system.” Ms. Salmon noted, “I would like to attend a professional development on the topic. I feel it would be good to know the laws in the event someone challenged what we were teaching.”

District level administrators were much more passionate about their need for professional development on the laws that govern the teaching of evolution, creationism, and intelligent design. All of the administrators embraced the notion that they and/or their staffs needed a refresher on the topic. Several administrators thought it was important for such a training to be for principals and science department chairs as well as district level administrators that oversee science. Ms. Tan stated, “Well, I feel I would benefit from a refresher course on the laws of evolution. I think it would be good for our principals to attend such a session.” Mr. Gray noted, “If there was such a professional development, I would like to send my middle and high school science leads, and I would encourage them to go!” The administrators thought it would be important to know how other districts handled situations on the topic. Mr. Buff noted, “I would attend that. I think I would gain content knowledge and learn how other schools have handled things.” Mr. Blue expressed his concern,

I would like to attend because there are certain legal ramifications that could come up. We’re trying to deal with the economy and we do not want issues like this to affect our budget. We can’t afford to be in the court right now. We have an \$8,000,000 deficit. Plus the public relations aspects that could be associated with it. There is never a winner in a legal battle like that.

Administrators noted the topic of evolution had not been addressed by their school boards or superintendants in all 12 districts. However, several district level administrators related they had actually been part of district level discussions on the topic. Mr. Blue related his experience, “We discussed that this topic and others should not be handled at the district level. We would handle this at the school level with assistance from the COB.” One science administrator related a discussion that transpired from the issues that revolved around the textbook disclaimers in Cobb County. “I went to seek guidance from our superintendant. We waited and held our breath, but no issues occurred in our district.”

Administrative Coursework and Evolutionary Law

All college and university departments of educational leadership and administration design courses to prepare future administrators for a leadership role in education. One aspect of that training involves one or more classes in educational law that involves historic landmark cases and their ramifications at the school and district levels. There have been two United States Supreme Court cases on evolution as it relates to public education and at least nine other court cases that involve evolution. In an ever changing demographic nation, an administrator must be aware of the law when making decisions in situations that could lead to litigation. The teaching of evolution is one such area due to the controversy and religious overtones associated with the topic. In the qualitative interviews, questions were designed to explore the level of knowledge possessed by the administrators on the topic of evolution.

Administrators in the qualitative interviews were asked: “Do you think you are aware of the laws that govern the teaching of evolution in public schools?” Four administrators thought

they were knowledgeable about the laws while eight were fuzzy or not knowledgeable. Mr. Pink commented on his knowledge,

I am somewhat familiar with the laws as far as the teaching of evolution. I am fuzzy on some things because of things like the Cobb County thing. I never heard any kind of resolution with that so I am not aware of any school board decisions. According to what I know and understand, the GPS is set forth by the State Board of Education and it does include evolution therefore we teach those standards because we are responsible for that and that is our job. The legal concerns. . . . I have not heard of any local concerns except Cobb County putting stickers in front of textbooks. Didn't those stickers state evolution is a theory?

Ms. Goldenrod gave her opinion, "Yes, I think so. We'll just use the common sense approach. If you teach one, you should teach both. You do not teach one exclusive of all the others." A district level administrator noted,

I should be but I am not. Anytime there is a controversial issue out there, it can lead to court proceedings; in fact, after we are done, I think I am going to do some research. You have made me think.

Most district level administrators cautiously believed they were knowledgeable about the laws. They used language like: "probably not" . . . "I hope so" . . . "that is a good question" . . . "I should be, but I am not." Mr. Gray offered the solution, "Specific laws? Probably not. When in doubt, I can look them up or go with logic, because I have good sound reason behind what I do."

Two hypothetical questions in the interview protocol delved into specific issues regarding free speech and the entanglement of religion with public education. One question revolved around a teacher's right to free speech regarding the teaching of intelligent design. Principals varied on their responses. Mrs. Canary responded,

We have been very lucky because I do not know of any issue we have had with free speech. Our teachers are always very professional and we're always willing to allow students to discuss or debate, but as far as them imposing their person opinions, I don't remember that ever happening at the high school.

Mr. Salmon remarked on his plan of action,

I would tell her that it was very important that she teach what is in the standards because students would be tested on it. I would urge her to be professional. She needs to be able to make sure she separates the two theories because one of them would be tested. It is okay to teach both sides because of the expectations of the community. I would caution her about muddying the water.

Mr. Green offered his suggestion,

I would try my best to not micromanage. I believe in academic freedom, but it is just like in some of the social sciences, there is a limit on how far you can push things and still be within the confines of your professional job. There's ways you can get kids to bring things up so it is their idea and not yours. That is easy to do as a teacher of biology, especially in middle school. If you mention evolution, someone is going to mention creation or ID. The door is open to explore that. I wouldn't want a teacher just doing that. They would definitely have to present both sides.

Mr. Blue, a district level administrator noted, "I don't have a problem with teachers teaching creationism. We can supplement the curriculum. If they are going to teach creationism they had better put evolution right beside it." Three district level administrators and one principal noted that a teacher's free speech was limited to nonexistent in the classroom. Mr. Pink retorted,

There is no free speech. I would not have anybody speaking about their personal beliefs or faith. I have teachers that put Bible verses at the end of their emails and I have had to talk to them about it. Inappropriate! Find what you believe in but keep your religious life separate from your school life. I am a Christian and I understand that, but I would not want them to put a Nazi slogan on there. It is not professional.

Another district administrator, Mr. Gray, weighed on the topic of free speech,

Well, we had this issue in history and sociology and I had to have conversations with them and let them know, yes, they do have free speech, but your free speech in the classroom is limited. It really doesn't exist. You are working for someone. You have a set curriculum to teach. Outside of the school setting, you are still an authority figure and your speech is still somewhat limited. The thought that educators have free speech is just not true and even more so in the classroom.

The second hypothetical question revolved around a creationist teacher refusing to teach evolution because it was a form of secular humanism. School level administrators were very

concise on this issue. All seven were in agreement that the teacher must deliver the prescribed instruction on evolution. One commented, “You must deliver to Caesar, what is Caesar’s.” Mr. Pink offered, “I would call and talk to them and then go sit in their room. It’s really not negotiable. I would make sure the teacher is teaching what they should be teaching.” Mr. Salmon sees it in a similar light but puts a twist on the question,

I would tell them they have to teach evolution because it is part of the GPS. My fear is the opposite. You cannot implement the curriculum based on your personal beliefs. The climate of the community is very important. A hard liner proselytizing evolutionary theories in this community would certainly face community concern. There would probably be picketing and it would be very hard for me to protect this individual. I am not sure I would try.

District level administrators had similar thoughts regarding religion and science teaching. They all agreed that there was not an option: The state curriculum must be taught regardless of the teacher’s perception that evolution was a religion. Mr. Gray discussed this situation,

We don’t know enough about any of these to be factual. ID, by design, is not factual. And I’m a firm believer that many of the things in ID will never be solved. That’s the design itself. If you only teach a child ID, when they are older and in college where other ideas will be brought out, they will not be equipped to deal with it. We have to help our kids be able to be equipped with other thoughts and religions using their own knowledge. They should decide what to support and what is fact. I taught math, it’s very factual, it is what it is. Science is very different, it is our obligation, to help students keep an open mind and have enough knowledge to make a decision. I see children that were sheltered and then all of a sudden when the real world came up and hit them, they did not know how to deal with it. They couldn’t deal with it! Unfortunately that happens too often. I would try to convince the teacher that this is your job. If you don’t want to teach the standards then you don’t have to teach here.

Summary of Theme 1

Administrators reported that overall they lacked in-depth instruction on the topic of evolution as it relates to the public school law in their college and universities. Professional development on the topic was nearly nonexistent. The only time the topic was discussed was

occasionally by science supervisors to their teachers. Administrators recalled a few conversations with other administrators in different districts where there had been issues but these were not formal discussions led by superintendants or school boards. Overall, administrators reported they needed to “brush-up” on the laws that govern the teaching of evolution in public schools. Administrators stated that teachers had very limited free speech in the classroom when it came to science instruction regarding the origins of life. Furthermore, they noted that teaching religious concepts not in the GPS were not necessarily appropriate.

Theme 2

The second theme discovered during the coding process was that evolution was not a major controversial issue in the study area. When administrators were asked about issues concerning the teaching of evolution with parents and teachers, three principals out of seven noted they had experienced minor problems in their tenure. One principal noted that a parent wrote a letter to the editor when the GPS was introduced in 2005 concerning evolution. The parent requested a conference,

I cannot remember all the details since it has been so long ago. It really did not go anywhere. We showed her the standards created by the state of Georgia and she left okay with the matter. I think she thought they were part of our county’s curriculum, not a state mandate.

Another principal noted the issues were about misinformation. In this administrator’s clinical experience he noted he had many more issues as a teacher. He related that he generally called the parent in for a conference and related to them what was going to be taught. It would satisfy them. He stated,

I had more issues in my teaching career than my administrative career. In my teaching career, it was primarily verbal feedback from parents. “I really don’t want my child being taught that portion of biology” and I would sit them down and actually have a

discussion on what was in the standards/curriculum, and what was expected, and it wasn't an attempt to challenge religious beliefs. That always seemed to end the parent's concern. As an administrator, I remember when a discussion came up: it was about earth science and the fossil record. Once I sat down with the parent, and had a discussion on what the students needed to know with the GPS in hand, it was fine. It was all about giving the parents the information about what was being taught.

Principal Salmon noted how he handled similar situations in a different manner. "On several occasions, I have had parents and students express concerns over the teaching of evolution. They wanted alternative assignments to evolution and I allowed parents to take their kids out of the classroom and get an alternative assignment."

District level administrators were more aware of minor evolution issues and noted that they were even cognizant about issues in other districts. The instances were very isolated and solved at the school level. Several noted their experience as a teacher or with colleagues. In all instances these were minor events. One administrator noted, "I would stick to the standards and tell students I could not teach creation because of the laws of church and state. Parents never had a problem because I handled it gently." Mr. Purple noted, "I haven't had a whole lot of controversy or discussion. There's been a little bit . . . I know one of the counties had an issue with putting disclaimers in the front of their books, but I haven't had anything to that level." The majority of parent concerns revolved around religious issues. Mrs. Tan gave her opinion,

I think our issues are the same as others that I commonly hear from other places. We live in a conservative community and some parents do not want evolution taught or to even have their kids exposed to it. They want origins taught in a Biblical way. They have said to me, 'I want it taught as the church teaches it.' This is not a major problem in our district like sex education but it does come up every so often.

Administrators noted evolution was not a hot button issue. When asked about the controversial nature of evolution, administrators shifted the interview without solicitation and discussed their powder keg issues. Four administrators discussed sex education as a major issue. Two principals noted that plays in the drama departments elicited great controversy in their

school districts. One administrator noted gay and lesbian issues have been a major controversial issue in their district. Issues with teachers and their teaching of evolution were rare. All seven principals reported they have limited or no instances with teacher concerns over the teaching of evolution. District administrators had experienced some issues in their tenure. Mrs. Tan related her experiences,

I think we have had teachers that were concerned due to the conservative nature of our community. I do not know if it's because of their personal beliefs. But I believe they are afraid they will evoke some kind of feelings from the churches or ministers or families. They feel evolution is wrong. That in itself leads them to be very careful. They are afraid to teach it the scientific way. So they teach it in their classrooms, but they do it quietly, in a way not to disturb the churches.

Several administrators noted their teachers had asked for guidance on the matter in district level meetings. Mr. Buff noted, "The most important thing is to make parents feel comfortable when you communicate with them about evolution. Welcome them into your classrooms and show them your lesson plans as they relate to the GPS." Mr. Purple suggested,

I've had discussions with teachers that advocated the teaching of evolution and those that did not. For the most part, biology teachers I have been associated with have no problem teaching evolution. Children would occasionally question that, and they had a set answer for that. We understand there are alternative theories, but we are not teaching that at school. I've never been called to a meeting, or never had to deal with parents, none of that.

ID and Creationism Concerns

During the interview process, questions were asked about issues that revolved around creationism and intelligent design, as opposed to evolution, in an effort to understand clinical experiences of administrators. Administrators reported there were even fewer issues with creationism and ID than evolution at their schools. Four out of 12 administrators reported there

were issues with ID and/or creationism with parents, students, or teachers. Mr. Salmon discussed issues he had with parents,

I have had several parents want creation taught in the biology classroom. The GPS does not have creation in the standards but for parents who did not want their students to be taught evolution, I allowed students to research creation origins as an alternative assignment. I have never had a teacher express concerns about teaching creation or intelligent design; however, I may have some that may be uncomfortable teaching creationism and intelligent design. I know that most of my teachers teach both evolution and creationism in their biology science classrooms.

Mrs. Magenta talked about her Christian Asian students,

We had Asian students that wanted the teacher to teach creationism. They did not understand why the teacher wouldn't. I said he should not, could not, and would not! The community became involved and the newspaper came and interviewed the teacher. He said it was not in the curriculum or the book and it was left at that.

One district level administrator remembered some issues,

I remember in some of the trainings in our district, we had people that wanted to balk over that issue. They wanted to be able to teach ID or creation or make it an option. Those were professional teachers and we had to discuss with them that they taught the standards and not anything else.

Several administrators noted that they had issues with creationism in other parts of the curriculum. One principal noted, "This issue has also has come up in social studies and our Bible classes. While the delivery is historical, the creation story is covered as well." Mr. Gray discussed problems in other areas,

We had a problem, but not in science, it was with a history teacher that got into trouble with posters on the wall and she was trying to connect creationism with her curriculum. We had to talk with that teacher and make sure she got back to her curriculum and concentrated on the things she need to concentrate on. At that point a sociology teacher began to push the issue and we had to squelch it as well. I had to get them back on their content. In science we have never had any issues.

Summary of Theme 2

Evolution is viewed as a controversial issue by many American as evidenced by poll data (Newport, 2007, 2009, 2010). Administrators in this study noted it was a “non-issue” or one that “demands little attention”. Most complaints by parents and students were very isolated incidents and were resolved quickly at the school level. The issues were most commonly resolved by communicating with parents by explaining the curriculum prescribed by the state of Georgia, and by teachers who handled the topic respectfully. Creationism and ID were topics that elicited few problems as well. Administrators have had a few parents who wanted creationism taught alongside evolution. The response by administrators was (1) to allow alternative assignments to evolution, (2) to have their teachers teach both evolution and creationism, or (3) demonstrate to parents the topics are not in the curriculum and would not be taught. Administrators noted creation issues were not only in the realm of the science curriculum but also in the social studies curriculum and the new Georgia Bible classes in literature. Principals reported evolution, creationism, and ID were not of great concern for them compared to the hot button issues of sex education, drama, and homosexuality.

Theme 3

The third theme revealed in the coding process revolved around the legal understanding of the GPS as it related to the delivery of instruction related to evolution. Questions in the interview protocol probed administrators’ knowledge of the curriculum as well as the feelings about their department heads that were responsible for carrying out the curriculum in their respective schools. Hypothetical questions answered by the administrators demonstrated their depth of knowledge of the law with respect to evolution in their clinical practice.

Delivery of the New GPS

The GPS in science was delivered to lead teachers and administrators in 2004 for redelivery in 2005 in their buildings. Lead teachers had 5 to 7 days of training and administrators had optional trainings. Since that time there has been no state level follow-up training on the science standards. New administrators would have to learn the GPS from a mentoring administrator or by reading a manual. During the interview protocol, administrators were asked about their knowledge of the GPS. Seven of the 12 noted they had a good working knowledge of the GPS and those that did not said they knew where to get the information. Mrs. Ivory noted, “I know enough, can’t recite it; when you look at all the domains in my school, evolution is the lowest.” Mr. Salmon expressed, “I know it relatively well. I acquired my information from the department of education training for administrators on the GPS in general. The evolution standards are in biology and I could get to them by going to Georgiastandards.org.” Several administrators noted the website in their interview and were able to quote it without any hesitation. Mr. Purple said,

When the GPS started, I was on the original training for the DOE and attended at least six trainings, and I was the department head so it was my duty to make sure those standards were implemented not only at my school, but the system.

The administrators had much confidence in the GPS keeping the curriculum legal. One administrator stated, “I am assuming that if the state has put this in the curriculum that the teachers would be held accountable for teaching it.” Mr. Salmon commented on his knowledge,

I don’t think I need to know the laws that govern the teaching of evolution. I believe the state department made the GPS sound without fear of us being sued for teaching content in evolution. It is the role of the teacher to follow the state curriculum and the local board.

Mrs. Ivory offered a suggestion,

If I had an incident, I would have to call the Professional Standards Commission to find out the right of teachers teaching evolution. I am assuming that if the state has put it in the curriculum that teachers would be held accountable for teaching it.

Mr. Pink relied on the GPS,

According to what I know and understand, the GPS is set forth by the State Board of Education and it does include evolution. Therefore we teach those standards because we are responsible for that and that is our job. A teacher under contract must teach the standards. What she does outside the classroom is her choice. But in the classroom, she must teach the GPS. She is expected to teach the standards!

Teaching the GPS

Ten out of 12 administrators noted they had great confidence in the science department heads to interpret the GPS and what could or could not be taught with regard to evolution, creation, or ID. They discussed how the science leads ensured the curriculum was followed to keep the school on track and out of the courtroom. Mr. Green said, “Yes, I know she is doing a good job because we do focus walks, and I am in their classrooms.” Mrs. Magenta stated, “When I am there I see the projects they are doing. Seeing them create models with different layers of sand fossils and pieces according to the GPS.” Mr. Salmon discussed the role of his department head,

I think the department head knows as much as the principal. It is important for her to help implement the curriculum. I would encourage her to weave in both schools of thought into the department. Teachers have to submit their lesson plans according to the curriculum map and the lessons are checked to see if they are following the GPS.

Several hypothetical questions were asked during the interview protocol to examine how an administrator would deal with a teacher that they felt did not conform to the GPS. One hypothetical question targeted how an administrator would deal with a science teacher who refused to teach evolution according to the GPS. The principal’s comments were clear and concise. Mrs. Canary stated that it was not an option,

I would have to talk with that teacher and explain to them that it is part of their requirement as a teacher and if it is in the GPS, it is not optional and that failure to do that would result in a reprimand in their personnel file.

Mr. Pink discussed teacher contracts,

My first reaction would be . . . yes you will teach the standards because that is your job and you are under contract to perform the duties of your job of which teaching the GPS is one of those. On a more personal level, I would sit down and try to explain why it is important for students to be exposed to the standards and the necessity of teaching it right now. When they get to biology, these kids will be short-changed if they do not know this from basic instruction. If they still refuse, that would be a personnel issue and I would have to document they refused to do their duties and responsibilities.

Mr. Green commented,

I would sit down with a teacher and find out their feelings and reasons for not wanting to teach the GPS. I'm a good listener and I think I could work it out and understand where they are coming from. I am a Southern Baptist all the way, strong roots there. But at the same time I was a teacher and I knew what my job was.

District level administrators were even stronger in their tone. Mr. Blue would research the laws,

I don't know what we would do with such a teacher, especially if it was a complaint that came from the public. I do not think it is something we go looking for. If a parent said my daughter was taking 7th grade science and they were teaching evolution, we would have to request that it be taught in some form. I would ask for a research project, or audio visual, or deliver the content directly. I would hate to do it, but then I would have to go to a Professional Development Plan if the teacher refused. It's the law, they are required to teach it. Are they not? I would find out the laws before I dealt with the teacher. Unfortunately, I can't make the laws the way they should be.

Two district level administrators noted they would try to work with a teacher. One way would be to have another teacher come into their room and teach the evolution standards.

Another way was for the teacher to not teach biology or life science where evolution was a requirement. In the future, their course load would be limited to areas that would not include evolution. However, if push came to shove, both of these administrators would not hesitate to reprimand the teacher. Mr. Purple would use the Professional Standards Commission,

We would have to use the observation instrument to document it was not being taught or it was being taught incorrectly. Then we would meet with the teacher and hopefully that would be the end of it. If they refused, we would not hesitate to go to the Professional Standards Commission.

Mrs. Tan also said, “If the teacher laid down a gauntlet then she refused to teach the GPS, we would have to use a Professional Development Plan or terminate her for refusal to follow required duty.”

Summary of Theme 3

Administrators rely on the GPS because it is legally sound since it was created by the state of Georgia. Science department chairs helped administrators ensure that the GPS was followed and teachers stayed on course. Administrators expressed a strong feeling that teachers must follow the GPS and teach the evolution standards. Refusing to do so could incur a reprimand or worse.

Theme 4

A fourth theme that surfaced during the interviews was evidence of religious mores and mores in the school climate with respect to the presence of evolution in their schools. Administrators were very mindful of the role religion played in their respective communities. They openly and willingly allowed the clergy into their schools. Often parents and students were honest about their beliefs. Principals and teachers turned a blind eye to matters of church and state due to pressures by the conservative climate and/or their personal beliefs.

Clergy in the Schools

Principals described the religious climate of their communities in the following ways: “e xtremely conservative,” “the Bible belt,” “far to the right,” “deeply religious,” “almost fanatical,” “c hurch going.” Several principals in more urban school districts were less emphatic in their descriptions. One administrator noted, “I think we live in a religious area, but the people here are more tolerant. Yet we have prayer at board meetings.” Mr. Gray discussed religious issues,

Our community is very diverse and Christian is the dominant religion. Our population has changed. I can’t say if it is Protestant dominated. We have a large Asian population. Our student population is very diverse and anything that has a religious context... we have to be very cautious about it. Although we have one religion as the prominent, we have so many others, we have to be cautious.

Many administrators noted that local ministers were welcomed into the schools and supported the school system. Mr. Salmon stated, “I have never had any members of the clergy come into my office and express a concern over the teaching of evolution. The clergy in our community are very active. They are in our schools regularly.” Mrs. Ivory commented on the support of the clergy,

Most of the individuals in our community are Baptist and the churches really support the school system. They are at the board meetings and are invited to come in at the beginning and support our athletic teams. Religion is very important to our community and it is a small community. Ministers support the school in all aspects.

Mr. Buff discussed committees,

We have a committee for sex education and the clergy are on the committee. We involve them and they ask about evolution. When I told them our stance on that, they never mentioned it again. About a year ago, a pastor requested we have something on the board about evolution and they were going to bring it before the board. I forwarded the information to our superintendent and never heard anything further about it.

Several administrators noted the clergy was often quiet at the school about evolution, but from the pulpit they were more vocal. One administrator admitted he had been confronted by members of his church about the topic of evolution. Mr. Gray stated,

In the school setting, I cannot ever recall evolution being an issue. Outside, in church, I hear comments all the time. They know I work in the school system, but still make comments. I can remember comments being made, but never any confrontations or anyone wanting to look at the material we chose. At church I would politely inform parents about misunderstandings about what the school was teaching regarding evolution, creationism, and intelligent design.

Mrs. Tan had a different view on ministers in her community,

We have not had any ministers come in to discuss evolution. Since we live in such a conservative community, it is most likely a parent has not expressed a concern to the minister. I think that ministers sometimes realize that evolution is fact. People that are educated, realize that evolution is fact, but they don't preach that because some people think it is direct conflict with what the Bible teaches. I personally feel that you can believe in the Bible and believe in evolution.

The Relationship between Evolution and Religious Beliefs

Administrators must also be mindful of the religious values of parents and students in their respective schools. Several mentioned incidents involving evolution as it related to their religious beliefs. Mr. Gray revealed one such conversation, "I've had conversations with students about the topic of evolution. They just wanted to come in and talk about it. No complaints about how we were doing it, they were just concerned about why the religious side was not taught." Mr. Buff talked about fielding parent calls,

I have had a couple of parent calls and I've called them in and I have discussed the standards and stressed we have to give them the education. Even though I am a Christian, when I was teaching Sunday school, I taught about other religions so my kids would be informed. To be an educated scientist, you would have to know the theories.

Mrs. Magenta had a poignant example of how a new teacher had to tread the icy waters between church and state,

I had a student teacher who came in when evolution was being taught, he was a leader of Young Life Fellowship of Christian Athletes, he actually taught the evolution chapter and some of his kids were in his Young Life organization, and were talking about him doing that. So it became a community issue. The parents of kids kept asking, why is he doing this? The parents came and talked to me, so I asked him to not be the FCA sponsor until he was done with evolution. He was struggling with this all together. He was young and inexperienced. It was five parents. I showed them the curriculum and asked what they would not want taught to their child. Do you want your child to grow up and not be able to discuss evolution? We are not teaching for or against, we are just presenting the information. None of them balked at that.

A parent called Mrs. Tan and expressed her concerns about creationism as part of the curriculum. She noted how she handled this situation,

It is the teacher's responsibility to teach the GPS and creationism is not part of the GPS. What you are asking us to do is not part of the school curriculum. And as far as we are concerned as administrators, it is her responsibility to teach evolution and not creationism. Of course this answer did not satisfy her. We always try to be helpful to the parent and make things go smoothly. Obviously, this was not a situation where I could make the parent happy.

Mr. Salmon remarked about the fears of teachers,

Many of my teachers fear the teaching of evolution in the school. They feel it could set off some parents in our religious community. My response is that it is part of the GPS and they must teach it . . . which helps them get over some of the fear.

Pressures from the Religious Community

Administrators noted that they had to be very cognizant of their role in the community. Some of them spoke about how they had felt pressure from the religious community in various ways. They also discussed their own personal struggles with their feelings about evolution, creation, and ID as it revolved around their role as instructional leader. All 12 administrators believed that evolution should be taught in the curriculum and 9 thought creationism and ID should also be taught side-by-side with evolution. Mr. Salmon noted, "The religious climate in

our school district is very strong. A principal must be mindful of that to politically survive this community.” Mr. Blue noted,

I’m very empathetic with our parents. I would tell them up front, I am a Christian and I do believe in creationism and ID. I also would point out that it is not a law that we teach creationism. Once again, I would research and make sure I am correct on that. Unfortunately, that is the world in which we live.

Principals and central office staff had mixed feelings about creationism and ID being taught in their school districts. Mrs. Canary thought that we should teach creationism in the school system,

I think it should be taught as part of the curriculum. I think it should be allowed to be discussed in a controlled setting with the teacher and a facilitator or a mediator in case it gets heated. Students need to be able to properly discuss issues that are hot topics... sometimes this brings out emotional viewpoints. It’s important they learn to debate those things. Certainly they should be open to discussion. Students should be able to share their views and opinions. It should be very well supervised and not allowed to become hurtful or negative.

Mr. Gray distinguishes between evolution, creationism, and ID,

We had members of the community that were upset with us teaching evolution. I would tell them that we were not forcing them to teach it to their children as a belief. Creationism and ID are beliefs. Evolution is not a belief, it is a theory. We do not know enough about any of these to be factual. ID, by design, is not factual.

One district level administrator spoke more boldly,

My father was a preacher and I grew up in an atmosphere that we didn’t believe in Santa . . . we didn’t believe Christmas was associated with the birth of Christ. I try to be tolerant of religious activities with school children. But . . . we have a pretty good Christian school in our area. If people are unhappy with us teaching evolution, I think they should go the private route first.

Summary of Theme 4

Administrators described the religious community in the study area as conservative.

Principals and district level administrators must be cognizant of the atmosphere created by the

clergy and conservative feelings in the community. Parents wanted their students to be successful on state exams, even when the curriculum went against their religious beliefs. Parent fears about evolution in the curriculum were often allayed by a discussion of the GPS with a teacher. Many administrators and teachers had to leave their personal feelings about ID and creationism at the school door and only allow the evolutionary theory of life origins prescribed by the GPS. Other administrators turned a blind eye as creationism and ID were taught illegally in their schools side-by-side with evolution.

Theme 5

Administrators reported they had a working knowledge about the theory of evolution. However, when they were asked to expand on the components of the theory, they could provide few details. Principals were often reticent to express their feelings about evolution, yet others had no problem declaring their position about the scientific theory. Administrators had different opinions about the meaning of the term “scientific theory.”

Levels of Content Knowledge Regarding Evolution

When administrators were asked, “What is your level of content knowledge regarding evolution?,” all 12 responded in a favorable manner. “I have a good understanding of it because I have a science degree.” “I have a good idea about the main ideas about evolution, but it would be difficult for me to express them.” “I understand it, but I am not an expert.” “Strong. But I’m a little rusty.” “I do, especially the way it should be taught, not so much as a change in species, but more of natural selection as it is being taught by the standards.” “I think I understand the main ideas, but not as good as Darwin.” Mr. Gray noted, “I think I have a basic understanding.

Math and science are my strong points. I can carry on a conversation about it and be very comfortable. If I had to teach it, I would have to review it.” One administrator noted their knowledge level was very high. Mr. Pink sees it in a different manner,

I took a class, *Science and the Bible*. I approach it from a very different side. From a Christian school it was discussed on an intellectual level. Guest speakers on creation science. They did a good job of presenting all sides of the subject. There was an interesting run of speakers that came to the class. There was a seminar on evolution. I appreciate the way it was done. From the intellectual discussion and presentation, it made a lot of sense. Even the creation science guys would talk about change over time, adaptation, allowing us to see the overlap.

When asked to expound on the main ideas concerning evolution, none of the interviewees cared to respond to the question or they stammered and never really gave a definitive answer.

Most mentioned that natural selection was the process for evolution.

Administrative Thoughts about Evolution

When administrators were asked to express their personal thoughts about evolution, three immediately declined to answer the question. Several administrators were very open about their anti-evolutionary thoughts. Mr. Salmon responded, “I believe the Bible is what guides all my beliefs and evolution is not part of that.” Other administrators were less demonstrative in their feelings. Mr. Pink noted, “I kinda have my own take on it. I think it is a definite work in progress, but I guess I choose to believe there is a higher power at work, as the saying goes.” Mr. Gray noted, “I have no problems with it. If God wanted to create it that way, he could have used the Big Bang and evolution. He created man in his own image. I have no problem putting all the ideas together.” Mr. Green said,

I believe evolution occurred. I believe in archaeological facts and I do know there are gaps. I believe it occurred and was guided by the hand of God. I do not believe in creationism, but I do believe that God influenced change with evolution.

Two administrators were very adamant in their understanding of evolution. “I believe in evolution. It is fact!” Mr. Purple noted, “I agree with evolution. That part of what happened one hundred million years ago, I have to take on faith. I do believe evolution has created higher beings that have developed over time.”

Scientific Theory versus Theory

Administrators had great variance in their understanding of the word “theory” as it was related to science. On one end of the spectrum, we have Mr. Salmon who stated, “I agree with the statement that evolution is only a theory. It is a hunch. A thought. A belief.” Mr. Blue told the story,

I actually had a situation where a parent was getting some information from me. It was my pastor’s daughter. He was interested in what was going on. He was concerned that evolution was being taught as fact. His daughter took exception to it, that it was being taught as fact and not theory. It is a theory, just as creationism is a theory. I presented that to her teacher, and they had a discussion and solved the issue.

Mr. Grey responded,

I do not think the standards need to be taught as fact. Evolution can be taught as theory. There are multiple theories and I have no problem with them sharing these multiple theories and evolution is one of those theories. Students do not have to accept the theory. I do not have any problem with teachers teaching other theories as an option. When you teach one theory, you are limiting students’ awareness.

Other administrators were more middle-of-the-road with their responses. Mr. Blue noted,

It depends on what form of evolution we are talking about. When you are talking about natural selection, there is some very strong scientific evidence and there are subtle characteristics in changes of species. But the evidence of change of a species is very limited. Too many gaps, when you look at the chain of evidence there are breaks in that chain which I think pulls it away from true scientific fact. If there is such a thing...and places it in the realm of theory. In natural selection, I do not see those breaks. There are breaks in the fossil record and what they present as evidence. There are errors missing in what they present as evidence for change of species. I don’t see any difference in the term “scientific theory” or “theory” as we use it in everyday language. Theory verses

Law. In theory, there are certain facts that point in that direction. Law is undisputable fact.

Mrs. Goldenrod gave his explanation on the differences,

I would imagine there is data to support either way you look at things. Probably, I would guess it cannot be absolutely proven. I think the scientific definition and the regular definition should be the same. Scientific theory is held to a higher standard than the everyday language.

On the other end of the spectrum, there were administrators who fully understood the difference between theory and scientific theory. Mr. Pink explained, “Theory will be something totally different to someone who is not a science person. Someone who is not a science person will throw that word around without justification.” Mr. Green noted, “I think a lot of people are not as well versed on what a theory is. It is just an attempt to explain natural phenomenon. I think the word is misused.” Mr. Buff talked about the theory,

Theory in science is more than just a hunch. It has been proven over and over again and replicated. I guess understanding the background of the theory in science is different than theory used in the everyday language. People use the word ‘theory’ flippantly as more of an idea. This is my idea....this is my theory. Scientific theory has a lot more research and a lot more support. There are steps you have to go through. The term theory in common conversation is used with much less research and support in the non-scientific arena. This is very confusing to most people.

Summary of Theme 5

Administrators have a great variance in their understanding of evolution and the concept of a scientific theory. Administrators expressed a basic understanding of the tenets of evolution but could not provide examples on the subject. Not all principals realized there was a difference between “scientific theory” and the word “theory” used in everyday English. Several administrators refused to express feelings about their own personal beliefs about evolution while others had no hesitancy providing their view points.

Conclusion of the Qualitative Data

Most of the 12 administrators in the study were very candid in their interviews concerning their views on the topic of evolution in the public schools. Principals in the study area lacked initial coursework or professional development that would apprise them of the laws that govern the teaching of evolution. Most administrators were willing to take part in a professional development session to enhance their knowledge of the laws concerning what can or cannot be taught in Georgia science classrooms. The few principals who were hesitant about spending time on a future professional development cited that there were very few issues in the schools on evolution. It was not worth a full day of training, but several noted they would like a webinar session on the topic. Overall, administrators noted that evolution problems were low on the list compared to sex education, drama, and homosexuality issues in their respective schools. Most issues on evolution were peacefully solved at the school level. One of the most common requests of parents was to teach ID or creationism alongside evolution. Several administrators catered to parents' requests by giving alternative assignments or allowing teachers to teach creationism. Creationism and ID were not only curricular issues in science, but also for social studies and literature. Administrators were not worried about the legality of evolution issues because the curriculum was created by the state of Georgia. A curriculum developed by the state would be legally sound as long as teachers focused on the standards. Administrators reported that their communities were overly conservative and Christian. The clergy were very active in their schools. Expectations of the community were to maintain status quo with respect to religion. Some Christian administrators left their religion at the school door and kept a separation of church and state. Other administrators turned a blind eye to creationism and ID being taught in their schools. Administrators reported they all had a working knowledge of the

tenets of evolution but could not describe any part with great detail. Some administrators were not knowledgeable in the differences in the term scientific theory versus the vernacular meaning of the word theory. Former science teachers who became administrators were very knowledgeable of this difference. Some principals refused to discuss their personal views about evolution, yet others were very open about being a creationist, believer in ID, evolutionist, or the blending of the beliefs and the theory.

CHAPTER 5
FINDINGS, IMPLICATIONS, AND RECOMMENDATIONS
FOR FURTHER STUDY

Chapter 5 is divided into three sections. The first section is a summary of findings in this study, which explored principals' knowledge of the Georgia Performance Standards and the laws that govern the teaching of evolution in public schools in Georgia. Administrators' clinical experience and personal thoughts about evolution are discussed in this section. The quantitative and qualitative findings are co-mingled as each research question is sequentially presented. The second section is a discussion of the possible implications from this study. Implications for public school administrators and university and college professors are discussed. The final section is a list of recommendations for future research studies.

Summary of Findings

Research Questions 1 and 2

Research Question 1: What is the current knowledge level of middle and high school principals and assistant principals in 36 North Georgia public school districts regarding the laws that govern the teaching of evolution?

Research Question 2: What is the current knowledge level of curriculum directors that oversee science curriculum in 36 North Georgia public school districts regarding the laws that govern the teaching of evolution?

The analysis for these two questions clearly indicated that principals in the area were not knowledgeable about the laws that govern the teaching of evolution. In fact, their test scores were alarming in light of the responsibilities and power principals have at the school level. The most disconcerting issue was that many administrators thought they knew the law but they did not. Their law exam scores on questions 22-43 in the survey were less than 12% correct for the true score and less than 38% correct for the hunch score. District administrators fared better on the test but still had failing scores. They scored 45.9% on the true law score and a 64.6% on the hunch score. The number of years of administrative experience was significant. The data reflected the longer one was an administrator, the more he/she knew about the laws; however, the range for the groups was 8.1% correct to 50.0% correct on the exam. Clearly these data reflected that administrators with differing levels of administrative experience were not knowledgeable about what can or cannot be executed in Georgia classrooms regarding the teaching of evolution, creationism, and ID.

One of the reoccurring misconceptions revolved around the teaching of creation and ID in the science classroom. In the interviews, many stated they knew their teachers were teaching creationism and/or ID but often turned a blind eye to it because of the expectations of the religious community. Other administrators did not realize it was against the law for their science teachers to include creationism while teaching about evolution. In fact, 87% of the administrators responding to the survey thought it was acceptable to include instruction on creationism. Teaching creation in the classroom places a school system into the possibility of perilous litigation. In the interviews, many principals reported that they did not feel they needed to know the laws because the state of Georgia created a curriculum that was legally sound. Several noted it was the role of the teacher to follow the state curriculum; however, in the same

breath some principals noted they knew their teachers were teaching creationism, which is not in the GPS. They further stated that their lack of knowledge was due to the fact that evolution had not been an issue in their district. In the event a school district is taken to court for a principal allowing the teaching of creationism, ignorance of the law will not be an adequate defense.

The one exception to poor law exam scores was the district level science administrators from the large districts that could afford these positions. These individuals were clearly knowledgeable about the laws and received a hunch score of 91.4%. Their sample size was too small to make any major assumptions, but the test scores indicated they were very knowledgeable about what can or cannot be taught in Georgia science classrooms. Other large districts in Atlanta-Metro, Savannah, Columbus, and Augusta have similar positions in their central offices. It would be of interest to obtain results in the future from them.

Research Question 3

Do school administrators have a strong working knowledge of the Georgia Performance Standards (GPS) regarding evolution and the topic of evolution in general?

The quantitative analysis for Research Question 3 indicated that administrators were not knowledgeable about the GPS concerning evolution. The three administrative groups all had failing GPS exam scores: district level 65.7%, high school principals 42.2%, and middle school principals 35.5%. There was a statistical significance between the principal and district level scores. In the interviews, administrators deemed knowledge of the GPS was not important because they knew where to find the standards and many quoted the state website: Georgiastandards.org. Seven of the 12 interviewees reported they had a good working knowledge of the GPS. There is no mention of creationism or ID in the standards. Still, several

principals reported that creationism was okay to teach because it was in the GPS. This assumption proved their lack of knowledge. One administrator gave a very detailed description about natural selection that was scientifically incorrect. Another principal had misconceptions about the fossil record regarding the Cambrian explosion and was off by 400 million years.

The Pareto data indicated that two questions about the GPS were the most missed questions on the survey while the remaining questions were in the bottom third on the chart. Question 19 asked about the GPS and human evolution and question 17 asked if Darwin's theories had to be covered in the GPS. Administrators indicated that human evolution was covered in the GPS and Darwin in particular had to be studied: These were incorrect assumptions. Ironically, the most missed question on the survey regarding human evolution was an area that has been scrutinized by assessors of curriculum. In 2009, Georgia's score for evolution dropped from a "B" to a "C" (Mead & Mates, 2009). The reason for this drop was that human evolution was not explicitly addressed in the Georgia science standards; however, the majority of administrators in this research study believed human evolution was part of the GPS.

To better understand the content area strength of the principals, question 2 on the survey asked principals to indicate their strongest subject area. This question was asked in order to explore the possibility that former science teachers turned administrators might be more knowledgeable than administrators from other content areas. Former science teachers scored significantly higher on the exam than the other content areas yet only 54.3% received a correct score on their hunch exam.

Research Questions 4 and 5

Research Question 4: What building level issues have administrators faced in their clinical experience regarding evolution, creationism, and intelligent design?

Research Question 5: What district level issues have administrators faced regarding evolution, creationism, and intelligent design?

Research Questions 4 and 5 are discussed simultaneously because they are very similar. The quantitative data regarding district and building level clinical issues were limited to raw data on parent phone calls and the number of teachers who expressed fears or concerns to their administrators regarding the teaching of evolution. The number of parent calls to principals and district level administrators was very limited. A vast majority of the principals, 93.8%, reported receiving less than five calls on evolution in their entire administrative career. All district level administrators reported they, too, had less than five calls about evolution in their administrative tenure. At the district level, there were interview comments made about evolution as it related to parents, students, and teachers. District level administrators reported the calls were few and were often misunderstandings about the curriculum. The curriculum directors noted most of the calls were from parents who wanted evolution and creation taught simultaneously. Several parents wanted equal treatment. Administrators in this predicament at the district and school level reported they met with the parents and gave them a copy of the standards. They told parents the teachers had to teach the curriculum as prescribed by the state of Georgia. District level administrators had a better grasp of the standards and were more reticent to mention equal treatment or allowing alternative assignments on the evolution standards.

The quantitative data for teacher fears and concerns reported to building level principals paralleled the data on phone calls. Building level principals reported that 93.8% of them had 0 to

5 teacher concerns in their career. All district level administrators also, reported they had less than five teacher fears and concerns in their administrative career. The data indicated that evolution is not a major issue in schools and school districts within the study area. This is of interest because evolution and creationism are controversial subjects but are not viewed as important because the issue is not raised by parents and teachers in their respective communities. Teachers sidestepping evolution or overtly teaching creationism may suggest a reason for so few complaints about the teaching of evolution. The qualitative data confirmed the quantitative data. In the interview process, principals and district level administrators reported that issues with evolution, creationism, and ID were small compare to other hot button issues like sex education, drama, literature, and homosexuality. The vast majority of building principals reported few issues with students or parents. Several principals noted parents wanted alternative assignments to evolution and their requests were allowed. Unfortunately, some of the alternatives described were to have students openly debate evolution and creationism in the science classroom, skip evolution all together, or research alternative origin theories which implied students would be studying creationism and ID in the public school setting.

Principals reported overall they had few teacher issues with evolution. Most of the issues were concerns regarding the conservative nature of their community and the involvement of the clergy in the schools. Some teachers wanted confirmation that the principal thought it was acceptable to teach both sides of the issue. Some principals tiptoed around the issue, other principals had no problem teaching both sides, and one said “should not, could not, and would not” regarding the teaching of creationism or ID. All principals believed that evolution should be taught to prepare the students for high-stakes testing on the CRCT or GHSGT or EOCT. One

district level administrator reported some limited training in their district on evolution as it related to the standards during the rollout of the GPS.

Research Question 6

What is the level of initial and ongoing training regarding evolutionary law experienced by educators?

The quantitative data were very clear that principals lacked initial training on evolution in their college coursework, regardless of the type of institution they attended. Administrators who attended public universities scored the highest on the exam. Their score was 14.9 percentage points higher than administrators who attended religious institutions. However, all groups failed the test and the highest percent score for any group was only 44.8%. Administrators reported that very few of their education professors discussed evolution as it related to law in their coursework. For the entire group, only 38.3% had received some instruction in their administrative courses concerning evolution. In the statistical analysis, principals who received law instruction on evolution out-scored principals who did not receive instruction on the hunch exam by 12 percentage points. Principals lacked professional development on evolution, creationism, and ID as it related to their classrooms. Only 17.5% of principals reported they had any professional development that discussed evolution as it related to the law. In the interviews, all 12 principals in the study reported they had not received any professional development on creationism, ID, or evolution. In addition, all 12 reported their superintendant or board of education had never discussed issues on evolution. Ten of the 12 administrators recognized they needed professional development and were willing to attend a session on the topic. Several

district administrators noted they felt it was more important for their principals and science department chairs to take part in this type of training as well.

The Pareto analysis was of most concern. Professors who train future administrators need to focus more on creationism, ID, and evolution. Following the two most missed questions on the GPS, the next six questions missed most frequently revolved around misunderstandings about disclaimers, creationism and ID in public school textbooks, equal treatment of evolution and creationism, and scientific creationism. Professors need to make it very clear that disclaimers are not allowed in Georgia and teachers cannot be forced to read them. Public monies cannot be used to adopt science textbooks that include creationism or ID. Professors in science education and administration need to note that creationism and ID have no scientific merit according to the most recent court rulings.

Research Question 7

What are the beliefs of administrators regarding the teaching of evolution in public schools of North Georgia?

The quantitative data gleaned from the survey can provide some insight on the beliefs of administrators regarding the teaching of evolution. The survey wanted to acquire some information on principals' religious affiliations, political ideologies, and their interpersonal conflicts with religion and their jobs. These questions were asked to provide insight on their personal beliefs about evolution, creationism, and ID. The survey indicated that nearly 80% of the principals were Protestant. Only 8.4% were Catholic, and 9.7 % described themselves as Other. Agnostics and the category of Other scored the highest on the exam. Catholics scored better than Protestants; yet all religious groups failed the exam.

The examination of political ideologies revealed the group consisted of 52.4% of the principals who described themselves as far right or conservative, 36.4% middle of the road, and 11.1% that leaned to the left. No principal described their political ideology as far left. The statistical analysis indicated that no group passed the exam and the range in scores was 38.0% to 46.0%. The interpersonal conflicts between religion and evolution were evident with some administrators. Seventy-two percent of the principals indicated that their religious views do not conflict with the theory of evolution. Nearly 30% of the principals reported that they had interpersonal conflicts with religion and evolution. In the statistical analysis, principals with no conflicts reported an exam score of 42.2%, which was statistically significant, compared to principals that scored 32.7% and had conflict with their religious views and evolution.

The qualitative data indicated that principals were very opinionated about their personal beliefs but they reported that they kept them in check at school. When asked if they personally thought that creationism or intelligent design should be taught in the classroom, 9 out of 12 thought these two beliefs should be taught in the science classroom. Several principals noted that it should also be taught in social studies classes and literature of the Bible courses in Georgia classrooms. Every principal thought evolution should be taught in science. However, a closer interpretation of their words leads to speculation that they were really not in favor of the scientific theory of evolution. "I think it should be taught as a theory." Another principal noted, "I believe evolution should be taught from the Christian perspective," Mr. Gray stated, "Yes, it is a theory. It has the right to be taught. But I say theory. Theories are not facts yet." From these comments it was obvious many administrators were confused about the difference between a scientific theory and a theory used in the vernacular. Some district level administrators had a more scientific view of the term theory. They realized that scientific theory has more research

and support than a theory in a nonscientific area. As one principal stated, “this is very confusing to people.”

Several administrators refused to expose their personal beliefs about evolution. Most stated they believed in some form of evolution. Several reported that God’s hand was on the evolutionary process. There were principals on the two extremes. “I believe that the Bible is what guides all my beliefs and evolution is not part of that” and “I do believe in evolution, it is fact.” All principals declared that their personal beliefs about evolution never conflicted with their job as an administrator. However, some reported they had inner struggles. They all agreed it was their duty to follow the GPS and it be their guiding influence as an administrator.

Comparison of Administrator Knowledge to Science Teacher Knowledge

It would be remiss if some comparisons were not made between Dr. Moore’s teacher study in 2004 and the findings in this research study on administrators. Dr. Randy Moore created a survey that explored how well biology teachers understood the legal issues associated with the teaching of evolution (Moore, 2004a). This research study was based on Dr. Moore’s study. Teachers in Dr. Moore’s survey had 20 questions that pertained to the law, while this research study had 22 questions. The 20 questions in Dr. Moore’s survey were essentially the same used in this research study with the addition of two questions that pertained to the laws in Georgia. While the surveys were not exactly the same, they were very similar. In Dr. Moore’s study 103 science teachers took the test, receiving an average score of 78.5% correct. In this research study, 154 administrators took the test and the average score for middle school principals was 37.76% and for high school principals was 36.97%, using the hunch data. The hunch data were more similar to the answer choices in Dr. Moore’s survey. The difference in

these test scores indicated the knowledge of law regarding the teaching of evolution for science teachers is much greater than the knowledge of administrators. Science teachers and science department chairs need to take a more proactive stance on teaching evolution in Northern Georgia. Clearly, the results of this study indicated the instructional leaders of the school are not knowledgeable. Biology teachers may have to step up to the plate and take a stance on teaching evolution as John Scopes, Susan Epperson, Don Aguillard, and the biology teachers of the Dover Pennsylvania school district did to make sure children are taught science without the entanglement of religion.

Practical Implications

The findings for this research study have implications for public secondary school leaders as well as college and university education professors. Middle and high school principals are responsible for monitoring science instruction in their respective buildings and to ensure the GPS are being taught. This study has applications for the central office staff who oversee science curriculum in their respective districts. Their role is to ensure the curriculum adopted by the district strongly mirrors the GPS, is consistently taught across the district, and is legally sound. Superintendants and Boards of Education set policy and procedures to protect students, teachers and administrators. This protection also includes curriculum.

The findings for this research study have implications for colleges and universities with education programs. Professors who deliver secondary science methods courses need to apprise their students about the laws that govern the teaching of evolution, emphasizing that creationism and ID are not part of any public school curricula. Educational administration and leadership

courses concerning education law need to focus more attention on the laws that govern the teaching of evolution in public schools.

Public School Superintendents and School Boards of Education

Superintendents and school boards of education need to be aware that their administrators need some basic training on what can or cannot be taught with respect to evolution, creationism, and intelligent design. Professional development is needed and wanted by administrators on the topic of evolution and the law. School systems are creating an environment for litigation, poor test scores, and negative publicity concerning evolution, ID, and creationism. The two most recent major cases regarding evolution were in Dover, Pennsylvania, and Cobb County, Georgia. In the Dover case, the school board was given a chance to back down but they chose to move on with the lawsuit (Humes, 2007; Lebo, 2008). This resulted in the school district having to pay \$1,000,000 in legal fees. The law firm actually billed the district nearly \$2,000,000 for the hours they had worked on this case. Every school board member was voted out of office and replaced (Strike, 2007). Cobb County, Georgia, was involved in a lawsuit over disclaimers in their textbooks which resulted in them losing \$166,000 in lawyer fees alone (Stickel, 2011). The judge ruled the disclaimers were illegal and ordered them removed from every textbook. The district had to pay \$30,000 to remove the stickers from the textbooks. The time lost for staff to prepare for the case was not calculated. These monies could have been better spent to buy lab equipment or computers for students. The Pareto analysis noted two of the most missed questions referred to the issue of using disclaimers. Administrators noted that they could make teachers read the disclaimers aloud to their classrooms. They also stated that disclaimers could be put in the textbooks in Georgia. The Cobb County case happened only 6 years ago and was in

the study areas' backyard. How could so many administrators miss this question? Litigation in an economic downturn could be devastating to a school district.

District Level Administrators

District level administrators need to ensure that the GPS are consistently and legally adhered to across the district. District administrators need to plan professional learning to update school level administrators' knowledge of the laws that govern the teaching of evolution. Curriculum directors need to apprise principals and lead science teachers that teaching creationism and ID is strictly forbidden by law. The training would include how to deal with parents who did not want their children to be exposed to the evolution standards and have a plan in place to administer across the district to resistant parents. The plan would have to be legally accurate to avoid litigation. District level administrators are usually responsible for the adoption and procurement of textbooks. They need to be aware that disclaimers in textbooks in Georgia are illegal regarding evolution and that teachers cannot read disclaimers about evolution to their students. Curriculum directors should ensure all learning resources adopted by the district conform to the GPS, and creationism and ID are not in the adopted texts.

School Level Administrators

Implications for school level administrators indicate that they need to be more aware of issues of church and state in their public schools. This may require the provision of additional training. The conservative Christian climate of many communities spills over into the school buildings and impacts the science curriculum. Nativity sets in the school foyer, staff wearing large crucifixes and shirts proclaiming they are running for God, ministers leading prayer at the

local football ballgames, or principals reading scripture and leading prayer at faculty meetings, are just a few examples the author has witnessed in the public schools of Georgia. This overt entanglement of religion in many of the schools perpetuates the status quo of things being taught or not taught as they have been in the past. Principals often feel the pressure of the community to maintain the status quo and silently cave to the wishes of parents and the clergy by turning their backs to teachers who break the law by teaching intelligent design or creationism in their classrooms. This study revealed that some administrators may be part of maintaining the status quo by encouraging both evolution and creation not realizing it is against the law. Yet other administrators know it is against the law and pretend they do not know that Ms. Jones is teaching about Adam and Eve in her science classroom. Religious pressures on administrators and teachers in the community denude the teaching of evolution in certain school districts.

Realistically, administrators cannot know every standard in every subject of the GPS. However it is critical they at least be familiar with the philosophical framework that provides structure and meaning to science. Administrators need professional development to become aware of the overarching standards in science and particularly ones that are controversial. This study revealed that administrators were lacking in basic scientific knowledge. Not only were administrators not knowledgeable about the laws that govern the teaching of evolution, but they were equally ignorant of the nature of science. The GPS require that the “habits of mind” and the “nature of science” be interwoven in all science courses. Scientific theory is one of those overarching standards that is imperative to the understanding of all the sciences. This study revealed that some administrators were ignorant of the difference in the term “scientific theory” and “theory” as it is used in the vernacular. The study also revealed that administrators could not provide any details about the main tenets of evolution, yet evolution is THE unifying concept in

biology and is crucial to the understanding of the life sciences. Because the administrators are the instructional leaders of their schools, they should be knowledgeable about the overarching concepts in the major disciplines especially when they are controversial such as life, sex education, and evolution.

Administrators need to have a solid plan with respect to the teaching of evolution in the classroom. The GPS are very clear on what is to be presented in the classroom. The courts have made it very clear that ID and creationism are not to be taught in public school classrooms. School level administrators need to ensure the GPS are being taught in science classrooms. Because the principal is the instructional leader of the school, it is imperative he/she is knowledgeable about the curriculum, especially on controversial topics. Districts that perform low on the evolution section of the Life Science CRCT or Biology EOCT need to examine the practice of teachers in their respective subject areas. This study revealed that many principals turned a blind eye or overtly allowed teachers to include ID or creationism in their science classrooms or skip teaching evolution all together. This practice could lead to lower test scores on these high stakes tests. Principals need to oversee teachers by doing focus walks during lessons on the evolution standards. Principal-facilitated discussions with the department head and science teachers make the expectations clear for the staff. This action would bolster teacher confidence in teaching evolution to their students without fear of not having administrative support. Principals purposely overlooking educators teaching creation and ID are putting the entire school district in jeopardy. It takes only one parent to call a lawyer to start a court case or a verbal battle in the community where no one is a winner and children suffer in the melee.

Colleges and Universities

This research justifies the need for colleges and universities with administrative school leadership programs to make a concerted effort to focus on including the laws that govern the teaching of evolution in public schools. Only 38% of the administrators noted they were exposed to the laws that govern the teaching of evolution in their administrative coursework. Their performance on the law portion of the survey further illustrated their need for increased content knowledge on the subject. Obviously colleges and universities have not prepared their administrators to understand the complexities of these issues that can lead to litigation. Knowledgeable administrators can implement preventative measures to diffuse litigation issues before they occur. Additionally, science methodology classes need to enlighten their teachers what can and cannot be taught in science classrooms. Dr. Moore's original survey would work well for higher education science methodology classrooms across the country as a pre-test/post-test activity regarding the teaching of evolution. Professors could offer titles of texts that would enhance a teacher's knowledge on the subject: *Not in our Classrooms: Why Intelligent Design is Wrong in our Schools*, by Eugenie Scott; *The Creation Controversy & The Science Classroom*, by James Skehan and Craig Nelson; *Evolution in Perspective: The Science Teacher's Compendium*, by Rodger Bybee; and *NSTA Tool Kit for Teaching Evolution*, by Judy E Jensen. Teachers who are knowledgeable about the laws should be more willing to take their concerns to their administrators. Unfortunately, sometimes the teacher has to educate the administrator.

Recommendations for Further Study

The following are recommendations for further research based on the results of this study:

1. The study needs to be replicated in other areas of Georgia or the South for comparison to determine the working knowledge of administrators concerning the laws governing the teaching of evolution.

2. The study should be replicated with science teachers in Georgia school districts to determine the working knowledge of the laws regarding the teaching of evolution of school practitioners who teach the topic of evolution.

3. A study should be replicated in school districts that employ a science supervisor whose job description is solely targeted at science supervision of teachers to determine if they are more knowledgeable about the laws governing the teaching of evolution.

4. A study should be conducted on what is being taught about evolution in colleges and universities by examining syllabi in education law classes and secondary science methods courses.

5. Professional development needs to be created for administrators on evolution and the law. This professional development needs to be studied to check for effectiveness. Once perfected, the professional development needs to be placed online by the state department of education to allow principals to enhance their knowledge of the subject statewide.

Summary

The research in this study provided insight concerning administrators' knowledge of the law and the Georgia Performance Standards in Northern Georgia regarding evolution, creationism, and ID. The research shed light on administrators' clinical experiences, perceptions, and personal thoughts about the teaching of the controversial subject area. Much has been written concerning creationism, ID, and evolution in American public schools.

However, studies primarily focused on the law, curriculum, teachers, and students. School administrators have not been part of the research even though they are the responsible agents for ensuring the curriculum delivered to students is in a proper, legal, and ethical manner. There is a definite gap in the literature regarding administrators and their knowledge of the laws that govern the teaching of evolution.

Administrators at the district and school levels have a myriad of responsibilities. They are problem solvers and often spend their time on areas that need immediate attention to survive the demands of their jobs. Administrators reported that evolution, creationism, and ID were not topics in their respective schools and districts that afforded their time and attention. In their administrative careers the topic was rarely an issue, with the exception of a few parents and students. These parents and students were shown the mandated science curriculum by the state, which included evolution, and this seemed to satisfy most parents. However, some parents were placated by offering alternative assignments to their children that allowed them to sidestep the evolution curriculum. These assignments often included ID and creationism, which are not allowed in public schools.

This research revealed that administrators are very ignorant of the laws on evolution at the school and district level. Their average exam scores were all failing, with the exception of district level science supervisors. District level administrators were more knowledgeable about the laws regarding evolution than were school principals. School level administrators were not concerned about the laws because the state of Georgia created the GPS and the curriculum had to be inherently sound and free from litigation as long as their teachers adhered to the curriculum. However, principals reported that they often knew their teachers were teaching both evolution and creationism. This was allowed by some because it was the expectation of the religious

community or principals did not know that teaching creationism was not an option in public schools.

Administrators were cognizant of the pressures placed on them by the religious communities they served. The clergy were often in the schools and at school activities yet they generally did not overtly interfere with the curriculum of the school. Principals had no problem with evolution being taught in their schools; however, a few had personal struggles with the curriculum but knew they had to keep their personal feelings separate from their jobs as public school educators. On a personal level, many principals indicated they wanted equal treatment of creation and evolution allowed in the science classroom. The separation of church and state is blurry in North Georgia regarding the teaching of evolution, creation, and ID in science classrooms. An unsolicited comment scribbled on one of the surveys indicated the feelings of one administrator: “If you are intelligent you know there is a creator. The Bible proves evolution is a THEORY.” This administrator’s charge is to ensure the separation of church and state in their building. One of the leading ethical theorists, Kenneth Strike, summarized why creationism and ID are problematic in public schools.

Creationism and intelligent design are religious ideas, not scientific ones. Their content is religious, and it is believed for reasons of theology and faith, not reasons of science. And creationism and intelligent design are partisan religious ideas. Many versions of Christianity, Judaism, and other faiths have come to terms with evolution. Some have even given it a theological import. And, of course, there are religions with very different creationist stories. Hence, for schools to give creationism or intelligent design the kind of authority in the biology classroom that is demanded by the equal status view is not only to give authority to a religious view in the classroom, but to take sides in a disagreement among religions. (Strike, 2007 p. 61)

The Pareto charts indicated that administrators thought that human evolution was part of the GPS. Human evolution is not part of the GPS and its omission from the standards afforded the state a grade of “C” for evolution in a recent national curriculum analysis. The Pareto

analysis indicated that principals thought creation and ID had been awarded scientific merit by the courts and the Supreme Court allowed the evidence against evolution to be taught to students. Administrators also believed that disclaimers against evolution could be placed in textbooks and read aloud to students. Administrators indicated they could purchase textbooks that covered ID or creationism and their teachers could teach out of these learning resources. All of these were incorrect assumptions made by principals. These incorrect assumptions were the most common misconceptions revealed in the Pareto analysis.

The qualitative and quantitative data clearly indicated that administrators lack knowledge of the laws regarding evolution. Professional development on the topic for administrators was nearly nonexistent and was not a topic discussed by superintendents or school boards. For administrators to become more knowledgeable about the laws governing the teaching of evolution, professional development on the topic needs to be made available for all school leaders. Georgia superintendents and school boards across the state gather annually at the summer conference and delegate assembly to discuss rules and regulations. A workshop is needed targeting the legality of the following: evolution disclaimers, adoption of textbooks free of creationism and ID, and of the teaching of evolution excluding ID and creationism. This study indicates that school districts in Northern Georgia are like ticking time bombs waiting for litigation to explode and costing their school districts hundreds of thousands of dollars their systems cannot afford to lose. It is ultimately the superintendant and school board that is responsible to ensure the separation of church and state. Curriculum directors and principals need professional development on the same topics with more focus on the clinical aspects of the legal teaching of evolution. The Georgia Association of Educational Leaders Legal Conference each spring would be the perfect venue for professional development on evolution issues.

Science department chairs would benefit from professional development on what can and cannot be discussed legally in the science classroom. The Georgia Science Teachers Association Convention would be the perfect venue for such professional workshops.

The study indicated that evolution as related to school law was a topic that was not covered in any detail in administrative courses at universities and colleges. University and college professors in education administration and science methods courses need to discuss what can and what cannot be taught in the science classroom regarding evolution, creation, and ID. Future administrators need more in-depth exposure to the laws that revolve around the teaching of evolution in the United States. Future science teacher leaders need to be apprised of the laws so they can advise their colleagues and their administrators of the laws that regulate what can or cannot be taught in their classrooms.

Administrators also lacked a clear understanding of evolution and the nature of science. There were misconceptions about the difference between scientific theory and theory used in everyday language. These areas need to be addressed in professional development at the district level.

Historically evolution litigation has ebbed and flowed in American public schools. The current evolution climate in Georgia is ebbing. The research in this study indicates that school leaders lack legal knowledge to make informed decisions regarding evolution issues. An impending tsunami awaits for an school board or administrator that wants to shake up the debate.

REFERENCES

- Aguillard, D. (1999). Evolution education in Louisiana public schools: A decade following Edwards v Aguillard. *The American Biology Teacher*, 61(3), 182-188.
- Aldridge, B. G. (Ed.). (1996). *Scope sequence and coordination: A framework for high school science education* (1st ed.). Arlington, VA: National Science Teachers Association.
- American Association for the Advancement of Science. (1989). *Project 2061: Science for all Americans* (ed.). Washington, DC: Author.
- American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. New York: Oxford University Press.
- American Civil Liberties Union. (2004). "Intelligent design" is religious argument, not science say parents. Retrieved January 14, 2005, from <http://www.aclu.org/ReligiousLiberty/religiousliberty.cfm?ID=17207&c=139&subsiteI>
- American Geological Institute. (2005). Evolution Debate in Georgia. Retrieved March 12, 2009, from <http://www.agiweb.org/gap/evolutioin/GA.html>
- Anderson, J., (2000). The revolution against evolution, or "well, Darwin, we're not in Kansas anymore." *Journal of Law and Education*, 29(3), 398-404.
- Anderson, R. D. (2004). *Religion and spirituality in the public school curriculum*. New York: Peter Lang.
- Applegate, D. (2001). Evolution grades for the states. *The Professional Geologist*, 38(5), 13-14.
- Armstrong, K. (2000). *The battle for God: A history of fundamentalism*. New York: Ballantine Books.
- Armstrong, P. H. (2007). *All things Darwin: An encyclopedia of Darwin's work*. Westport, CT: Greenwood Press.
- Ayala, F. J. (2000). Arguing for evolution. In R. W. Bybee (Ed.), *Evolution in perspective: The science teacher's compendium* (pp. 1-4). Arlington, VA: NSTA Press.
- Barlow, D. (2006, February). Dover schools' unintelligent design. *The Education Digest*, 64-68.

- Bateman, B. W. (2005, March 12). Bringing in the state? The life and times of laissez-faire in the nineteenth-century United States. In K. D. Hoover (Ed.), *History of economic thought workshop: The history of political economy* (pp. 175-199). Durham, NC: Duke University Press.
- Bateman, C. A. (2006). Evolution and creationism in science: 1880-2000 . *BioScience*, 56(2), 151-158.
- Beardsley, P. M. (2004). Middle school student learning in evolution: Are current standards achievable? *The American Biology Teacher*, 66(9), 604-612.
- Beckwith, F. J. (2003). *Law, Darwinism, and public education*. Lanham, MD: Rowman & Littlefield.
- Benton, M. (1991). *Rise of the mammals*. New York: Crescent Books.
- Berkman, M. B., Pacheco, J. S., & Plutzer, E. (2008). Evolution and creationism in America's classrooms: A national portrait. *PLoS Biology*, 6(5), 920-924.
- Berra, T. M. (1990). *Evolution and the myth of creationism*. Stanford, CA: Stanford University Press.
- Bleckmann, C. A. (2006). Evolution and creationism in science: 1880-2000. *Bioscience*, 56(2) 151-158.
- Boltwood, B. B. (1907). On the ultimate disintegration products of the radio-active elements. Part II. The disintegration products of uranium. *American Journal of Science*, 23, 77-88.
- Borenstein, J. (2008). Textbook stickers: A reasonable response to evolution? *Science and Education*, 17, 999-1010. (DOI 10.1007/s11191-006-9032-z)
- Braden, L., Finn, C. E., Lerner, L. S., Munroe, S., Raimi, M. J., & Saxe, D. W. (2000). *The state of the state standards* (Thomas Fordham Foundation). Washington: Fordham Foundation.
- Bridges, H. (2005). *House Bill 179*. Atlanta, Georgia: Georgia General Assembly.
- Brownfield, E. L. (2007). The first amendment implications of teaching the theory of evolution. *Journal of Land and Education*, 36(1), 141-148.
- Bybee, R. W. (2004). Introduction: Evolution in perspective. In R. W. Bybee (Ed.), *Evolution in perspective: The science teacher's compendium* (pp. xi-xvii). Arlington, VA: NSTA Press.
- Campbell, J. A., & Meyer, S. C. (Eds.). (2003). *Darwinism, design, and public education*. East Lansing, MI: Michigan State University Press.
- Cander, R. Y., & Monroe, J. (1989). *Historical geology evolution of the earth and life through time*. St. Paul, MN: West Publishing.

- Cavanaugh, S. (2005). Teachers torn over religion, evolution. *Education Week*, 1, 18.
- Ching, G. M. (1984). Creation in public schools. *Origins*, 11(2), 99-100.
- Chuang, H. C. (2003). Teaching evolution: Attitudes & strategies of educators in Utah. *American Biology Teacher*, 65, 669-674.
- C.N.N. (2004). *Carter slams Georgia's evolution proposal*. January 30, 2004.
- Cooper, J., Miller, R., & Patterson, J. (1990). *A trip through time: Principles of historical geology* (2nd ed.). Columbus, OH: Merrill Publishing.
- Creswell, J. W. (1998). *Qualitative inquiry and research design*. Thousand Oaks, CA: Sage Publications.
- Cretzinger, J. I. (1941). An analysis of principle or generalities appearing in biological textbooks used in the secondary schools of the United States from 1800 to 1933. *Science Education*, 25, 310-313.
- Cruver, T. C. (2000). *You be the judge*. Dayton, TN: The College Press.
- Curtis, W. C. (1918). The value of service of zoological science. *Science*, 47(1224), 571-579.
- Dayton, D. W. (1995). Creationism in twentieth-century America. *Journal of Religion and Science*, 32(1), 105-113.
- Dean, C. (2005, February 1). Evolution takes a backseat in U.S. classes. *The New York Times*, p. Science section.
- Dembski, W. (1999). *Intelligent design: The bridge between science and theology*. Dowers Grove, IL: InterVarsity Press.
- Dobzhansky, T. (1965). Mendelism, Darwinism, and evolutionism. *American Philosophical Society*, 109(4), 205-215.
- Dobzhansky, T. (1973). Nothing in biology makes sense except in the light of evolution. *The American Biology Teacher*, 35(3), 125-129.
- Dobzhansky, T. G. (1937). *Genetics and the origin of species*. New York: Columbia University Press.
- Duncan, A. (2009, March). *Keynote address*. Paper presented at the National Science Teachers Association Convention, New Orleans, LA.
- Dunn, L. C. (1965). Mendel, his work and his place in history. *Proceedings of the American Philosophical Society*, 109, 189-198.
- Edwards v. Aguillard, 482 U.S. 578 55 (1987).

- Edwards, R. (1981). News briefs from the editor. *Creation/Evolution*, 2(6), 48.
- Ellis, W. E. (1983). Biology teachers and border state beliefs. *Society*, 20, 26-30.
- Epperson v. Arkansas, 393 U.S. 97 (1968).
- Evolution controversy. (2004-2010). In L. D. Stephens (Ed.), *The new Georgia encyclopedia*. Retrieved May 10, 2010, from <http://www.georgiaencyclopedia.org>
- Forrest, B., & Branch, G. (2005). Wedging creationism into the academy. *Academe*, 24-31.
- Freiler et. al. v. Tangipahoa Parrish Board of Education et. al., 185 F. 3rd 337 (5th Cir. 1999).
- Georgia Department of Education. (2005). *Georgia science standards, grades 7-12*. Retrieved from <http://www.georgiastandards.org>
- Georgia Science Teachers Association (2004). *Position Statement on the Teaching of Evolution*. Retrieved March 14, 2010, from <http://www.georgiascienceteacher.org/position.htm>
- Gingrich, N. (2005). The official homepage of the speaker Newt Gingrich a speech titled “math and science technology: the key to the 21st century”. Retrieved March 25, 2005, from <http://Newt.org>
- Gingrich, N. (2009). *A tripartisan plan for education reform*. Retrieved August 23, 2009, from <http://Newt.org/tabid/193/articleTYPE/ArticleView/ArticleId/4480/A-Tripartisan-Plan-For-E>
- Glass, B. (1967). The centrality of evolution and biology teaching. *The American Biology Teacher*, 29(9), 705-715.
- Grabiner, J. V., & Miller, P. D. (1974). Effects of the Scopes trial. *Science*, 185, 832-838.
- Gregg, T., Jassen, G., & Bhattacharjee, J. (2003). A teaching guide to evolution. *The Science Teacher*, 70(8), 24-31.
- Gross, P. R., Goodenough, E., Haack, S., Lerner, L., Schwartz, M., & Schwartz, R. (2005). *The state of state science standards* (Thomas B. Fordham Institute). Washington, D.C.: Fordham Foundation.
- Gunn, A. M. (2004). *Evolution and creationism in the public schools*. Jefferson, NC: McFarland & Company.
- Hessler, F. (2000). Two “e” words: Ecology and evolution. *MnSTA*, 37(6).
- Holden, C. (1988). Japanese views on science compared to US attitudes. *Science*, 240, 277.
- Howard Hughes Medical Institute (Producer). (2006). *Evolution: Fossils, genes, and mousetraps* [Motion picture]. (Available from Biointeractive, 4000 Jones Bridge Road, Chevy Chase, MD 20815-6789).

- Hudgins, H. C., & Vacca, R. S. (1995). *Law and education: Contemporary issues and court decisions* (4 ed.). Charlottesville, VA: MICHIE Law Publishers.
- Hull, D. L. (2002). History of evolutionary thought. In M. Pagel (Series Ed.) & (Vol. Ed.): *Vol. 1*, (ed., pp. E-7-E-17). Oxford: Oxford University Press.
- Humes, E. (2007). *Monkey girl: Evolution, education, religion, and the battle for America's soul*. New York: HarperCollins Publishers.
- International Association for the Evaluation of Educational Achievement. (1988). *Science achievement in seventeen countries: A preliminary report*. Oxford: Pergamon Press.
- Israel, C. A. (2004). *Before Scopes: evangelicalism, education, and evolution in Tennessee, 1870-1925*. Athens, GA: The University of Georgia Press.
- Jurinski, J. J. (2004). *Religion on trial*. Santa Barbara, CA: ABC-CLIO.
- Kelley, P. H., Bryan, J. R., & Hansen, T. A. (1999). *The evolution/creation controversy II: Perspectives on science, religion, and geological education* (The Paleontological Society). London: The Paleontological Society.
- King, M. C., & Watson, A. C. (1975). Evolution at two levels in humans and chimpanzees. *Science*, 188, 107-116.
- King, M. L. (1963). *A tough mind and a tender heart: Strength to love*. Boston: Howard Gotlieb Archival Research Center.
- Kitzmiller, et. al. v. Dover Area School District, et. al., 400 F. Supp. 2d 707 (M.D. PA 2005).
- Kraemer, K. A. (1995). *A comparative study of Minnesota teachers' attitudes toward the teaching of evolution and creationism. Master's thesis*. Bemidji State University, Bemidji, MN.
- Laba, E. R., & Gross, E. W. (1950). Evolution slighted in high-school biology. *The Clearing House*, 24, 396-399.
- Ladouceur, R. (2009). The evolution of textbooks: 1930s edition. *Textbook history*, 79-83. Retrieved from <http://www.textbookhistory.com/?p=79>
- Lapidus, D. (1987). *The facts on file: The dictionary of geology and geophysics*. New York: Facts on File Publications.
- Larson, E. J. (1997). *Summer for the gods: The Scope's trial and America's continuing debate over science and religion*. New York: Oxford University Press.
- Larson, E. J. (2003). *Trial and error: The American controversy over evolution and creationism* (3rd ed.). New York: Oxford University Press.

- Larson, E. J. (2004). *Evolution: The remarkable history of a scientific theory*. New York: The Modern Library.
- Lebo, L. (2008). *The devil in Dover: An insider's story of dogma v Darwin in small-town America*. New York: The New Press.
- Lemon v. Kurtzman, 403 U.S. 602 (1971).
- Lerner, L. (2000). *Good science, bad science: Teaching evolution in the states* (Thomas Fordham Foundation). Washington, D.C.: Fordham Foundation.
- Levine, J., & Miller, K. R. (2009). *Biology* (Georgia ed.). Boston: Pearson Education.
- Livingstone, D. N. (1987). *Darwin's forgotten defenders: The encounter between evangelical theology and evolutionary thought*. Grand Rapids, MI: William B. Eerdsman.
- Livingstone, D. N. (1992). The preadamite theory and the marriage of science and religion. *American Philosophical Society*, 82(3), 1-78.
- Lovgren, S. (2005). Chimps, humans 96 percent the same, gene study finds. *National Geographic News*. Retrieved from <http://news.nationalgeographic.com/news/pf87202973.html>
- Macon Telegraph. (2004, January 31). "Evolution: Should stay in Georgia students' curriculum. Retrieved, July 2, 2005. from Macontelegraph.com
- Maldonado-Rivera, J. G. (1998). An examination of the factors affecting the teaching and learning of evolution (Doctoral dissertation, Columbia University, 1998). *Dissertations Abstracts International*, 59, 1-393.
- Martin, M. (2005). State of Arkansas 85th general assembly regular session intelligent design house bill. March 10.
- Marzilli, A. (2004). *Religion in public schools*. Philadelphia, PA: Chelsea House Publishers.
- Mc Donald, M. (2004a, February 6). Evolution back in teaching plan. *Atlanta Journal-Constitution*, p. A12.
- Mc Donald, M. (2004b, February 2). Evolution comments irk scientists. *Atlanta Journal Constitution*, p. 14.
- McLean v. Arkansas Board of Education, 529 F. Supp. 1255 50 (U.S. Law Week 1982).
- Mead, L. S. (2009). Why science standards are important to a strong science curriculum and how states measure up. *Springer Science & Business Media*, doi:10.1007/s12052-009-0155-y.
- Mead, L. S., & Mates, A. (2009). Why science standards are important to a strong science curriculum and how states measure up. *Evolution Education Outreach*, 2, 359-371.

- Miller, J. D., Scott, E. C., & Okamoto, S. (2006). Public acceptance of evolution. *Science*, 313(5788), 765-766.
- Milner, R. (1990). *The encyclopedia of evolution: Humanity's search for its origins*. New York: Facts on File.
- Mindel, D. P. (2009). Evolution in the everyday world. *Scientific American*, 300(1), 92-99.
- Moody, D. (1900). *Moody's latest sermons*. Chicago: The Bible Institute Colportage Association.
- Moore, J. A. (2002). *From Genesis to genetics: The case of evolution and creationism*. Berkeley: University of California Press.
- Moore, R. (2000). The revival of creationism in the United States. *Journal of Biological Education*, 35(1), 17-21.
- Moore, R. (2002a). *Evolution in the courtroom a reference guide*. Santa Barbara: ABC-CLIO, Inc.
- Moore, R. (2002b). The sad status of evolution education in American schools. *The Linnean*, 18, 26-34.
- Moore, R. (2002c). Teaching evolution: o state standards matter? *Bioscience*, 52(4), 378-381.
- Moore, R. (2004a). How well do biology teachers understand the legal issues associated with the teaching of evolution? *BioScience*, 54(9), 860-865.
- Moore, R. (2004b). Minnesota state standards and evolution. *The Science Teacher*, 71(6), 41-44.
- Moore, R. (2005). Nature, vanity, and the teaching of evolution. *Journal of College Science Teaching*, 34(4), 8-11.
- Moore, R. (2007). What are students taught about evolution? *McGill Journal of Education*, 42 No. 2, 177-188.
- Moore, R. (2009). *Teaching evolution: Do the state science standards matter?* Washington, DC: National Center for Science Education.
- Moore, R., & Cotner, S., (2009). Educational malpractice: The impact of including creationism in high school biology courses. *Evolution Education Outreach*, 2, 95-100. (DOI 10.1007/s12052-008-0097-9)
- Moore, R., & Decker, M. D. (2008). *More than Darwin: An encyclopedia of the people and places of the evolution-creationism controversy*. West Port, CT: Greenwood Press.
- Moore, R., Jensen, M., & Hatch, J. (2003). Twenty questions: What have the courts said about the teaching of evolution and creationism in public schools. *Bioscience*, 53(8), 766-761.

- Moore, R., & Kraemer, K. (2005). The teaching of evolution and creationism in Minnesota. *The American Biology Teacher*, 67(8), 457-466.
- Moore, R., & Miksch, K. (2003). Evolution, creationism, and the courts. *Science Education Review*, 2(1)5, 1-15.
- Moustakas, C. (1994). *Phenomenological research methods*. Thousand Oaks, CA: Sage Publications.
- Mullis, I. V., & Jenkins, L. V. (1988). *The science report card: Elements of risk and recovery. Trends and achievement based on the 1986 national assessment*. Princeton, NJ: Office of Educational Research Improvement.
- National Academy of Sciences (Producer). (2009, April 27). Remarks by the President at the National Academy Of Scientists Annual Meeting [Show]. Podcast retrieved from <http://www.sciencedebate2008.com/www/index.php?id=65>
- National Academy of Sciences. (1998). *Teaching about evolution and the nature of science* (ed.). Washington, DC: National Academy Press.
- National Academy of Sciences. (1999). *Science and creationism: A view from the National Academy of Sciences*. Washington, DC: National Academy Press.
- National Academy of Sciences Institute of Medicine. (2008). *Science, evolution, and creationism*. Washington, DC: National Academy Press.
- National Association of Biology Teachers. (1997). Position statement on the teaching of evolution. *NABT News and Views*, June, 4-5.
- National Association of Biology Teachers. (2003). *NABT statement on teaching evolution*. Retrieved March 20, 2010, from http://www.nabt.org/sub/position_statements/evolution.asp
- National Association of Biology Teachers. (2008). *NABT statement on teaching evolution* [Press release]. Retrieved from <http://www.nabt.org/websites/institution/index.php?p=92>
- National Center for Science Education. (2003, Sept 11). School board won't require teaching arguments against evolution. Retrieved from <http://www.ncseweb.org/resources/news/2004/CA/188>
- National Center for Science Education. (2004, December 9). Anti-evolution legislation stirring. Retrieved from <http://www.ncseweb.org/resources/news/2004/MO/104>
- National Center for Science Education. (2005, April 26). Texa Bill would open the door to creationism, says sponsor. Retrieved from <http://ncse.com/news/2005/04/TX-Bill-would-open-door-to-creationism-says-sponsor-00693>

- National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform* (U.S. Department of Education). Washington, DC: U.S. Department of Education.
- National Research Council. (1985). *Mathematics, science, and technology education: A research agenda*. Washington, DC: National Academy Press.
- National Research Council. (1995). *National science education standards*. Washington, DC: National Academies Press.
- National Science Board. (1989). *Science and engineering indicators*. Washington, DC: U.S. Government Printing Office.
- National Science Teachers Association. (July, 2003). *NSTA position statement: The teaching of evolution*. Retrieved March 27, 2010, from <http://www.nsta.org/about/positions/evolution.aspx>
- Nelson, C., & Skehan, J. (2000). *The creation controversy and the science classroom*. Arlington, VA: NSTA Press.
- Newport, F. (2007). Majority of Republicans doubt the theory of evolution. *Gallup News Service*. Retrieved June 11, 2007. Retrieved from <http://www.gallup.com/poll/27847/Majority-Republicans-Doubt-Theory-Evolution.aspx>
- Newport, F. (2009). *On Darwin's birthday, only 4 in 10 believe in evolution*. Retrieved May 1, 2010, from <http://www.gallup.com/poll/114544/Darwin-Birthday-Evolution.aspx>
- Newport, F. (2010). Four in 10 Americans believe in strict creationism. Retrieved February 15, 2011, from <http://www.gallup.com/poll/145286/Four-Americans-Believe-Strict-Creationism.aspx?vers>
- Nickels, M. (1987). Human evolution: A challenge for biology teachers. *The American Biology Teacher*, 49(3), 143-148.
- Nowak, M. A. (Speaker). (2004). *Evolutionary dynamics* [podcast]. Cambridge, MA: Presidents and Fellows of Harvard College.
- Numbers, R. L. (1992). *Creationists: The evolution of scientific creationism*. Berkley: Alfred A. Knopf.
- Numbers, R. L. (1998). *Darwinism comes to America*. Cambridge, MA: Harvard University Press.
- Obama, B., & McCain, J. (2008). *Science debate 2008* [White paper]. Retrieved from <http://www.sciencedebate2008.com/www/index.php>
- Orr, A. H. (2009). Testing natural selection. *Scientific American*, 300(1), 44-50.

- O'Dell, L. (2007). Anti-evolution movement. In (Ed.), *Encyclopedia of Oklahoma history and culture*. Retrieved July 15, 2010, from <http://digital.library.okstate.edu/encyclopedia>
- Patterson, A. (1903). *The other side of evolution*. Chicago: The Winona Publishing Company.
- Patterson, C. C. (1956). Age of meteorites and the earth. *Geochimica et Cosmochimica Acta*, 10, 230-237.
- Patterson, R. (2006). *Evolution exposed*. Hebron, KY: Answers in Genesis.
- Paul, D. B. (2002). Darwinism, social Darwinism and eugenics. In J. Hodge & G. Radick (Eds.), *The Cambridge companion to Darwin*. Cambridge, MA: Cambridge University Press.
- Pelozo v. Capistrano Unified School District, 37 F.3d 517 (9th Cir. 1994).
- Pennock, R. T. (2001). *Intelligent design creationism and its critics: Philosophical, theological, and scientific perspectives*. Ambridge, MA: MIT Press.
- Perakh, M. (2004). *Unintelligent design*. Amherst, NY: Prometheus Books.
- Petto, A. J., & Godfrey, L. R. (2007). *Scientist confront intelligent design and creationism*. New York: W.W. Norton.
- Potter, C. (2004). *Comparing the acceptance of evolutionary theory and possible influencing factors in two groups of Georgia biology educators*. Unpublished masters thesis, University of Georgia, Athens, GA.
- Potter, R. L. (2007). A legal analysis of the legitimate pedagogical interest of teaching alternatives to evolution in public schools (Doctoral dissertation, Pennsylvania State University, 2007). *Dissertations Abstracts International*, 1-190.
- Reh, J. F. (2011). Pareto's principal--The 80-20 rule. Retrieved from [http://management.about.com/cs/generalmanagement/a/Parento\)81202.htm](http://management.about.com/cs/generalmanagement/a/Parento)81202.htm)
- Reynolds, J. C. (1976). American textbooks: The first 200 years. *Educational Leadership*, 33, 274-276.
- Riddle, O. (1941). Preliminary impressions and facts from a questionnaire on secondary school biology. *The American Biology Teacher*, 3(5), 151-159.

- Riddle, O., Fitzpatrick, F. L., Glass, H. B., Gruenberg, B. C., Miller, D. F., & Sinnott, E. W. (1942). The teaching of biology in secondary schools of the United States: A report of results from a questionnaire. *Union of American Biological Societies, Committee on Teaching Biology*.
- Robinson, B. A. (2005). Recent evolution/creation science conflicts in US schools. Retrieved May 7, 2006, From Religioustolerance.org
- Rubin, H. J., & Rubin, I. S. (2005). *Qualitative interviewing: The art of hearing data*. Thousand Oaks, CA: Sage Publications.
- Rutherford, F. (1993). *Benchmarks for science literacy*. Oxford: Oxford University Press.
- Rutledge, M. L., & Warden, M. A. (2000). Evolutionary theory, the nature of science & high school biology teachers: critical relationships. *American Biology Teacher*, 62, 23-31.
- Rudolph, J. L. (2002). *Scientists in the classroom: The cold war reconstruction of American science education* (ed.). New York: Palgrave.
- Ruse, M. (Ed.). (1996). *But is it science? The philosophical question in the creation/evolution controversy*. Amherst, NY: Prometheus Books.
- Ruse, M. (2002). *The evolution wars a guide to the debates*. New Brunswick, NJ: Rutgers University Press.
- Rutledge, M. L., & Mitchell, M. A. (2002). High school biology teachers' knowledge structure, acceptance, and teaching of evolution. *The American Biology Teacher*, 64(1), 21-28.
- Rutledge, M., & Warden, M. (1999). The development and validation of the measure of acceptance of the theory of evolution instrument. *School Science and Mathematics*, 99(1), 13-18.
- Scott, E. C. (1999). Problem concepts in evolution: cause, purpose, design, and chance. *Paleontological Society Papers*, 5, 169-181.
- Scott, E. C. (2004). *Evolution vs. creationism and introduction* (1st ed.). Berkley, California: University of California Press.
- Scott, E. C. (2009a). Science standards evolve. *Evolution Education Outreach*, 2, 538-540.
- Scott, E. C. (2009b). The latest face of creationism. *Scientific American*, 300(1), 92-99.
- Scott, E. C., & Branch, G. (2006). *Not in our classrooms: Why intelligent design is wrong for our schools* (ed.). Boston, MA: Beacon Press.
- Segraves v. State of California, 278978 CA (Sacramento Superior Court 1981).
- Selman v. Cobb County School District, 390 F. Supp. 2d 286,1313 (N.D.GA 2005).

- Shankar, G., & Skoog, G. D. (1993). Emphasis given evolution and creationism by Texas high school biology teachers. *Science Education*, 77(2), 221-223.
- Shaver, C. (2003). The debate over the teaching of evolution in public schools. *Journal of Law and Education*, 32(3), 399-404.
- Shermer, M. (2006, October). Darwin on the right. *Scientific American*, 38.
- Simpson, G. G. (1961). One hundred years without Darwin are enough. *Teachers College Record*, 60, 617-626.
- Skoog, G., & Bilica, K. (2002). The emphasis given to evolution in state science standards: A lever for change in evolution education. *Science Education*, 86, 445-462.
- Slevin, P. (2006, March 14). Battle on teaching evolution sharpens. Washington Post. Retrieved from http://MSL1.MIT.edu/FURDLOG/DOCS?Washpost/2005-03-15_washpost_know_nothings.pdf
- State v. Scopes, Scopes v. State, 152 TN 424,278 (S.W.-57(Tenn.) 1926).
- Staver, J. (2003). Evolution and intelligent design. *The Science Teacher*, 70(8), 32-35.
- Stephens, L. D. (1994). Darwin's disciple in Georgia: Henry Clay White, 1875-1927. *Georgia Historical Quarterly*, 78, 66-91.
- Stephens, L. D. (2000). Southern spokesman for modern biology: John P. Campbell of the University of Georgia 1888 -1918. *Georgia Journal of Science*, 58(4), 183.
- Stickel, G. (2005, August). *Evolution in the Georgia performance standards*. Paper presented at the Georgia Science Supervisors Association Fall Meeting, Marietta, GA.
- Strauss, J. M. (2008). Preservice teachers: Future first responders in the evolution versus intelligent design battle (Doctoral dissertation, Claremont Graduate University, 2008). *Dissertations Abstracts International*, 3318541, 1-270.
- Strike, K. A. (2007). *Ethical leadership in schools: Creating community in an environment of accountability*. Thousand Oakes, CA: Corwin Press.
- Tatina, R. (1989). South Dakota high school biology teachers and the teaching of evolution and creationism. *American Biology Teacher*, 51(5), 419-427.
- Taubenberger, J. K., Krafft, A. H., & Bijwaard, K. E. (1997). Initial genetic characterization of the 1918 "Spanish" influenza virus. *Science*, 275, 1793-1796.
- Thomas, R. M. (2006). *Religion in schools*. Westport, CT: Praeger Publishers.
- Trani, R. (2004). I won't teach evolution; it's against my religion. And now for the rest of the story..... *The American Biology Teacher*, 66(6), 419-427.

- Tucker, C. (2005, January 27). Until we grasp science, the future will elude us. *Atlanta Journal Constitution*, p. A14.
- Van Wyhe, J. (2006). *Charles Darwin: Gentleman naturalist: A biographical sketch*. Retrieved March 30, 2010, from <http://www.darwin-online.org.uk/darwin.html>
- Wade, N. (1972). Creationists and evolutionists: confrontation in California. *Science*, 178, 724-729.
- Wade, N. (2010, May 20). Researchers say they have created a synthetic cell. *The New York Times*, p. A17.
- Wallis, C. (2005, August 15.). The evolution wars. *Time*, 26-35.
- Webster v. New Lennox School District #122, 917 F.2d 1004 (7th Cir. 1990).
- Weld, J., & McNew, J. C. (1999) *Attitudes toward evolution*. *The Science Teacher*, 66(9), 27-31.
- Wells, J. (2006). *The politically incorrect guide to Darwinism and intelligent design*. Washington DC: Regnery Publishing.
- Wendel, P. J. (2006, October). *A history of teaching evolution in U.S. Schools: Insights from teacher surveys and textbook reviews*. Paper presented at the MidWestern Educational Research Association, Columbus, OH.
- White, A. D. (1896). *A history of the warfare of science with theology and Christendom*. New York: D. Appleton and Company.
- Wicander, R., & Monroe, J. S. (1989). *Historical geology evolution of the earth and life through time*. St. Paul, MN: West Publishing Company.
- Wiles, J. R., & Branch, G. (2008). Teachers who won't, don't, or can't teach evolution properly: A burning issue. *The American Biology Teacher*, 70(1), 6-7.
- Winerip, M. (2006, June 28). Evolutions lonely battle in a Georgia classroom. *The New York Times*. Retrieved from <http://query.nytimes.com/gst/fullpage.html?res=9504E3D81730F93BA15755COA9609C8B63>
- Winslow, M. W. (2008). *Evolution and personal religious beliefs: Christian biology-related majors' search for reconciliation at a Christian University* (Doctoral dissertation, Kansas State University, 2008). *Dissertations Abstracts International*, 1-14.
- Wylie, C. (2003). *Reflection on the difficulties of teaching evolution in high school biology* (Doctoral dissertation, University of Georgia, 2003). *Dissertations Abstracts International*, 1-110.
- Zimmerman, M. (1987). The evolution creation controversy: Opinions of Ohio high school biology teachers. *Ohio Journal of Science*, 87(4), 115-125.

APPENDIX A

DEMOGRAPHIC CHART OF SCHOOL DISTRICTS IN THE STUDY

North Georgia Systems Included in the Quantitative Survey

Student Population Categories: Top Tier (39,000-13,000), Middle Tier (10,533-4,171) and Lowest Tier (4,004-1,128)

	System	Student Population	Land Area	Percent Free and Reduced Lunch	Number of Surveys	% Asian	% Black	% Hispanic	% Native American	% White	% Multi-racial	% Students with Disabilities	Percent English Language Learners
1	Banks County	2,871	234	60	6	2	3	6	0	89	1	15	3
2	Bartow County	14,271	459	56	28	1	9	9	0	80	2	12	5
3	Bremen City	1,962		26	5	1	7	1	0	89	3	12	0
4	Calhoun City	3,233		53	6	2	8	30	0	58	1	10	11
5	Cartersville City	3,891		52	7	1	22	15	0	56	5	8	10
6	Catoosa County	10,533	162	48	22	2	3	3	0	91	2	14	1
7	Chattooga County	2,732	313	77	6	0	10	5	0	80	4	14	1
8	Cherokee County	37,796	424	28	51	2	7	13	0	76	3	11	4
9	Chickamauga City	1,336		23	5	0	0	0	0	98	1	7	0
10	Dade County	2,348	174	53	5	0	0	1	0	96	1	14	0
11	Dalton City	6,537		75	8	2	5	66	0	23	3	7	24
12	Dawson County	3,449	211	43	11	1	0	5	0	93	1	11	2
13	Fannin County	3,080	386	59	9	0	0	2	0	93	3	12	1
14	Floyd County	10,028	513	54	25	1	6	8	0	82	3	15	3
15	Franklin County	3,735	263	56	9	0	10	5	0	82	2	10	2
16	Gainsville City	6,296		77	8	3	19	55	0	20	2	8	31
17	Gilmer County	4,171	427	65	10	0	0	18	0	80	1	9	10
18	Gordon County	6,510	356	60	13	1	2	13	1	82	2	11	6
19	Habersham County	6,795	278	56	13	3	2	23	0	69	2	14	9
20	Haralson County	3,617	282	59	7	0	3	1	0	92	3	16	1
21	Hall County	25,658	394	57	42	2	5	36	0	55	2	10	20
22	Hart County	3,383	232	58	9	1	25	5	1	66	3	9	2
23	Lumpkin County	3,834	284	53	7	0	1	0	0	96	1	12	3

24	Murray County	7,393	344	71	12	0	0	19	1	77	2	8	8
25	Paulding County	28,316	419	37	51	1	20	7	0	68	4	9	2
26	Pickens County	4,462	232	50	10	1	1	4	0	93	2	10	1
27	Polk County	7,286	311	62	12	1	15	15	0	66	3	14	7
28	Rabun County	2,301	371	63	5	0	1	13	0	85	1	11	6
29	Rome City	5,457		72	10	2	36	25	0	31	6	10	12
30	Stephens County	4,004	179	56	9	1	14	3	0	78	3	13	1
31	Towns County	1,128	167	54	4	1	0	2	0	97	1	9	1
32	Trion City	1,334		35	5	1	1	9	0	89	1	9	4
33	Union County	2,584	323	59	6	1	0	4	1	93	1	12	2
34	Walker County	9,073	447	68	21	0	5	2	0	89	3	14	1
35	White County	3,851	242	54	8	1	1	4	0	90	4	12	2
36	Whitfield County	13,188	290	66	26	1	2	37	1	57	3	9	17
Tot		258,443	8,717		491								
GA		1,625,745	57,906	49		3	37	11	0	45	3	10	6
%	Study Area	15.9%	15.1%										

Source: Georgia Department of Education (2009-2010 Report Card) Governor's Office of Student Achievement

APPENDIX B

SURVEY COVER LETTER AND QUANTITATIVE SURVEY INSTRUMENT

Fellow Administrator,

My name is Gregory Bailey and I am the Director of Teaching and Learning for the Whitfield County School District in Dalton, Georgia. I am working on my doctorate degree from the University of Alabama under the supervision of Dr Natalie Adams, professor of Instructional Leadership and Social Foundations of Education and the Assistant Dean of the Graduate School at the University of Alabama. My dissertation research focuses on administrators' understandings about the teaching of evolution in Georgia public schools. Interestingly many studies have reviewed teachers' and students' thoughts on the subject of evolution, but there have been NO studies that explore the challenges administrators face regarding the teaching of evolution in their respective buildings and school districts.

The reason I am writing you is to ask you to take a few minutes to complete a survey for my dissertation research and return it to me in the stamped envelope provided.

Over 500 surveys will be sent to administrators in Northern Georgia. Historically surveys on evolution have low response rates; thus, I am asking (or begging) you to please help me with this research. As a fellow administrator, I understand the importance of maintaining your confidentiality and privacy on this sensitive topic. Only Dr. Adams and I will have access to the completed surveys. No administrator or individual school district will be identified by the survey instrument or written in the final research document.

I am hoping the administrators of Northern Georgia will have the courage to take part in the survey in an effort to better understand clinical experiences and knowledge on the topic of evolution from the eyes of principals and central office staff.

I am humbly requesting that you return the survey in two weeks from the date you receive the instrument. If you have questions regarding the survey, you may contact Gregory Bailey at 706-537-9289 or email at gbailey@whitfield.k12.ga.us I am not being paid or expect to profit from the study. I am personally paying for the postage. The survey should take approximately 20 minutes to complete.

Taking part in this survey is strictly voluntary. The University of Alabama Instructional Review Board is the committee that protects the rights of people in research studies. The IRB may review study records from time to time to be sure that people in research studies are being treated fairly and the study is being carried out as planned. If you have questions about your rights as a person in a research study, call Ms. Tanta Myles, the Research Compliance Officer of the University, at 205-348-8461 or 1-877-820-3066. There are no foreseen risks associated with this study.

Gregory Bailey
Director of Teaching and Learning
Whitfield County Schools
706-537-9289

QUESTIONNAIRE ON ADMINISTRATOR PERCEPTIONS, LEGAL ISSUES,
PROFESSIONAL DEVELOPMENT AND CURRICULUM CONCERNING
CREATIONISM, INTELLIGENT DESIGN AND EVOLUTION IN THE PUBLIC
SCHOOLS OF NORTH GEORGIA

Please check area(s) that apply

1.	My current role is best described as...
	Assistant Principal at a middle school
	Assistant Principal at a high school
	Principal of a Middle School
	Principal of a High School
	District Level Science Administrator
	District Level Administrator
2.	“Check” the following subject areas taught and “X” area of your content strength .
	Elementary Education
	Fine Arts
	Foreign Language
	Guidance
	Language Arts
	Math
	Physical Education and Health
	Science
	Social Studies
	Special Education
	Vocational
	Other
3.	My school would be best characterized as...
	Urban
	Rural
	Suburban
4.	I am...
	Female
	Male
5.	I have been an educator for _____ years?
	1-6
	7-13
	14-20
	21-27
	28 or more
6.	I have been an administrator for _____ years?
	0-4
	5-10
	11-15
	16-20
	21 or more
7.	My undergraduate degree is from?
	A religious affiliated college or university

	A private non-religious college or university
	A public college
	A public university
8.	I have received professional development regarding controversial issues about teaching evolution.
	Yes
	No
9.	I received instruction in my administrative course work about the laws regarding the teaching of evolution.
	Yes
	No
10.	Which of the following best describes your religious affiliation?
	Non- religious affiliated
	Agnostic
	Catholic
	Protestant
	Jewish
	Other
11.	My political ideology is best described as...
	Far Left
	Liberal
	Middle of the road
	Conservative
	Far Right
12.	In my administrative career, I can think of ____ times parents have called me with concerns regarding their students being taught evolution in science classrooms.
	0-5
	6-10
	11-20
	21 or more
13.	In my administrative career, I can think of ____ times teachers have voiced their fears/concerns regarding the teaching of evolution.
	0-5
	6-10
	11-20
	21 or more
14.	My personal religious views do not conflict with my understanding of the theory of evolution.
	Agree with above statement
	Disagree with the above statement

(Please respond by placing an “X” in the appropriate box)

	Question (15-22 about Georgia)	Strongly Agree	Agree	Don’t Know	Disagree	Strongly Disagree
15.	The 7th Grade Georgia Life Science Performance Standards ask students to examine evolution through various tasks and actually uses the word evolution in the standards.					
16.	The 7th Grade Georgia Life Science Performance Standards ask students to describe ways in which species on earth have evolved due to natural selection.					
17.	The 7th Grade Georgia Life Science Performance Standards have students learn about Darwin’s theories in particular.					
18.	The High School Biology Georgia Performance Standards have students examine evolution through various tasks and actually use the word evolution in the standards.					
19.	The High School Biology Georgia Performance Standards have students study human evolution.					
20.	The High School Biology Georgia Performance Standards have students trace the history of the theory of evolution.					
21.	The High School Biology Georgia Performance Standards have students explain how fossils are used as evidence of evolution.					
22.	Georgia school districts can place disclaimers in biology text books informing students that evolution is “just a theory”.					
	Question (Law Questions)	Strongly Agree	Agree	Don’t Know	Disagree	Strongly Disagree
23.	Districts can adopt textbooks that teach intelligent design.					
24.	Science teachers who teach evolution MUST give equal time to creationism.					

25.	Science teachers who teach evolution have the option to include instruction on creationism.					
26.	A teacher in any state can be convicted of a crime for teaching human evolution.					
27.	Students and their parents can claim that evolution offends and is incompatible with their religious beliefs. Teachers must modify their teaching to accommodate the students' rights to religious freedom.					
28.	The government can use tax money to support the teaching of evolution.					
29.	If the school uses tax money to purchase science textbooks that feature evolution, it must also provide funds to support textbooks that feature creationism.					
30.	If the government uses tax money to produce public exhibits that support evolution, it must also provide funds to produce exhibits that support creationism.					
31.	The First Amendment Right to Free Speech entitles teachers to teach creationism in science classes.					
32.	A district court determined that creationism has no scientific merit.					
	Please Turn Page and Finish Survey					
		Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
33.	Students, their parents, school administrators, and other local residents all want a teacher to teach evolution and creationism in her science class. These are the people whose taxes pay the teacher's salary and support the local school. If these people want the teacher to teach evolution and creationism, she can teach them both.					
34.	A school district can force a science teacher to stop teaching creationism.					
35.	A school district can force a science					

	teacher to teach evolution.					
36.	The US Supreme Court has endorsed the teaching of “evidence against evolution”.					
37.	The science teacher’s right to free speech entitles him or her to teach “evidence against evolution”.					
38.	Science teachers can be required by school administrators to read aloud a disclaimer saying that their teaching of evolution is not meant to dissuade students from accepting creation or intelligent design.					
39.	Science teachers can teach creationism if their school district adopts a course textbook that presents creationism.					
40.	According to the courts, evolution is a religion.					
41.	Teaching evolution can be perceived as promoting evolution as a religion and therefore violates the establishment clause of the constitution.					
42.	The Scopes Monkey Trial overturned the laws that banned the teaching of human evolution.					
43.	In the Scopes Monkey Trial, Scopes was convicted of teaching human evolution.					

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Bailey to be more applicable to Georgia.

APPENDIX C
ORIGINAL QUESTIONS BY DR. RANDY MOORE

Table 1. Results of an examination of Minnesota high school biology teachers' understanding of the legal issues associated with the teaching of evolution and creationism in public schools.

Question (ruling)	Correct answer	Teachers answering correctly (percentage)
Must science teachers who teach evolution give equal time to creationism? (McLean v. Arkansas Board of Education, 529 F. Supp. 1255 [E.D. Ark. 1982]; Edwards v. Aguillard, 482 U.S. 578 [1987]; Daniel v. Waters, 515 F. 2d 485 [6th Cir. 1975])	No	98
Can science teachers who teach evolution give equal time to creationism? (McLean v. Arkansas Board of Education, 529 F. Supp. 1255 [E.D. Ark. 1982]; Edwards v. Aguillard, 482 U.S. 578 [1987])	No	73
Is it still a crime to teach evolution anywhere in the United States today? (Epperson v. Arkansas, 393 U.S. 97 [1968]; Wright v. Houston Independent School District, 366 F. Supp. 1208 [S.D. Tex. 1972], aff'd, 486 F.2d 137 [5th Cir. 1973], cert. denied sub. nom.; Brown v. Houston Independent School District, 417 U.S. 969 [1974])	No ^a	71
Students and their parents claim that evolution offends and is incompatible with their religious beliefs. Must teachers modify their teaching to accommodate the students' right to religious freedom? (Wright v. Houston Independent School District, 366 F. Supp. 1208 [S.D. Tex. 1972], aff'd, 486 F.2d 137 [5th Cir. 1973], cert. denied sub. nom.; Burstyn v. Wilson, 343 U.S. 495, 505 [1952]; Epperson v. Arkansas, 393 U.S. 97 [1968])	No	91
Can the government use tax money to promote the teaching of evolution? (Willoughby v. Stever, Civil Action no. 157472 [D.D.C. 25 August 1972], aff'd mem., 504 F.2d 271 [D.C. Cir. 1974], cert. denied, 420 U.S. 927 [1975])	Yes	88
If the government uses tax money to produce science textbooks that promote evolution, must it also provide funds to promote textbooks that promote creationism? (Willoughby v. Stever, Civil Action no. 157472 [D.D.C. 25 August 1972], aff'd mem., 504 F.2d 271 [D.C. Cir. 1974], cert. denied, 420 U.S. 927 [1975])	No	93
If the government uses tax money to produce public exhibits that promote evolution, must it also provide funds to produce exhibits that promote creationism? (Crowley v. Smithsonian Institution, 636 F.2d 738 [D.C. Cir. 1980])	No	94
Does the First Amendment right to free speech entitle teachers to teach creationism in science classes of public schools? (Webster v. New Lenox School District #122, 917 F. 2d 1004 [7th Cir. 1990]; Bishop v. Aronov, 926 F.2d 1066, 1077 [11th Cir. 1991]; Hellend v. South Bend Community School Corporation, 93 F.3d 327 [7th Cir. 1996], cert. denied, 519 U.S. 1092 [1997])	No	95
Has a court determined that creation science has no scientific merit? (McLean v. Arkansas, Board of Education, 529 F. Supp. 1255 [E.D. Ark 1982])	Yes ^b	41
Students, their parents, school administrators, and other local residents all want a teacher to teach evolution and creationism in her science class. These are the people whose taxes pay the teacher's salary and support the school. If these people want the teacher to teach evolution and creationism, can the teacher teach them both? (McLean v. Arkansas Board of Education, 529 F. Supp. 1255 [E.D. Ark 1982]; Edwards v. Aguillard, 482 U.S. 578 [1987])	No ^c	72
Can a school district force a teacher to stop teaching creationism? (Webster v. New Lenox School District #122, 917 F.2d 1004 [7th Cir. 1990])	Yes ^d	87
Can a school require that a teacher teach evolution? (Peloza v. Capistrano Unified School District, 37 F.3d 517 [9th Cir. 1994])	Yes	83
Has the US Supreme Court endorsed the teaching of "evidence against evolution"? (However, the strategy of presenting the "evidence against evolution" resulted from the minority opinion in Edwards v. Aguillard, 482 U.S. 578 [1987], which mentions "whatever scientific evidence there may be against evolution.")	No	85
Does a science teacher's right to free speech entitle him or her to teach "evidence against evolution"? (LeVake v. Independent School District #656, 625 N.W. 2d 502 [MN Ct. of Appeal 2000], cert. denied, 534 U.S. 1081 [2002])	No ^e	72
Can science teachers be required by school administrators to read aloud a disclaimer saying that their teaching of evolution is not meant to dissuade students from accepting the biblical version of creation? (Freiler v. Tangipahoa Parish Board of Education, 185 F.3d 337 [5th Cir. 1999], cert. denied, 530 U.S. 1251 [2000])	No ^f	35
Can science teachers teach creationism if their school district adopts a course textbook that promotes creationism? (Hendren v. Campbell, Superior Court No. 5, Marion County, Indiana, 14 April 1977)	No	72

Table 1. (continued)

Question (ruling)	Correct answer	Teachers answering correctly (percentage)
Is evolution a religion? (<i>Peloza v. Capistrano Unified School District</i> , 37 F.3d 517 [9th Cir. 1994])	No	97
Does teaching evolution promote the religion of evolution and therefore violate the establishment clause of the Constitution? (<i>Peloza v. Capistrano Unified School District</i> , 37 F.3d 517 [9th Cir. 1994])	No	97
Did the Scopes trial strike down the laws that banned the teaching of human evolution? (<i>Scopes v. The State of Tennessee</i> , 289 S.W. 363 [Tenn. 1927])	No	72
At the Scopes trial, was Scopes convicted? (<i>State of Tennessee v. John Thomas Scopes</i> , Nos. 5231, 5232 [Tenn. 1925])	Yes	53
<p>a. In fact, it has never been unlawful to teach evolution per se. All of the laws banning the teaching of evolution (passed in Tennessee, Mississippi, and Arkansas in the 1920s, and overruled by the Supreme Court) applied only to the teaching of <i>human</i> evolution.</p> <p>b. Creation scientists “cannot properly describe the methodology used as scientific, if they start with a conclusion and refuse to change it regardless of the evidence developed during the course of the investigation.”</p> <p>c. “The application and content of the First Amendment principles are not determined by public opinion polls or by a majority vote.... No group, no matter how large or small, may use the organs of government, of which the public schools are the most conspicuous and influential, to foist its religious beliefs on others.”</p> <p>d. “If a teacher in a public school uses religion and teaches religious beliefs or espouses theories clearly based on religious underpinnings, the principles of the separation of church and state are violated as clearly as if a statute ordered the teacher to teach religious theories.”</p> <p>e. LeVake, a biology teacher, was reassigned because he taught the alleged evidence against evolution despite the fact that this topic was not in the approved curriculum. The court found that “the established curriculum and LeVake’s responsibility as a public school teacher to teach evolution in a manner prescribed by the curriculum overrides his First Amendment rights as a private citizen.”</p> <p>f. Such a disclaimer is “intended to protect and maintain a particular religious viewpoint, namely belief in the Biblical version of creation,” and is “contrary to an intent to encourage critical thinking.”</p>		

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APPENDIX D
QUALITATIVE INTERVIEW PROTOCOL

Interview Protocol

1. Describe your current role as an administrator.
 - Describe your former roles as an administrator
 - Describe your former teaching roles
2. Do you think you have a good working knowledge of the Georgia Performance Standards regarding evolutionary biology in 7th grade and/or high school biology?
 - Yes--How did you acquire your knowledge?
 - No---Where or whom would you go to in the event you needed to acquire this knowledge?
3. What issues concerning the teaching of evolution have you experienced with parents and/or students in your administrative career?
 - How were they resolved?
4. What issues concerning the teaching of evolution have you experienced with teachers in your administrative career?
 - How were they resolved?
5. What issues concerning the teaching of creationism/intelligent design have you experienced with parents and/or students in your administrative career?
 - How were they resolved?
6. What issues concerning the teaching of creationism/intelligent design have you experienced with teachers in your administrative career?
 - How were they resolved?
7. What training if any did you received in your **administrative** college course work concerning what can and cannot be taught regarding evolution, creationism or intelligent design?
8. Do you think that creationism or intelligent design should be taught in the curriculum?
 - Yes---Why and where in the curriculum?
 - No---could you explain your reason?
9. Do you think that evolution should be taught in the curriculum?
 - Yes---Why and where in the curriculum?
 - No---could you explain your reason?
10. What professional development as a principal/administrator have you participated in regarding the teaching of evolution?

11. Do you think you are aware of the laws that govern the teaching of evolution in public schools?
 - Yes, could you summarize the main legal concerns for administrators?
 - No, could you explain why this has not been a concern for you or your district?
12. How would you handle a science teacher that refused to teach evolution according to the Georgia Performance Standards?
13. How would you deal with a parent that complained that her child's science teacher refused to teach intelligent design or creationism as viable scientific theory?
14. Has your school board or superintendent ever initiated a discussion or concern regarding issues with the teaching of evolution/creationism or intelligent design with administrators/teachers?
 - Yes---Could you describe the concern?
 - No----Do you think there is a need for such a discussion?
15. What is your level of content knowledge regarding evolution?
16. How do you determine your teachers are teaching the Georgia Performance Standards in evolution?
17. Have you ever had clergy or other community leaders express a concern about the teaching of evolution?
 - Yes---Describe the concern and your response.
 - No---Why do you think there has been no concern from the clergy considering the controversial nature of the topic?
18. Would you consider attending a professional development session focusing on the laws that govern the teaching of evolution in public schools?
 - Yes---Why?
 - No----No?
19. How would you deal with a teacher that believed her right to free speech allowed her to teach intelligent design in her classroom?
20. "Evolution is only a theory." What does this statement mean to you?
And Do you agree or disagree with the statement---explain?
21. Is/are your science lead(s)/department chair knowledgeable about what can and cannot be taught regarding evolution, intelligent design and creationism?
 - Yes---how do you know?
 - No----are you concerned and what should be done if anything to resolve their lack of knowledge?

22. Is there a fear regarding the teaching of evolution at your respective school(s)?
23. How would you deal with a creationist science teacher who argues evolution is a religion and refuses to teach the theory?
24. What are your personal beliefs about evolution?
25. How would you characterize the religious climate in your respective school district?
26. Do you feel a sense of pressure related to the religious climate in your school district? If the answer is yes, please explain how you have dealt with the situation(s).
27. Do your personal beliefs about evolution ever conflict with your responsibilities as a principal/administrator?
 - Yes—how do you deal with the conflict?
 - No---No response

APPENDIX E

CORRELATING INTERVIEW QUESTION DATA TO QUALITATIVE THEMES

	Theme	Interview Question
1	Graduate level coursework and professional development on evolution for administrators is a rarity	7,10,11,14,18,19,23,27
2	Evolution is not a major controversial issue in schools in the study area.	3,4,5,6, (Possible 18)
3	The Georgia Performance Standards concerning evolution ensure that no laws are broken as long as the standards are being taught as written.	2 13,16, 21, 12--- (Possible 9)
4	Religious modes and mores were evident in the school climate with respect to evolution in the schools.	8,9,17,22,25,26
5	There is variance in the understandings of the term scientific theory and evolution expressed by administrators.	15, 20,24

APPENDIX F

TABLE CORRELATING RESEARCH QUESTIONS TO QUANTITATIVE
SURVEY QUESTIONS AND INTERVIEW PROTOCOL QUESTIONS

Research Questions	Quantitative Survey Question Numbers	Qualitative Interview Protocol Question Numbers
Question 1: What is the current knowledge level of middle and high school principals and assistant principals in 33 North Georgia public school districts regarding the laws that govern the teaching of evolution?	22-43	11,12,13,19 and 23
Question 2: What is the current knowledge level of district level administrators who are responsible for science curriculum in 33 of North Georgia school systems regarding the laws that govern the teaching of evolution?	22-43	11,12,13,19, and 23
Question 3: Do school administrators have a strong working knowledge of the Georgia Performance Standards regarding evolution and the topic of evolution in general?	15-21	2
Question 4: What building level issues have administrators faced in their clinical experience regarding evolution, creationism, and intelligent design?	12 and 13	3,16,17,21 and 22
Question 5: What district level issues have administrators experienced with evolution, creationism and intelligent design in their respective school systems?	12 and 13	3,4,5,6,16,17,21,22,25 and 26
Question 6: What is the level of initial and on-going training regarding evolutionary law experienced by administrators?	7-9	7,10,14,15, and 18
Question 7: What are the beliefs of administrators regarding the teaching of evolution in public schools of north Georgia?	10,11 and 14	8,9,20,24, and 27
Solely Demographic Questions	1-6	1

APPENDIX G

FREQUENCIES AND PERCENTAGES OF PARTICIPANT
DEMOGRAPHICS AND EXAM SCORES

	Variable	<i>f</i>	%
Q0 Size of System			
	Large System 13,000 - 39,000 students	50	32.5
	Medium System 4,171 - 10,533 students	53	34.4
	Small System 1,128 - 4,004 students	51	33.1
Q1 Role of Respondent			
	Assistant Principal of a High School	49	31.8
	Assistant Principal of a Middle School	36	23.4
	District Level Administrator	8	5.2
	District Level Science Administrator	2	1.3
	Principal of a High School	33	21.4
	Principal of a Middle School	26	16.9
Q1b Condensed Adm Role			
	District Level	10	6.5
	High School	82	53.2
	Middle School	62	40.3
Q2 Role			
	Elementary Education	10	6.5
	Fine Arts	1	0.7
	Foreign Language	2	1.3
	Guidance	1	0.7
	Language Arts	23	14.9
	Math	23	14.9
	Physical Education	29	18.8
	Science	23	14.9
	Special Education	8	5.2
	Social Studies	20	13.0
	Vocational	8	5.2
	Other	6	3.9
Q3 School Type			
	Rural	99	65.1
	Suburban	45	29.6
	Urban	8	5.3
Q4 Gender			
	Female	57	37.0
	Male	97	63.0
Q5 Educational Experience			
	1-6 years	1	0.6
	7-13 years	17	11.0

	14-20 years	55	35.8
	21-27 years	37	24.0
	28 or more years	44	28.6
Q6 Administrative Experience			
	0-4 years	32	20.8
	5-10 years	70	45.5
	11-15 years	27	17.5
	16-20 years	12	7.8
	21 or more years	13	8.4
Q7 College Type			
	Private College	31	20.1
	Private Non-Religious College	12	7.8
	Public University or College	78	50.7
	Religious Affiliated University or College	33	21.4
Q8 Professional Development			
	No	127	82.5
	Yes	27	17.5
Q9 Administrative Course Work			
	No	95	61.7
	Yes	59	38.3
Q10 Religious Affiliation			
	Agnostic	2	1.3
	Catholic	13	8.4
	Jewish	1	0.7
	Protestant	123	79.9
	Other	15	9.7
Q11 Political Ideology			
	Conservative	78	50.6
	Far Right	3	1.9
	Liberal	17	11.1
	Middle of the Road	56	36.4
Q12 Number of Parent Calls			
	0-5 calls	145	94.2
	6-10 calls	5	3.2
	11-20 calls	2	1.3
	21 or more calls	2	1.3
Q13 Number of Teacher			

Concerns			
	0-5 concerns	145	94.2
	6-20 concerns	7	4.5
	21 or more concerns	2	1.3
Q14 No Conflict			
	Agree - No conflict with Evolution and Job	111	72.1
	Disagree	43	27.9
Questions about the GPS		TRUE	Hunch
Question 15		24%	53.90%
Question 16		26.60%	57.80%
Question 17		4.50%	11.00%
Question 18		24.00%	51.30%
Question 19		3.20%	9.70%
Question 20		22.70%	51.30%
Question 21		21.40%	51.90%
Question 22		9.10%	19.50%
Law Questions			
Question 23		7.10%	13.60%
Question 24		12.30%	44.80%
Question 25		12.30%	35.10%
Question 26		29.90%	63.60%
Question 27		13.00%	35.10%
Question 28		17.50%	61.00%
Question 29		16.90%	40.30%
Question 30		16.20%	39.00%
Question 31		13.60%	46.70%
Question 32		9.10%	17.50%
Question 33		14.30%	40.90%
Question 34		16.20%	54.50%
Question 35		16.90%	57.10%
Question 36		7.10%	20.10%
Question 37		13.60%	46.10%
Question 38		7.10%	18.20%
Question 40		21.40%	56.50%
Question 41		16.90%	56.50%
Question 42		11.00%	27.30%

Question 43		11.00%	40.30%