

CREATIONISM VS. EVOLUTION:
A STUDY OF THE OPINIONS OF GEORGIA BIOLOGY TEACHERS

by

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(Under the Direction of DAVID F. JACKSON)

ABSTRACT

This study surveyed Georgia public high school biology teachers for opinions regarding the teaching of creationism and analyzed respondents' opinions regarding attitudinal and biographical variables, and compared current opinions to 1983 Georgia science teachers. Additionally, the study intended to document reasons for the teaching of creationism and evolution and evaluate respondents' opinion regarding if the inclusion of evolution in State standards and exams influenced teaching.

Of the educators responding, 92% stated they were familiar with the term creationism, 17% claim to teach creationism and evolution, 3.4% to teach creationism without mention of evolution and 1.4% claim to teach neither. Biology teachers' approvals of teaching creationism were related to the teacher's familiarity with creationism, self-view on religiosity, conservatism in religion and age. Consistent with a 1983 Georgia study, teachers more familiar with the creationist movement and teachers of conservative religious beliefs were more likely to approve of teaching creationism.

Since the inclusion of evolution in Georgia standards, this study revealed more than 20% of respondents continue to include instruction on creationism demonstrating no effective change

since 1983; meanwhile, respondents claiming to teach evolution increased from 39% to 78% and those teaching neither decreased from 31% to 1.4% in the same time period. The study revealed nearly a 50% increase in teachers reporting to frequently have students troubled by the conflict between evolution and religious beliefs. Although Georgia biology teachers generally disapprove of teaching creationism, responses revealed some teachers do not believe evolution necessary to biology curriculum while others do not understand evolution and creationism are irreconcilable for creationists.

This dissertation argues that policy matters. Although teachers' personal beliefs are major contributors to classroom practices regarding the teaching of evolution and creationism, data indicate that state standards, in part, have influenced the teaching of evolution. This dissertation reasons administrative policy providing guidance and strategies to science teachers directing the manner in which creationism is introduced during the teaching of evolution may limit the wide range of creation teaching practices occurring currently and increase student understanding of scientific practices through the development of emotional and deductive reasoning.

INDEX WORDS: Education, Science Education, Teaching, Evolution, Creationism, State Standards, Biology, Intelligent Design, Creation-science, Creationist

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DEDICATION

This dissertation is dedicated to my loving, devoted and selfless wife, Katrina Nye, our exuberant, brilliant, daughter, Alyssa Nye and always supportive, ever faithful parents, Bill and Phyllis Nye.

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CHAPTER 1

INTRODUCTION

Creationism, intelligent design, scientific creationism, and creation-science are all terms used by certain religious groups for a movement driven to include, in public school science curriculum, instruction about a sudden creation of life directly manipulated by a Creator. Sponsors of this movement insist on their literal interpretation of the Judeo-Christian scriptural account of creation. Creationists believe support for their position exists within biological and physical sciences and it is for this reason creationist doctrine has been called scientific creationism and creation-science. Teaching creationism, within the structure of a science course, was first proposed in a Georgia public school system in the late 1970s (Milstein, 1979; see also Blum, 1980; Golem, 1980; Haas, 1980; Kohlman, 1980; Lienesch, 2007) Similar proposals, in one manner or another exist to present day in the United States ("Creationists bills die," 2013; see also Lienesch, 2007).

However, not until March 17, 1981, did any state legislature mandate the teaching of creation-science. The Arkansas State Legislature became the first to pass legislation requiring the teaching of creation-science in public schools (Young, 2004) with the Louisiana Legislature soon following with a nearly identical law (Broad, 1981). Although lawmakers in Georgia were pressed by constituents to follow Arkansas and Louisiana, a similar bill never left the Georgia House Committee on Education, as Georgia lawmakers were hesitant to move forward with the bill after a Federal District Court rejected the Arkansas law in a suit filed by the American Civil Liberties Union (ACLU) (Lewin, 1982). The constitutionality of mandating creationist materials

be placed in public schools fell into question, requiring creationists adopt new strategies. The goal shifted to desire inclusion of creationist material alongside evolution material in the public classroom and adopting the term intelligent design in place of creation-science.

Louisiana legislature again moved the discussion further with the passage of the Creationism Act, which mandated the co-teaching of creationism and evolution; however, The Supreme Court ruled in a seven to two decision the Louisiana law violated the Establishment Clause of the First Amendment, because it lacked a clear secular purpose (McKown, 1993). In Washington State, a teacher was directed by supervisors not to teach creationism in his science class after parents and the ACLU expressed concerns to the Burlington-Edison District in 1998 (Forest, 2004). The biology teacher used a pro-creationism textbook, *Of Pandas and People*, to promote the creationist position called intelligent design theory in the unapproved text (Davis, Kenyon & Thaxton, 1993). The name, intelligent design, is derived from the religiously based idea that an intelligent designer changed life on earth rather than naturalistic evolutionary processes.

The controversy between the theory of evolution and creationism shows no sign of easing as we continue further into the twenty-first century. Court rulings, such as the one in 2005 case *Kitzmiller vs. Dover*,¹ illustrate this. The ruling declared it unconstitutional for the Dover Area School District to endorse intelligent design as an alternate theory to evolution. Since it is clear, at this time, court rulings desire to separate creationist doctrine from public classrooms, the movement may concentrate on introducing creationist material through the influence of legislative bodies, local school boards, administrative decisions and practices of teachers. Such a

¹ Tammy Kitzmiller, et al. v. Dover Area School District, et al., 400 F. Supp. 2d 707 (M.D. Penn. 2005)

² Louisiana Science Education Act, Act 473 (SB 733 of 2008)

³Scopes v. State of Tennessee, 154 Tenn. 105, 289 S.W. 363 (1927)

strategy may be underway in Louisiana. The Louisiana Science Education Act² signed into law by Governor Bobby Jindal June 25, 2008 allows public school teachers, principals and administrators supplement materials in a science class to promote “open and objective discussion of scientific theories being studied including, but not limited to, evolution, the origins of life, and human cloning.”² The creationist movement’s success ultimately depends on the classroom practices of science teachers. The presentation of material may be influenced by the teacher's perception of creationism, philosophy of teaching and religious convictions in addition to community and administrative pressures (Berkman & Plutzer, 2010).

The Purpose

The purpose of this study is exploratory. Georgia public high school biology teachers were surveyed about creationist activity in their communities, their opinions on creationism as a part of the biology curriculum, and, if applicable, teaching creationism practices whether by administrative direction, community influence or personal choice of the teacher. The study seeks to investigate relationships between the teachers' approval of creationism and their religious philosophy, familiarity with the tenets of creationism, and understanding of the role of evolution in biology. Influences of biographical factors such as academic degree, age, locale, and teaching experience will also be investigated. Results from this study will be compared to a similar study completed by Paula Eglin in 1983 from Georgia State University (Eglin, 1983). The results of these two studies may provide insights into the development of Georgia’s creationist movement and if the addition of evolution to Georgia Performance Standards and state required assessments have driven classroom instruction. A goal of this study is to benefit education policy makers, curriculum coordinators, university science education departments, textbook publishers, and

² Louisiana Science Education Act, Act 473 (SB 733 of 2008)

researchers studying the evolution/creationism controversy and related impact on science education.

The Problem

There exists, as yet, no evaluation of the extent or success of the modern creationist movement in Georgia within public classrooms. Also, there exists no evaluation as to the impact the evolution of life Georgia Performance Standards and the required assessments for biology end of course tests (EOCT) and the science portion of the Georgia High School Graduation Tests (GHGST) have had on classroom instruction.

The questions to be answered by this study are:

- 1) How many teachers are familiar with the creationist movement?
- 2) How many teachers approve of including creationism in science courses, and how many would refuse to teach it if required? Is any biographical factor related to their positions?
- 3) With what materials and to what extent do teachers believe creationism should be taught, if at all?
- 4) How many teachers are actually teaching creationism and what size communities do they represent?
- 5) How many teachers have been faced with a local proposal that creationism be taught?
- 6) What reasons do teachers give for teaching or rejecting creationism? Are school board requirements or administrative decisions frequently reported, and if so, is this typical of any certain size community?
- 7) Is a teacher's approval of creationism related to any of the following factors: familiarity with creationism, self-rated religiosity, liberal or conservative religious

- beliefs, perception of the place of evolution in the science curriculum, local activity by creationist supporters, age, length of professional experience, degree level attained, specialization (biological or physical science), community size?
- 8) How many teachers have personal doubts about the validity of evolution, and is the area of the teacher's scientific training related to these doubts?
 - 9) To what extent have students expressed doubts about evolution because it conflicts with their religious beliefs?
 - 10) Is creationist activity, as reported by the teachers, stronger in any particular size community?
 - 11) To what extent, if any, has the addition of the Evolution of Life curriculum in the Georgia Performance Standards (GPS) had on the teaching of evolution and/or creationism?
 - 12) To what extent, if any, has the implementation of the High School Biology End of Course Test (EOCT), which can include questions from the Evolution of Life curriculum, had on the teaching of evolution and/or creationism?
 - 13) To what extent, if any, has the implementation of the science portion of the Georgia High School Graduation Test (GHS GT), which can include questions from the Evolution of Life curriculum and passing is a requirement for graduation, had on the teaching of evolution and/or creationism?

The answers to these questions are essential to school and state administrators in assessing the impact and the future of the creationist movement and the teaching of evolution. Whether the results support the creationists' view that teachers give creationism equal emphasis with evolution or the position of their opponents that creationism deserves no status in the

science curriculum or somewhere in-between, this study will provide needed information to the educational community.

Historical Background

What began as a trial against a Dayton, Tennessee biology teacher in July 1925 is now appreciated as the beginning of the modern anti-evolution movement in the United States. John Scopes was found guilty of violating a Tennessee statute that forbade the teaching, in a public school, the theory that man was descended from any lower form of animal. Since that day, the courts across the United States have consistently applied the constitutional principle separating church and state with numerous court rulings creating a division between science and religion within our public schools.

At the time of the Scopes trial, American culture and American Protestantism intertwined. An understanding of the cultural development of this era can allow an appreciation for the rift that formed between science and religion. The Scopes trial was the product of a growing conflict and was somewhat orchestrated by antievolutionist Williams Jennings Bryan, who argued for the defense. The Presbyterian Democratic politician began his “crusade against the teaching of evolution in schools and colleges” in 1920 and considered Darwinism responsible for World War I, claiming the theory of evolution persuaded Germans to believe “only the strong could or should survive” ultimately leading to the conflict (Armstrong, 2000, p. 175). James H. Leuba’s book, *Belief in God and Immortality*, influenced Bryan as he developed the belief college education was damaging to the religious belief of individuals. He further postulated Darwinism caused “young men and women to lose faith in God, the Bible and other fundamental doctrines of Christianity” (Armstrong, 2000, p.175). Although the trial was a journalistic disaster for fundamentalism, fundamentalists pressed for passage and enforcement of antievolution

legislation and were successful in some arenas (Gilbert, 1997). Religious fundamentalists, like Bryan, were also the most prominent vocal proponents of cultural fundamentalism during the 1920s (Gilbert, 1997). The growing movement in Protestant Christianity took its name from a series of pamphlets entitled *The Fundamentals: A Testament of Truth*, published by Milton and Lyman Stewart of Union Oil in California between 1909 and 1912. The most pertinent principle to creationism is the teaching that every word of the Bible is literally true from the creation of Eve from Adam's rib to visions in Revelations as there are no allegories in the Bible and subject matter is not open to interpretation.

Religious fundamentalist-modernist controversy heavily influenced this era. What began as theological and ecclesiological issues within the Presbyterian Church subsequently created fractions in most American Christian denominations (Longfield, 2000). The ensuing debate about Christianity's role in American society and culture led some Americans to rally against any and all perceived enemies of America. Most clearly identified as such were materialism, science, and evolution; to which William Jennings Bryan stated, "All the ills from which America suffers can be traced back to the teaching of Evolution" (Shipley, 1927, p.255). Prior to the 1920s, debate regarding evolution occurred mostly at universities and in colleges frequented by very few fundamentalists. As the teaching of evolution spread into the high schools it reached a broader audience and controversy ensued. Throughout the next decade, some twenty state legislatures considered antievolution bills with a law passing in Tennessee introduced by John Washington Butler, of whom Arthur Garfield Hays (1957) speculated he

thought, if indeed he thought at all, that the King James' version of the Bible was handed down by God in person to Moses, in printed form and in the English language. Any effort to enlighten Butler would have been met with the words of

one of the attorneys for the prosecution, 'If I must choose between religion and education, I choose religion.' (p. 37)

The fervor over the Scopes trial concluded with the Tennessee Supreme Court reversing the decision on a technicality, possibly to prevent an appeal to the U.S. Supreme Court.

The years that followed witnessed a steady decline across most portions of the country in the popularity of the Modernism movement. The New Deal moved the nation out of the great depression with the promise of a variety of programs that increased political power at the national level. This trend continued until the patriotic fervor of World War II swept America and moved us into the cold war era. Secondary education remained relatively unchanged until the Soviet Union's missile capability began to concern the public in the 1950s. The launching of Sputnik in 1957 secured the votes in congress to pass the National Defense Education Act (NDEA) in 1958. This program expanded math, foreign language, and science and technology education in secondary schools. The NDEA gave the Department of Health, Education, and Welfare (HEW), the administering agency, enlarged influence (Clowse, 1981). A science textbook reform movement began in 1957 through the development of a high school physics course by the Physical Science Study Committee (PSSC). The new program focused on a search for order through laboratory participation, films, and problem solving utilizing investigatory techniques following the scientific method. Soon thereafter, new curriculum studies were expanded to include the field of biology.

The Biological Sciences Curriculum Study (BSCS) abandoned the taxonomic approach high school biology texts used previously and moved toward relating the biological systems of different organisms using evolution to connect them. Different versions of the BSCS curriculum were developed emphasizing the evolution of the cell, the evolution of multicellular organisms,

and the evolution of higher levels of organizations, such as populations, societies, and communities (Glass, 1970). The curriculum re-ignited the controversy. Resistance existed primarily in southern states with a Texas fundamentalist congregation demanding the books be banned (Nelkin, 2000; see also Berkman & Plutzer, 2010). The materials later found acceptance when an alternate version was provided with a less direct evolutionary approach. The National Science Foundation conducted seminars and institutes for high school science teachers during the 1960s, which helped increase the BSCS textbooks' acceptance throughout the nation. Thereafter, the textbooks were sufficiently well received to ultimately capture half of the textbook market in the United States (Larson, 2003). Dorothy Nelkin (1982) placed into better perspective the initial community and religious influence on public school curriculum when she wrote:

During most of the 1960s, the major problem facing BSCS was less a matter of social protest than the inertia of high school teachers, who often failed to understand the materials and the methods of science sufficiently to convey the character and use of evolution theory in biology. (p. 47)

As the new decade moved forward though, fundamentalist reaction against the BSCS curriculum grew. The political power of conservative Christian churches developed alongside until the Religious Right became a recognized political force and platform for moral reform. The organizations that emerged in the late 1970s were the Moral Majority, the Religious Roundtable and the Christian Voice. The movement “made a broad, religiously based conservative appeal, its deepest roots and most lasting impact were among white evangelicals and fundamentalist Christians” (Himmelstein, 1990, p. 97). In a loosely organized effort they engaged in local battles over pornography, school prayer, obscenity, abortion, homosexuality and the content of textbooks in regards to evolution (Himmelstein, 1990). The claim was again levied that teaching

origins led to relativist ethics; when children were taught their ancestors were monkeys they would learn to behave like animals (Milstein, 1979). Officials in some communities responded by pasting “should be considered as theory, not fact” disclaimers in textbooks prior to distribution (Lienesch, 2007, p. 222). Evolution again became the scapegoat and was blamed for a rise in communism, fascism, socialism and Satanism.

The moralist agenda evolved into the 1990s when creationism gave way to a new label, intelligent design. A biology teacher in Washington State’s Burlington-Edison District used a pro-creationism textbook, *Of Pandas and People*, in 1998 to promote creationist belief. The unapproved text used the new intelligent design theory label to promote the same creationist ideas namely that an intelligent designer changed life on earth rather than evolutionary processes (Davis, Kenyon & Thaxton, 1993). The persistence of the evolution/creationism controversy combined with the perception, of some, that science curriculum can alter a child’s faith, provides insight to instructional difficulties public school teachers face. The resulting impact on teachers’ relationship in their community and personal misgivings some have regarding the place of evolution and creationism in the curriculum compound these difficulties.

Social Context

The interweaving of two scientific disciplines can have lasting unintended consequences. Herbert Spencer, originally a civil engineer and later a respected sociologist, blended biology and sociology through his application of evolution terminology to societal practices (Farrington, 1961). Social Darwinism resulted. This created another level of public misconception as noted by Banton, “ It is notorious that such fine sociologists as Herbert Spencer, E. B. Tylor, and J. G. Frazer were prone to ascribe to biological processes phenomena that demand sociological analysis” (Farrington, 1961, p. 132).

Unfortunately, this caused many to disregard not only improper uses of scientific principles, but of the substance of those principles as well. The creationist movement established itself slowly over decades in response to pressures faced by fundamentalists in society and their children attending public schools where instruction conflicted with their rigorous religious tradition. Five scientists of Christian faith founded one of the first organizations, American Scientific Affiliation (ASA), in 1941. Unaffiliated with Christian Scientists or Church of Christ, Scientist, the ASA was established in order to investigate any area relating Christian faith and science and to make known the results of such investigations for comment and criticism by both the Christian and scientific community (Gilbert, 1997). However, this “fundamentalist scientific association succumbed to the temptation of scientific professionalization and accepted some of the tenets of evolutionary theory” (Gilbert, 1997, p.18). The ASA’s domination by theistic evolutionists, who reconciled creation and science by relinquishing insistence on the literal six-day creation after recognizing the validity of biblical scholarship and criticism, caused dissatisfied members to form the Creation Research Society (CRS) in 1963. The subsequent movement following the formation of CRS became prominent in efforts to change textbooks used by public schools in California and eventually across the nation (Gilbert, 1997). Additional like-minded organizations formed, at times falling along denominational lines. A Christian apologetics institute in Dallas, Texas formed the Institute for Creation Research (ICR) in 1972 and also remain influential today (Numbers, 2006).

Educational Significance

From my perspective, as a science educator and science education researcher, a primary purpose of education is to prepare students to function effectively in the world, and thereby assist society to function effectively. This is often done through developing concepts or ideas. To

effectively pass these concepts from the mind of the teacher to the mind of the student a variety of materials and methods are used. Teachers use lectures, books, models, examples, inquiry and experiences to convey the mental message. Creationism necessitates an intelligent designer or creator and is synonymous with a deity or God and thus constitutes a religious ideal. The First Amendment strictly forbids public school teachers to promote this concept and those opposing the teaching of creationism, on constitutional grounds, take this position. Many dozens of creation myths exist worldwide, yet creationism and the creationist movement addresses only one. In contrast, the concept of evolution is not synonymous with a deity, but is a process that can be tested and disproved. Some can argue that the mechanisms involved are not testable within a reasonable timeframe; yet, evolution has consistently been supported by scientific disciplines, like genetics, that were unfathomable at the time of Darwin. Evolution has predictive capability and although its mechanisms are debated, the theory itself has yet to be disproved.

Any illusion that the evolution/creationism controversy exists with creationist positions on one end of the spectrum and evolutionists on the other must be dispelled. Eugenie C. Scott (2009) demonstrates in *Evolution vs. Creationism: An Introduction* that a continuum of positions exist in the American public ranging from those believing the Earth is flat to atheistic evolutionists. “Christians hold many views about evolution, and Christian views actually range along a continuum, rather than being separated into a dichotomy.” (Scott, 2009, p.57) Educators, and others impacting education policy, must appreciate the multiple views students and teachers enter the classroom with and return home to. Although the teaching of evolution does not necessarily require a student modify their religious beliefs, Scott’s continuum provides insight that some creationist positions can never allow any view other than a fundamentalist concept of

creation (2009). Students and teachers holding to such creationist positions are forced to choose between the two opposing views.

Personal Subjectivities

This study is of specific interest to me as a biologist, science educator and science education researcher. It is difficult, with such a passion for science and education, to remain passive after reading creationist materials attacking the ethics of scientists and educators or after witnessing difficulties some students encounter as they attempt to balance evolution with their religious beliefs. Nevertheless, every effort to maintain objective clarity was made in an effort to prevent any bias from appearing in this study.

Summary

In our public schools, teacher presentation is a major factor in determining student acceptance or rejection of ideas and concepts and is especially true with this controversial material (Moore & Cotner, 2009; see also Berman & Plutzer, 2010). Thus, the fate of the evolution/creationism controversy, to a great degree, depends on creationism acceptance by classroom teachers. This study will probe the teacher's understanding of both models, evolution and creationism, solicit opinions on the scientific validity of creationism and the infallibility of scriptural descriptions of creation, gather information on current practices in the presentation of evolution and creationism in the science classroom, investigate whether teachers' positions have changed since the early 1980s and whether teachers believe modifications to Georgia's curriculum standards and/or assessments required for graduation influenced their classroom practices.

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

Charles Darwin's historic book, *Origin of Species*, introduced evolution to public scrutiny in 1859. Instantaneously his work and the concept of evolution were intensely criticized. The ensuing controversy from the initial publication has yet to subside and impacts science curricula today. Initial debates focused on the integrity of evolution theory with attempts to prevent its introduction to high school students following. Courts across the country eventually approved the teaching of evolution while forbidding the concurrent presentation of creation, as understood in Judeo-Christian religion. Consequently, advocates of creationism changed their tactic claiming scientific support for their religious view and demanding public schools teach creationism alongside evolution declaring both of scientific value. This chapter reviews the literature of evolution/creationism controversy and relates the historical legal cases directing science curricula regarding evolution and creationism. Facets of policy and curricula are reviewed to appreciate the level of impact classroom teachers have on curriculum implementation.

Scientific Philosophy

In science, understanding is based on empirical evidence; whereas religious understanding, in part, is based on beliefs found in sacred texts or passed down through generations by tradition. A quality body of evidence is necessary for science to understand and effectively explain a natural phenomenon. Science comes to a better understanding or

approximates the truth only as the body of quality supporting evidence increases. In the case of gravity, scientific evidence is so overwhelming society considers it a truth although gravity is a scientific theory, and not considered fact. Still, very few people would jump from atop a 10-story building believing they might not fall to their death. Similarly, the body of evidence gathered for nearly a century continues to consistently support the theory of evolution in ways Darwin could not imagine. The problem, in part, comes from the notion that abiogenesis is linked to evolution.

Abiogenesis, a controversial hypothesis, postulates the origins of life developed from non-living matter. The body of evidence is not substantial for abiogenesis and it is not an accepted component of evolution theory. Segments of the population mistakenly believe the theory of evolution begins with the formation of life from a primordial soup and use this as an argument against evolution (Scott, 2005). A youth ministry specialist, Lane Palmer, illustrates the misconception relating the two with an anti-evolution posting on a Christian website, “From the goo to the zoo to you!” (Palmer, 2005).

Of great concern to many science educators is that revealed truth, as in religion, is not subject to change or verifiability unless the sacred text is declared misinterpreted. Thus, religious based beliefs cannot be subjected to non-biased testing or review. A foundation of scientific philosophy is that all scientific ideas and hypotheses be falsifiable. No compromise can exist on this tenet if any idea or concept is to be considered valid. Creationism, intelligent design and other religious based variations to the theory of evolution fail this validity test and thus must be considered philosophical points rather than scientific curiosities. Additionally, scientific understanding is subject to review and reinterpretation if new evidence is produced that is in conflict with the published theory and of great significance is that any scientist or layperson can point out an inconsistency.

Legal Challenges and Science Curriculum

Not until the fundamentalist revival of the 1920s resulted in several states enacting statutes forbidding the teaching of evolution, did Darwinism face its first day in court. Although Florida, Arkansas, Mississippi and Oklahoma adopted resolutions or enacted legislation against teaching the theory of evolution, Tennessee's legislation initiated the first court proceedings (Gatewood, 1968). The inaugural legal issue in the United States regarding the teaching of evolution was the Scopes monkey trial in 1925. John Scopes was found guilty of violating the Tennessee "monkey law" for teaching evolution using a chapter from the approved text, Hunter's *Civic Biology* (1914); the Tennessee State Supreme Court later overturned the conviction on a technicality.³ It is evident from the language in the original statute an attempt was made to insert into the Tennessee curriculum the legislators' interpretation of the Judeo-Christian story of creation.

The competing ideology became titled creationism and although Tennessee repealed the prohibition against teaching evolution, other states including Arkansas and Louisiana enacted legislation mandating the teaching of creationism. The U.S. Supreme court formally intervened in 1968 deciding Susan Epperson, a high school biology teacher, was unlawfully subjected to prosecution and dismissal by the Arkansas statute prohibiting the teaching of evolution.³ The Supreme Court declared protection of academic freedom vital and although school boards have a right to determine curriculum, individual rights were to be protected where conflicts arose, as Mr. Justice Fortas stated in the majority opinion.⁴ In the year prior, the Supreme Court heard a seemingly irrelevant case regarding New York's teacher loyalty laws and regulations. In *Keyishian v. Board of Regents*, the Supreme Court defined the First Amendment for the era by

³Scopes v. State of Tennessee, 154 Tenn. 105, 289 S.W. 363 (1927)

⁴Epperson v. Arkansas, 393 U.S. 97 (1968)

stating it “does not tolerate laws that cast a pall of orthodoxy over the classroom.”⁵ With *Epperson v. Arkansas* it took one step further noting government “may not aid or promote one religion or religious theory against another or even against the militant opposite.”⁶

State antievolution legislation was further damaged in 1970 when the Supreme Court held Mississippi’s statute unconstitutional after a mother filed suit claiming her daughter’s constitutional rights under the First Amendment were violated by her being denied the opportunity to be taught the scientific theory.⁷ In 1973, students of the Houston Independent School District sued to prevent the district from teaching evolution on grounds that evolution was a sectarian, atheistic religion. The Fifth Circuit harshly disposed of the case saying:

Teachers of science in the public schools should not be expected to avoid the discussion of every scientific issue on which some religion claims expertise. . . . To require the teaching of every theory of human origin, as alternatively suggested by plaintiffs, would be an unwarranted intrusion into the authority of public school systems to control the academic curriculum.⁸

Soon to follow was Tennessee’s equal time law when challenged twice in 1975 and struck down each time. Harold Steele, a biology teacher, challenged the Tennessee statute requiring the teaching of Genesis creation. The court ruled in his favor adding, “the requirement that some religious concepts of creation . . . be excluded on such grounds in favor of the Bible of the Jews and the Christians . . . is forbidden by the establishment Clause of the First

⁵Keyishian v. Board of Regents, 385 U.S. 589 (1967)

⁶Epperson, 21 L. Ed. at 234.

⁷Smith v. State, 242 So. 2d 692 (1970).

⁸Wright v. Houston Independent School District, 486 F. 2d 137 (5th Cir., 1973), Cert. Den. 417 U.S. 969, cited at 366 F. Supp. 1211.

Amendment.”⁹ Similarly, Joseph C. Daniel, Jr. also filed suit against the Textbook Commission of the State of Tennessee; however, the court’s majority opinion specifically identified, as unacceptable, the statute’s provision prohibiting “the selection of any textbook which teaches evolution unless it also contains a disclaimer stating that such doctrine is a theory as to the origin and creation of man and his world and is not represented to be scientific fact.”¹⁰

The first court case regarding the use of an outright creationist textbook came in 1977 when Jon Hendren and his parents sued the Indiana Textbook Committee. The Creation Research Society produced the textbook in question, *Biology: A Search for Order in Complexity*, in 1970. Judge Dugan ruled unambiguously that creationism was a specific sectarian religious view and that a close church relationship was implied. The text and teacher guide defined creation clearly in religious terms and specified Christian answers as the correct response. Judge Dugan wrote:

The question is whether a text obviously designed to present only the view of Biblical Creationism in a favorable light is constitutionally acceptable in the public schools of Indiana. Two hundred years of constitutional government demand that the answer be no.¹¹

The next influential case came in 1981 when the Arkansas statute requiring public schools give balanced treatment to creation-science and evolution went to Federal District Court in Little Rock, Arkansas. Judge William R. Overton held that a “balanced treatment” mandate in the science curriculum also violated the Establishment Clause of the U.S. Constitution.¹² His decision gave a detailed definition of the term science and declared that creation-science is not, in fact, a science; the court further ruled the statute had no secular purpose, noting the statute

⁹Steele v. Waters, 527 S.W. 2d 72 (1975).

¹⁰Daniel v. Waters, 515 F. 2d 485 (6 Cir. 1975).

¹¹Hendren v. Campbell, No. S577-0139 (Marion Super. Ct., No. 5, Ind. April 14, 1977)

used language unique to creationist literature when emphasizing origins of life as an aspect of the theory of evolution.¹² A case remarkably similar followed in the U.S. Supreme Court.

In the early 1980s, the Louisiana legislature passed a law titled the Balanced Treatment for Creation-Science and Evolution-Science in Public School Instruction Act. Lobbied heavily for by creationists, it did not require teaching either creationism or evolution, but rather mandated creation be taught alongside evolution (Drakeman, 1991). The Supreme Court, in a seven to two majority opinion written by Justice William J. Brennan, ruled the Act constituted an unconstitutional infringement on the Establishment Clause of the First Amendment, based on the three-pronged Lemon test, which is:

- 1) The government's action must have a legitimate secular purpose;
- 2) The government's action must not have the primary effect of either advancing or inhibiting religion; and
- 3) The government's action must not result in an "excessive entanglement" of the government and religion.¹³

The majority opinion did note alternative scientific theories could be taught:

We do not imply that a legislature could never require that scientific critiques of prevailing scientific theories be taught. . . . teaching a variety of scientific theories about the origins of humankind to schoolchildren might be validly done with the clear secular intent of enhancing the effectiveness of science instruction.¹³

¹²McLean v. Arkansas Board of Education 529 F. Supp. 1255, 1258-1264 (E.D. Ark. 1982) 50 U.S. Law Week 2412

¹³Edwards v. Aguillard 482 U.S. 578 (1987)

Additionally, the Court directed their opinion specifically at the Louisiana legislature stating they had limited, rather than improved, Louisiana teachers' academic freedoms by removing their ability to determine what scientific principles should be taught. They continued their comments by noting the legislature had a "preeminent religious purpose in enacting this statute."¹³

Several relevant cases to science curriculum developed thereafter. The Seventh Circuit Court of Appeals ruled in 1990 a school district may specifically prohibit a teacher from teaching creation-science when fulfilling its responsibility to ensure the First Amendment's establishment clause is not violated and religious beliefs are not introduced into the public school curriculum.¹⁴ Further defining the role of school districts regarding this issue came with the 1994 Ninth Circuit Court of Appeals ruling upholding a district courts finding a teacher's First Amendment right to free exercise of religion is not violated by a school district's requirement evolution be taught in biology classes.¹⁵

The issue of disclaimers against the teaching of evolution arose in 1997 when the United States District Court for the Eastern District of Louisiana rejected a policy requiring teachers to read a disclaimer to students any time evolution entered the curriculum. The policy was adopted under the guise of injecting critical thinking into the curriculum. The ruling noted the policy singled out only the theory of evolution for attention, that the only "concept" students were to be "dissuaded" from was "the Biblical concept of Creation" and that

in mandating this disclaimer, the School Board is endorsing religion by disclaiming the teaching of evolution in such a manner as to convey the message

¹⁴Webster v. New Lenox School District, 917 F. 2d 1004 (7th Cir., 1990)

¹⁵John E. Peloza v. Capistrano Unified School District, 37 F. 3d 517 (9th Cir., 1994)

that evolution is a religious viewpoint that runs counter to ... other religious views.¹⁶

This decision being noteworthy for recognizing curriculum proposals calling for “intelligent design” as equivalent to proposals for teaching “creation-science.”¹⁶ The further affirmation by the Fifth Circuit Court of Appeals on August 13, 1999 and subsequent Supreme Court denial to hear the School Board's appeal, June 19, 2000, elevate the lower court's decision to practice of law.

Additional support for districts and their mandated curriculum developed when Rodney LeVake, a high school biology teacher, argued for his right to teach “evidence both for and against the theory” of evolution.¹⁷ When the school district determined that the content LeVake was teaching did not match their mandated curriculum, he was asked to modify his instruction. LeVake filed suit in the Third Judicial District of the State of Minnesota where Judge Bernard E. Borene dismissed the case declaring LeVake did not have a free speech right to override the curriculum, nor was the district guilty of religious discrimination.¹⁷

In January 2005, U.S. District Judge Clarence Cooper ruled that an evolution-warning label, required in Cobb County textbooks, violated the Establishment Clause of the First Amendment. The stickers 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.”¹⁸

Following the ruling, the Cobb County School District removed the stickers while they awaited their appeal to the 11th Circuit Court. In May 2006, the Appeals Court remanded the

¹⁶Freiler v Tangipahoa Parish Board of Education, 185 F.3d 337 (5th Cir. 1999)

¹⁷Rodney LeVake v Independent School District 656, et al., C8-00-1613 (Minn. Ct. App. 2001)

¹⁸Selman et al. v. Cobb County School District et al., 449 F.3d 1320 (11th Cir. 2006)

case to the district court for clarification of the evidentiary record and on December 19, 2006, the lawsuit reached a settlement; the Cobb County School District agreed not to order the placement of “any stickers, labels, stamps, inscriptions, or other warnings or disclaimers bearing language substantially similar to that used on the sticker that is the subject of this action” and would not undermine science education in the future.¹⁸

The most significant recent case, leading to constitutional boundary, was the first to directly challenge a public school district mandating intelligent design curriculum, as an alternative to evolution. The plaintiffs successfully argued intelligent design is a creationism variant and the Dover Area School District board policy violated the Establishment Clause of the First Amendment. The “Intelligent Design” policy included a statement in the science curriculum that “students will be made aware of gaps/problems in Darwin’s Theory and other theories of evolution including, but not limited to, intelligent design.”¹ Teachers were further mandated to announce to students

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.¹

The judge ordered the Dover Area School Board to refrain from maintaining an Intelligent Design Policy in any school within the Dover Area School District and noted “Intelligent Design cannot uncouple itself from its creationist, and thus religious, antecedents.”¹ Furthermore, Judge Jones stated Intelligent Design “is not science and cannot be adjudged a valid, accepted scientific

theory as it has failed to publish in peer-reviewed journals, engage in research and testing, and gain acceptance in the scientific community.”¹

Another case of interest regarding curriculum and Intelligent Design resulted from a suit filed January 10, 2006 by the Americans United for Separation of Church and State on behalf of eleven parents against the school board, superintendent, and a teacher in the El Tejon School District in Lebec, California. The lawsuit concerned a class already in session in the El Tejon School District high school. Several parents raised objections to the class when it was first proposed to the school board in December 2005. The course description, syllabus, and materials indicated that the class would advocate creationism and intelligent design and undermine evolution education. The course description, as presented by the high school, read:

Philosophy of Intelligent Design: This class will take a close look at evolution as a theory and will discuss the scientific, biological, and biblical aspects that suggest why Darwin’s philosophy is not rock solid. This class will discuss Intelligent Design as an alternative response to evolution. Topics that will be covered are the age of the earth, a world wide flood, dinosaurs, pre-human fossils, dating methods, DNA, radioisotopes, and geological evidence. Physical and chemical evidence will be presented suggesting the earth is thousands of years old, not billions. The class will include lecture discussions, guest speakers, and videos. The class grade will be based on a position paper in which students will support or refute the theory of evolution (Matzke, 2008).

The case came to a quick resolution when the El Tejon School District agreed to immediately stop the course and agree not to offer again the course “entitled ‘Philosophy of Design’ or

‘Philosophy of Intelligent Design’ or any other course that promotes or endorses creationism, creation science, or intelligent design” (Matzke, 2008).

Resulting Science Curricula

The legal challenges science evolution curricula faced over the last near century parallel the legislative statutes, district mandates and local school policies teachers have contended with. In the 1920s, more than thirty legislative bills proposing to make the teaching of evolution in public schools illegal were introduced in 20 states (Phelps, 1926). Although most were unsuccessful in the courtroom, they were an intimidating force for teachers, policy makers, and textbook publishers. This intimidation was effective in directing curriculum. Many high school biology textbooks of the era failed to emphasize evolution in a manner commensurate with its status as a unifying concept in biology (Skoog, 1979, 1984). Thirty-three of sixty-six textbooks published for high school biology courses between 1900 and 1960 failed to use the word evolution in the text (Skoog, 1979). Coverage of evolution within texts became more comprehensive from the 1960s to 1990s, yet still lacked detail as a result of persistent pressures from antievolutionists, which also impacted science teachers (Skoog, 1984, 1992). Recent public high school biology textbook reviews found them “factually accurate” covering “the basics of evolution at a level... understandable for high school students” (Hillis, 2007, p. 1261). Although indications are that textbook content on evolution is improving, boards of education contend with negative public reviews, during adoption review processes, because texts do not “cover alternatives to evolution by natural selection” (Hillis, 2007, p. 1261).

The National Academy of Sciences released *Teaching About Evolution and the Nature of Science* in 1998 where they maintain “evolution is the central organizing principle that biologists use to understand the world” and that to “teach biology without explaining evolution deprives

students of a powerful concept that brings great order and coherence to our understanding of life” (National Academy of Sciences, 1998, p. 3). Multiple studies demonstrate many biology teachers fail to emphasize evolution to this degree (Berkman & Plutzer, 2010; see also Aguillard, 1999; Shankar, 1989; Zimmerman, 1987).

The level of importance society places on science literacy is reflected in educational reform efforts. The standards-based instructional movement influenced the development of *Goals 2000: Educate America*, which asserted that by year 2000, American students would be “first in the world in mathematics and science achievement” (Goals 2000: Educate America Act, 1994, p. 23). States have formulated standards and curriculum frameworks influenced by *The National Science Education Standards* (National Research Council, 1996) and Project 2061’s *Benchmarks for Scientific Literacy* (American Association for the Advancement of Science, 1993) (Skoog, 2002). State standards have the potential to influence all aspects of educational policy and practice, as they are designed to provide a direction for science education through the organization of content, transform teaching practice while linking policy and subject content (Blank, 1996). National Research Council policy recommendations for “rigorous instruction in evolution” were influential for states adopting standards promoting “evolution teaching” (Larson, 2003, p. 197). Illustrating both the importance of science standards and the interest society placed specifically on standards involving the teaching of evolution was the nationwide response the Kansas State Board of Education received in August, 1999 after approving standards that included only portions of evolution theory (Holden, 1999). Forty-nine states adopted, in some manner, education standards promoting evolution teaching by 2000 (Berkman & Plutzer, 2010).

Curriculum standards whether they are at the National, State or local level are policy documents developed via a political process (Lerner, 2000; see also Bybee, 1997; Collins, 1998).

Thus, it is little surprise they generally enjoy public support (Doyle, 1999). Because state standards are critical and a primary force in directing curriculum decisions, the absence or presence of concepts regarding evolution provide evidence of whether the historical marginalization of evolution in the science curriculum is continuing or being diminished (Skoog, 2004). Although standards presumably describe what students are to learn, classroom practices do not always aligned with standards for science education (Weiss 1997; see also Berkman & Plutzer, 2010). The question that must be answered is if science standards make a difference, will they in evolution education?

A study explored the relationship of state standards for the teaching of evolution to the actual teaching of the subject using Lerner's (2000) analysis of states' standards for the teaching of evolution as an indicator of the quality of those standards. Lerner (2000) used a variety of criteria to make his evaluations reporting:

- ten states do a very good to excellent job of treating evolution in their educational standards (i.e., received a grade of A).
- fourteen states do a good job (grade of B).
- seven states do a satisfactory job (grade of C).
- six states do an unsatisfactory job (grade of D).
- thirteen states received a grade of F or F-, indicating that their standards are "useless for purposes of teaching evolution" (p. 287).
- ten of the states receiving grades of D or worse do not use the word evolution in their educational guidelines, and one (Maine) uses it only once.

Table 1 summarizes the relationship of states' standards for teaching evolution (Lerner, 2000) to the evolution-related attitudes and actions of biology teachers in those states (Moore, 2002). Although limited survey data existed at the time, Moore maintained he was able to draw consistent conclusions. States with low standards for the teaching of evolution, including Georgia, had larger percentages of public school biology teachers believing creationism should be taught in public schools (see Table 1, page 28). The presence of unsatisfactory or useless standards for teaching evolution also coincided, Moore claimed, with biology teachers' lack of emphasis on evolution and with states' anti-science policies such as biology textbook disclaimers (2002).

Moore further concluded that states with “good” (e.g., Minnesota, South Dakota) or “excellent to very good” (Indiana, Pennsylvania) standards for teaching evolution have surprisingly large percentages of biology teachers spending little time teaching it, believe that creationism should be included in science classes, and question the scientific validity of evolution as is indicated by Table 2 (Moore, 2002, p. 378).

Evident from Moore’s study is that high standards for the teaching of evolution do not ensure all biology teachers will teach the subject; however, standards are necessary to provide support for teachers. Without these standards in place teachers would be without pedagogical guidance and likely succumb to pressures from creationists in the community; their desire being creationism be taught alongside evolution or that evolution not be taught. Additionally, when high standards for teaching evolution exist it can be determined whether evolution is taught or ignored in a biology class (Moore, 2002). State standards alone do not explain differences in teaching practices; ultimately, the success and status of evolution-related education lies with the

classroom teacher’s instruction, as their personal beliefs appear to be a better predictor than standards on the implemented curriculum (Berkman & Plutzer, 2010).

Table 1		
<i>Lerner’s State Standards in Evolution – Moore’s Action of Biology Teachers</i>		
State	Rating	Findings
MN	B	40% of biology teachers spend little or no time teaching evolution (Hessler, 2000)
OH	F	15% of biology teachers teach creationism; Most school board presidents believe that creationism should be taught in science classes; 38% of biology teachers want creationism to be taught in science classes (Zimmerman, 1987)
OK	F	33% of biology teachers place little or no emphasis on evolution (Weld & McNew 1999)
OR	B	26% of biology teachers teach creationism in their classes (Affannato, 1986)
PN	A	33% of biology teachers do not believe that evolution is central to biology (Weld & McNew, 1999)
SD	B	1) 39% of biology teachers believe that creationism should be taught in science classes (Weld & McNew, 1999) 2) 16% of biology teachers teach creationism in their classes (Tatina, 1989)
TN	F	23% of biology teachers place little or no emphasis on evolution (Weld & McNew, 1999)
TX	C	Evolution receives inadequate coverage in at least half of all biology classes (Shankar, 1990) & (Shankar & Skoog, 1993)
AL	D	All biology textbooks used in public schools include a disclaimer stating that evolution is a “theory, not fact” (Moore, 2002, p. 379)
GA	F	29% of biology teachers feel pressured to decrease their coverage of evolution or increase their coverage of creationism, or both; 30%-32% of biology teachers want creationism to be taught in science classes; 27% of biology teachers teach creationism (Eglin, 1983) & (Buckner, 1983)
IL	D	30% of biology teachers want creationism to be taught in science class (Nickels and Drummond, 1988)
IN	A	33% of biology teachers spend less than 3 days on evolution; 43% of biology teachers characterize their teaching of evolution as advanced or briefly mention; At least 20% of biology teachers do not accept or are undecided about the scientific validity of evolution (Rutledge & Warden, 2000) & (Rutledge & Mitchell, 2002)
KS	D	In some schools, up to 50% of biology teachers want creationism to be taught in science classes (Aldrich, 1991)
KY	D	Education officials group evolution with gun control and other controversial topics as subjects that "may or may not be suitable for assessment items" on state

		exams (Scanlon & Uy, 1999, p. A10) 21% of biology teachers feel pressured to decrease their coverage of evolution or increase their coverage of creationism, or both; 69% of biology teachers want creationism to be taught in science classes; 30% of biology teachers teach creationism (Ellis, 1986)
LA	C	29% of biology teachers want to teach creationism in their classes; 14% of biology teachers teach creationism; 24% of biology teachers believe that creationism is a scientifically valid concept, and another 17% believe that creationism may be scientifically valid; 23% of biology teachers place little or no emphasis on evolution in their courses (Aguillard, 1999) & (Moore, 1999)

Policy, Curriculum and Practice in Georgia

The State of Georgia science curriculum standards Lerner and Moore used in their respective studies have changed dramatically. Marshall S. Smith and Jennifer O’Day’s *Systemic School Reform* (1990) offer insights as to how policy implementations can cause educational reform and thus impact instruction in our schools and our students. The State of Georgia revised their mandated curriculum and created the Georgia Performance Standards (GPS) utilizing Project 2061’s Benchmarks for Science Literacy as the core of the curriculum while maintaining alignment to the National Research Council’s National Science Education Standards (Georgia Department of Education, 2006). Inclusion of evolution in the GPS is in essence a policy statement from the State of Georgia Department of Education and Superintendent’s Office. The addition of evolution to the content of the end of course test (EOCT) in 9th grade biology and to the Georgia High School Science Graduation Test (GHSSGT) adds a level of accountability to the policy.

The Georgia Board of Education made their intentions and expectation clear by releasing the following statement when unveiling the new GPS.¹⁹

¹⁹Georgia Department of Education. (2004, February 12). *Statement of expectations for the new Georgia curriculum*. Retrieved from <http://www.doe.k12.ga.us/doe/media/04/021204b.asp>

The Georgia Board of Education expects the new Georgia curriculum to be world-class, beginning with full inclusion of the recognized national standards in each curriculum area, and enhanced by proven curriculum successes both within the state and beyond. We expect the new Georgia curriculum to be in alignment with national assessments.

The Georgia Board of Education expects the new Georgia curriculum to be a document which is embraced by education professionals, respected internationally, and will result in Georgia leading the nation in improving student achievement.

The Georgia Board of Education recognizes our state curriculum as a living document, requiring continuous improvement and professional learning.

The Georgia Board of Education knows that the success of such a curriculum will depend on aggressive support of teachers and local system leaders in its implementation.

Let the word go out that the Georgia Board of Education fully intends to provide this support to educators and seek the funding necessary for its successful implementation.

Creation of Georgia's standards stems from the Quality Basic Education Act of 1985 (QBE) requiring Georgia Department of Education develop and maintain a curriculum that specifies what students are expected to know in each subject and grade.²⁰ The remaining requirement to satisfy wholly the QBE, is a series of standardized tests that align to the curriculum; Georgia meets the criteria using the Criterion Referenced Competency Test (CRCT)

²⁰Georgia Department of Education. (2004, January 14). *Georgia performance standards frequently asked questions*. Retrieved from <http://www.georgiastandards.org/faq.asp#faq1>

for grades 1-8 and End of Course Tests (EOCT) for select high school courses, including biology. The Georgia High School Graduation Test (GHS GT) for Grade 11, replaced by the EOCT, is phasing out as students entering high school under the previous mandate graduate or leave the system.

Although Georgia Department of Education provides required curriculum content, they do so in a manner that gives local systems the greatest control, electing not to mandate a statewide adoption of textbooks or curriculum materials. They view their input as a “guideline for instruction that helps teachers, students, and parents know what topics must be covered and mastered for a particular course.”¹⁹ Thus, curriculum in essence is a minimum standard that allows local systems or even teachers to add to these requirements and provide supplemental materials as long as they extend beyond the stated requirements. Actually, the Georgia Department of Education further supports this by stating they encourage teachers to “incorporate extra activities and projects that will stimulate critical thinking and in-depth learning on the part of their students.”¹⁹

The revision of performance standards differs from the previous curriculum content standards in several areas. Previously, the teacher was told what concepts a student was expected to master, but now standards are to include suggested tasks, sample student work, and teacher commentary on that work.¹⁹ The purpose of the performance standards is to provide clear expectations for assessment, instruction, and student work by defining the level of work that demonstrates achievement of the standard. Georgia maintains that the performance standards “isolate and identify the skills needed to use the knowledge and skills to problem-solve, reason, communicate, and make connections with other information” and “tell the teacher how to assess

the extent to which the student knows the material or can manipulate and apply the information.”¹⁹

Accountability, via testing, for the Georgia Performance Standards began during the 2005-2006 school year. Test alignment is complete for the “CRCT, GHS GT and EOCT of ELA K-12, Math 6, and Science 6, 7 & 9 -12.”²¹ The theory of evolution is included in the following areas of the GPS and thus is applicable to draw questions from for the EOCT in 9th grade biology or the science portion of the GHS GT.²²

Table 2	
<i>Evolution of Life</i>	
The basic idea of biological evolution is that the earth's present-day species developed from earlier, distinctly different species.	5b
Molecular evidence substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched off from one another.	5b
Natural selection provides the following mechanism for evolution: Some variation in heritable characteristics exists within every species, some of these characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.	4efg
Heritable characteristics can be observed at molecular and whole-organism levels-in structure, chemistry, or behavior. These characteristics strongly influence what capabilities an organism will have and how it will react, and therefore influence how likely it is to survive and reproduce.	5b
New heritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells. Changes in other cells of an organism cannot be passed on to the next generation.	2e 5b

²¹Georgia Department of Education. (2004, January 14). *Georgia performance standards proposed curriculum revision process*. Retrieved from

http://www.georgiastandards.org/_documents/gps_implementation.pdf

²²Georgia Department of Education. (2004, January 14). *Georgia performance standards biology alignment to benchmarks for scientific literacy*. Retrieved from

http://www.georgiastandards.org/_documents/science/ScienceHS-biology-alignment.pdf

Natural selection leads to organisms that are well suited for survival in particular environments. Chance alone can result in the persistence of some heritable characteristics having no survival or reproductive advantage or disadvantage for the organism. When an environment changes, the survival value of some inherited characteristics may change.	4ef
The theory of natural selection provides a scientific explanation for the history of life on earth as depicted in the fossil record and in the similarities evident within the diversity of existing organisms.	5bc
Life on earth is thought to have begun as simple, one-celled organisms about 4 billion years ago. During the first 2 billion years, only single-cell microorganisms existed, but once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved.	5b
Evolution builds on what already exists, so the more variety there is, the more there can be in the future. But evolution does not necessitate long-term progress in some set direction. Evolutionary changes appear to be like the growth of a bush: Some branches survive from the beginning with little or no change, many die out altogether, and others branch repeatedly, sometimes giving rise to more complex organisms.	5bd

To maintain compliance with the Georgia Department of Education, teachers must teach evolution in concrete terms. However, Georgia’s policy shift largely remained a silent one in many areas, perhaps intentionally given the nature of the controversy. Smith and O’Day explain schools must be restructured from within requiring teachers’ active participation (1990). They maintain reform efforts that have enjoyed success have extended up from individual schools to influence schools around them and their local system. This type of reform is not likely to happen with the teaching of evolution theory in that the controversy, one could argue, has changed little in the past 30 years. Also noted and supporting this position is the requirement of community and parents to ensure successful reform efforts (Smith, 1990). This model will most likely never be applicable for the evolution/creationism controversy for, if handled democratically, creationism would join evolution in the curriculum. A review of three decades of surveys and polls consistently demonstrates the publics’ preference for the teaching of creationism and evolution; thus, not one state employs science standards reflective of the “wishes of the majority of citizens” (Berkman & Plutzer, 2010, p.27). It appears the topic remains controversial at the

community level across the state of Georgia and the nation and will remain so in the foreseeable future.

Smith and O'Day go to great lengths to note that systemic barriers exist within our schools and maintain the bureaucracy of schools itself is inherent to resisting change. Schools are embedded in a fragmented, complex, multi-layered policy system (Cohen, 1990). This fragmented system creates a what-is-said versus what-is-done culture within reform efforts. One notable area of reform struggle is within the area of teacher training and curriculum. Periodic reform has not successfully addressed these areas and the implementation of the Georgia Performance Standards reflects this. Georgia's own timeline for the implementation of their standards called for teacher training in the area of "professional learning for specific content areas" to follow test alignment.²⁴ Thus, accountability actually took place prior to any state coordinated teacher training. The implementation of testing occurred during the 2005-2006 school year.¹⁹ In 2001-2002, Georgia employed 97,563 public school teachers from kindergarten through twelfth grade;²³ yet, only 2,800 teachers received the benefit of a total of "20 days of subject matter training."²⁴ Although it is nice sessions received a 95% or higher satisfaction rating by the participants and that sixty additional training sessions were planned, it is insufficient to have trained, pedagogical knowledge aside, less than 3% of Georgia teachers on the new standards before assessment takes place. A recent nationwide evaluation of educators regarding the evolution/creationism controversy indicates state standards do not always reflect teacher practices (Berkman & Plutzer, 2010). A disconnect between standards' creation, written curriculum, and implementation certainly impairs their effective practice.

²³The Heritage Foundation. (2004, April). *Policy research and analysis. School choice*. Retrieved from <http://www.heritage.org/Research/Education/Schools/georgia.cfm>

²⁴Georgia Department of Education. (2005, February 17). *Georgia's new math and english/language arts standards receive high marks on national academic standards report card*. Retrieved from <http://www.doe.k12.ga.us/doe/media/05/021705.asp>

Professional development is critical to any reform movement be it within a school, a system or statewide. Smith and O'Day found disjuncture exists between teacher knowledge and teacher practice in the classroom. Additionally, they identified that this disjuncture continues from the end of the teacher's educational process and is not adequately identified through certification and licensing (Smith, 1990). This information demonstrates that instructional guidance is paramount to affecting any desired curriculum or instructional change and responsibilities lie at different levels. At the building level the primary responsibility is to "develop a stimulating, supportive and creative environment to maximize student achievement" (Smith, 1990, p.254). A productive workplace and required resources to support professional educators instructing students must support this pinnacle; however, in the case of the teaching of evolution, via Georgia Performance Standards, the foundation is weakened by the lack of infrastructure for instructional guidance.

Without such an infrastructure in place a mixed message is sent throughout the state. In our present educational era with increased emphasis placed on school accountability and high stakes testing, why would teacher training follow student and school accountability? Is the State Board satisfied with just the mention of evolution in the curriculum standards? Are they concerned that directly implementing teacher training would offend local communities and thus risk a confrontation potentially threatening support in other areas? Whatever the reason, the lack of infrastructure will reduce the effectiveness and uniformity of the teaching of evolution and perhaps other performance standards in Georgia. No longer should the Georgia Department of Education answer the question, "How will teachers be trained on standards?" with "Details coming soon."¹⁹

Without specific direction from the state or other administrative element, secondary school teachers are going to respond to Georgia Performance Standards and subsequent assessments in a multitude of ways. Whereas many are predictable, the teaching of evolution presents unique challenges. Educators are professionals and thus accountable to the public and Marshall provides insight into how that accountability can be broken down (1996). Formal accountability is given by the state and the system in the form of mandates on what are expected students learn. However, there exists the great possibility of a conflict in the teaching of evolution between teachers' individual responsibility and expectations within the local school and community.

School culture is often dictated by locally determined norms and if fundamentalist Christian beliefs dominate the community, the mandated teaching is at odds with the local belief structure. Individual teachers may view the teaching of evolution as a moral conflict between the professionalism of teaching and their personal code of ethics. To this point a recent study concluded "personal belief" to be the "most powerful predictor" of teacher practices in the classroom on both sides of the evolution/creationism controversy (Berkman & Plutzer, 2010, p.189).

Siskin (1995) points out that division exist within the schools and departments. Similarly, Hargraves and MacMillan use the term balkanization to explain the isolation that can exist amongst teachers or teacher subgroups in a school (Hargraves & Macmillan, 1995). These divisions, when they exist in a school, make it difficult, at best, to discuss controversial topics amongst those within a department. As a result, alliances within departments form into sub-communities providing conditions for varied curriculum within a single school (Siskin, 1995). Regarding the teaching of evolution,

Professional contacts and friendships tie curriculum together and depending upon the community create a comfort zone teachers can find it difficult to remove themselves from. These friendships and contacts most often stem from community relationships; thus, the local community ultimately can influence classroom instruction. With the teaching of evolution being such an area of controversy for so many years, a fight against the standards could ensue in some localities if the subject matter is viewed as being forced on the local schools. Ultimately, department divisions are reinforced both externally and internally and this must be taken into consideration whenever changes in curriculum are desired (Siskin, 1995). Compounding this further is the appreciation such practices, in cases, extend to administrative leadership where the recruitment of individuals with similar views further exasperates desired curriculum shifts from community norms (Percival, Johnson & Neiman, 2009).

Balkanization can isolate individual teachers within a school when their personal views conflict with others in the school and alliances can form creating subgroups that can further insulate themselves from each other (Hargraves & Macmillan, 1995). The impact here is magnified when we realize that the opportunity for professional learning and exchange occurs mainly within subgroups culminating in a great disparity between what teachers in one subgroup know and believe from another (Ball, 1981; see also Goodson & Ball, 1984). Departmental structures can then become polarized and, although they may reflect the views of the community, they make change difficult at best. Furthermore, departmental balkanization has not easily been changed by strategies in secondary schools compounding the difficulty (Siskin, 1995).

These insights compliment the hardships Smith and O'Day point out in their research on systemic school reform. Teachers will always be the instruments responsible for curriculum change. With the teaching of evolution being such a controversial subject, the issue is

compounded substantially. A prediction as to how change in Georgia may commence or what possible impact Georgia Performance Standards or Next Generation Science Standards may have should not be attempted because a pulse on where teachers are in the classroom with this issue currently does not exist. Clearly, some larger secondary school science departments may become balkanized on this issue and predictably some teachers will refuse to teach the Georgia Performance Standards, as written, based on self-proclaimed moral and ethical grounds. Ultimately, as Marshall points out, teaching is an isolated activity and, as Joseph Schwab demonstrated, curriculum problems are of such a nature they can not be solved procedurally; he further argued, “solutions to them must be found by an interactive consideration of means and ends” (Reid, 1999; see also Schwab, 1978, p. 289).

Thus, Schwab too maintains curriculum problems face uncertain practical questions that cannot be effectively solved via mandated standards and legislation alone, but require the teacher within the classroom. The importance of practice in regards to curriculum standards can not be underestimated and must be investigated further as Schwab illustrates that curriculum “planners engage with the problems of curriculum making, and teachers and students with its translation into activities” (Schwab, 1978, p. 319).

CHAPTER 3

METHODOLOGY

This chapter includes the hypothesis, experimental design, statistical treatment, definitions and limitations. The design of the questionnaire and its validation are described in the population and sample selection outlined.

Central Presumption and Overall Hypothesis

In teaching and learning at secondary level, teacher and student interaction is here presumed to be an influential factor. Specifically, teachers' attitudes toward controversial elements in the high school Biology curriculum are expected to contribute to their students' acceptance or rejection of these elements, and therefore factors related to teachers' attitudes are of interest. Teachers' religiosity, religious beliefs, educational and professional background, age, cognizance of the role of evolution in the biology curriculum, and familiarity with creationism may be correlated with their attitudes and consequently potentially be reflected in their students' decisions. Likewise, characteristics of the surrounding community (size/setting, degree to which evolution/creation is a source of controversy) might influence teacher attitude. The formal null hypotheses used to evaluate this overall hypothesis are enumerated below.

Hypothesis One

The attitude of Georgia biology teachers toward teaching creationism is not related to the degree of religiosity of the teacher.

Hypothesis Two

The attitude of Georgia biology teachers toward teaching creationism is not related to the liberality or conservatism of the teacher's religious beliefs.

Hypothesis Three

The attitude of Georgia biology teachers toward teaching creationism is not related to the teacher's understanding of the relation of evolution to high school science curriculum.

Hypothesis Four

The attitude of Georgia biology teachers toward teaching creationism is not related to the teacher's familiarity with the creationist movement and its literature.

Hypothesis Five

The attitude of Georgia biology teachers toward teaching creationism is not related to the amount of controversy creationism has generated in the community.

Hypothesis Six

The attitude of Georgia biology teachers toward teaching creationism is not related to the size community the school represents.

Hypothesis Seven

The attitude of Georgia biology teachers toward teaching creationism is not related to the academic degree held by the teacher.

Hypothesis Eight

The attitude of Georgia biology teachers toward teaching creationism is not related to the age of the teacher.

Hypothesis Nine

The attitude of Georgia biology teachers toward teaching creationism is not related to the length of the teacher's professional experience.

Hypothesis Ten

The attitude of Georgia biology teachers toward teaching creationism is not related to the teacher's specialization in science.

The Research Design

The survey was conducted via email invitation to all known certified science teachers of biology or biology sciences at 458 public high schools throughout the state of Georgia. Although state standards for evolution exist in Georgia public high school earth science courses, these instructors were excluded because the distribution of schools electing to offer earth science was not evenly distributed across the state. Also excluded from the study were Department of Juvenile Justice and State Schools, as identified by the Georgia Department of Education, because of the unique nature of the teacher-student relationship within these institutions. Private schools were excluded because application of the First Amendment does not equitably apply.

The email invitation directed teachers to a third-party website hosting the survey; their email address served to gain entry to the site. The host company then generated a unique ID and password enabling them access to the survey while linking their ID to their respective

community size, be it rural, small-town, suburban, or urban. These processes ensured only invited participants accessed the survey while maintaining anonymity.

The Questionnaire

A questionnaire was designed to follow a Georgia study of science teachers completed in 1983 for purposes of comparison (Eglin, 1983). Additional questions were designed to determine the teacher's attitude regarding the addition of evolution content to Georgia curriculum toward creationism. Forty questions allowed respondents to choose between three choices: agree, disagree, or don't know. Respondents were further directed to choose the third response if they neither agreed nor disagreed or if the question was not applicable.

Eleven questions were designed to determine the teacher's attitude toward creationism, and at least four questions were assigned to each of the following areas of interest:

1. Familiarity with creationism
2. Self-related religiosity
3. Present religious beliefs
4. Opinions about the importance of evolution in the science curriculum
5. Activity, influence and impact of the advocates of creationism in the local community

Table 1 lists areas studied, numbers of related questions, and direction of responses. The wording of each question offered both negative and positive choices for the same attitude; respondents also were provided a "don't know" option and could skip a question if they so desired. Questions assigned to each area were arranged in a logical order, yet not sequential. The questionnaire requested respondents' age, academic degree, length of teaching experience, and area of specialization.

The statewide survey inquired about the practices of teachers in presenting creationism and explored pressures exerted on teachers by administrators, school boards, and additional community elements. Respondents were asked how creationism should be presented, if at all, and the degree of opposition they would express if required to teach it. Teachers were questioned about present teaching practices of evolution and/or creationism and what forces were influential in any decision made about this teaching. The questionnaire contained a total of fifty-five questions. A copy may be located in Appendix A.

Area	Questions	Low Score	High Score
1. Familiarity with creationism	1, 2, 3, 4, 5	Familiar	Unfamiliar
2. Attitude toward teaching creationism	7, 8, 9, 10, 12*, 13*, 14, 33*, 38*, 39, 40	Favor teaching creationism	Oppose teaching creationism
3. Religiosity	16*, 18, 20, 21	Religious	Not religious
4. Liberal/conservative attitude toward religion	17, 20, 22*, 23, 24*, 30	Conservative	Liberal
5. Cognizance of importance of evolution in teaching science	26, 27, 28, 29*, 34, 37	Not cognizant	Cognizant
6. Community involvement in creation/evolution controversy	2, 3, 7, 11, 15, 25, 31, 32	Not a controversy in locality	Probably a controversy in locality
* indicates questions on which scores were reversed			

The Sample

The sample consisted of 147 educators teaching the scientific discipline of biology or biological related science in Georgia public secondary schools. Included in the population were secondary science teachers in public school systems. Excluded from the study were administrators, supervisors, college teachers, and support personnel such as state department of

education employees. Additionally, teachers from Department of Juvenile Justice and State Schools were excluded, as defined by Georgia Department of Education. Because of the unique nature of teacher-student relationships in these schools it was determined that teachers attitudes may not influence student decisions in a like manner as within traditional secondary schools. Direct involvement with students in a classroom was determined to be a requirement for participation in this study. For this reason administrators, supervisors, college teachers and support personnel were excluded. The desires of this study, in part, are to gain insight into teachers' attitudes across the state of Georgia. When looking at curriculum statewide, biology is taught mainly at the secondary school level necessitating the exclusion of elementary and middle school teachers.

The survey was administered in 2009 when 193 public school systems existed in Georgia. Student enrollment numbers and teachers employed were obtained from the Georgia State Department of Education. Schools were categorized according to their 2007-2008 average daily attendance (ADA) figures. The following guidelines were used to classify the school systems by community size:

1. Urban: over 20,000 ADA
2. Small town: 8000-20,000 ADA
3. Suburban: counties surrounding Atlanta, including Cobb, Gwinnett, Clayton and Fulton counties
4. Rural: less than 8000 ADA

With the exception of Atlanta, City school systems were included in the counties in which they exist. For example, Buford City Schools reside within Gwinnett County and thus

were classified suburban. Although Atlanta lies within Fulton County, for purposes of the study, Fulton County was classified suburban, whereas Atlanta urban.

Georgia’s total public school average daily attendance for 2007-2008 was 1,609,681. Using the aforementioned criteria 40% of Georgia’s schools are rural, 29% urban, 19% small town and 12% suburban. The number of teachers asked to participate in the sample is proportional to the populations since teachers from each school were invited.

Statistical Treatment

Testing of the hypothesis was carried out via the software program IBM SPSS Statistics Version 21. Each hypothesis was tested using either the Spearman rank correlation coefficient or chi-squared statistical procedures as outlined in Table 4.

Table 4	
<i>Statistical Procedures or Testing of Hypothesis</i>	
Hypothesis	Procedure
The attitude of Georgia biology teachers toward teaching creationism is not related to the:	Spearman rank correlation coefficient analysis of attitude toward creationism vs. scores on the dimensions:
1. degree of religiosity of the teacher	1. degree religiosity
2. liberality of the teacher’s religious beliefs	2. liberal-conservative views of religion
3. teacher’s understanding of the relation of evolution to high school science curriculum	3. understanding of the importance of evolution to science
4. teacher’s familiarity with the creationist movement and literature	4. familiarity of the importance of evolution to science
5. amount of controversy creationism has generated in the community	5. amount of controversy generated in the community
	Spearman rank correlation coefficient analysis of attitude toward creationism vs.:
6. size community the school represents	6. community size
7. teacher’s academic degree	7. teacher’s academic degree
8. teacher’s age	8. teacher’s age
9. length of teaching experience	9. length of teaching experience
	Chi-Squared analysis of attitude toward creationism vs.:
10. teacher’s area of specialization	10. teacher’s area of specialization

Definition of Terms

For the purposes of this study the following definition of terms are provided for clarity of discussion.

Attitude: When used in the answering of questions or testing the hypotheses in this study, attitude reflects a position attributed to a teacher or group based on responses to an area surveyed and is not intended to reflect a belief.

Creation-science: The definition for creation-science is adopted from several legislative acts of the early 1980's. These include Act 590 of the Arkansas General Assembly (1981), Senate Bill No. 86 of the Louisiana Legislature (1981) and House Bill 690 of the Georgia General Assembly (1980).²⁵ The wording for each of these legislative acts is the same:

Creation-science means the scientific evidences for creation and inferences from those scientific evidences. Creation-science includes the scientific evidences and related inferences that indicate: (1) Sudden creation of the universe, energy, and life from nothing; (2) The insufficiency of mutation and natural selection in bringing about development of all living kinds from a single organism; (3) Changes only within fixed limits of originally created kinds of plants and animals; (4) Separate ancestry for man and apes; (5) Explanation of the Earth's geology by catastrophism, including the occurrence of a worldwide flood; and (6) A relatively recent inception of the earth and living kinds.

Creationism: Creationism, synonymous with creation-science or scientific creationism meaning the belief in a rapid and relatively recent creation of the universe in its present form.

²⁵Act 590 of 1981, Ark. Stat. Ann. secs. 80-1663 (1981); Balanced Treatment for Creation-Science and Evolution-Science Act, LA. Rev. Stat., secs. 3701-3706 (1981); Balanced Treatment for Creation-Science and Evolution-Science Act, H.B. 690, Gen. Assembly of Georgia (1979-1981).

Creationist: The term creationist refers to an individual whose belief system is parallel to the requirements for membership in the Creation Research Society. The Creation Research Society statement of belief includes:

1. The *Bible* is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in the original autographs. To the student of nature this means that the account of origins in *Genesis* is a factual presentation of simple historical truths.
2. All basic types of living things, including man, were made by direct creative acts of God during the Creation Week described in *Genesis*. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.
3. The great flood described in *Genesis*, commonly referred to as the Noachian Flood, was an historic event worldwide in its extent and effect.

Curriculum: The term curriculum in education can hold a variety of detailed definitions. For purposes of this study curriculum is considered what students learn resulting from being in the classroom. This includes exposure to materials (standards directed or supplemental), practices, experiences, and interactions with teachers and classmates.

Darwinism includes both the theory of natural selection and the concept of evolution of species as described by Charles Darwin in *The Origin of Species* (1859) and *The Descent of Man* (1871).

Evolution: The theory that all living things on earth are here as a result of descent, with genetic modification, from a common ancestor.

Intelligent Design: The theory that matter, all forms of life, and universe were created by a designing intelligence.

Natural Selection: The mechanism proposed by Charles Darwin explaining evolutionary change through adaptation of an organism to the environment in which it lives. Organisms able to survive to maturity with the most well adapted attribute allows those favorable traits be passed to their offspring and subsequent generations.

High School: For the purposes of this study, a high school is defined as one that includes grades 9-12. Schools that included grades other than high school were included in the study; however, science teachers of underclassmen were not invited to participate in this study.

Microevolution is the development of variations of organisms within one species that may result in changes within a population.

Macroevolution is the development of a new species from another; gross changes that demonstrate both the origin of a new species while establishing higher taxonomic patterns.

Opinion: For purposes of this study, opinion is considered to be a candid subjective judgment or viewpoint in response to the question asked and is not to be considered a belief or attitude.

Religiosity: For purposes of this study, religiosity is used to classify a respondent's attitude toward religion practices ranging from regular participation to disinterest.

Religion (Liberality or Conservatism): For purposes of this study, liberality or conservatism in religion classified a respondents self-identified beliefs ranging from conservative theology to liberal theology.

Science Teacher: A high school teacher holding Georgia certification in one or more areas as deemed appropriate by the state of Georgia and teaching a course in biology or a biological science during the course of the day.

Limitations

The Sample

The study is limited to public schools and cannot be generalized to private schools since application of the First Amendment is not equitably applied to both groups. Designations regarding urban, suburban, small town, and rural are based on school enrollment figures and do not reflect National Science Foundation definitions on school size. It is possible in rural areas where several communities form one large school that their designation based on enrollment place them in the small town category rather than rural. Therefore, community size selection must be regarded as arbitrary.

The Bias

This study is of specific interest to me as a biologist, science educator and science education researcher. It is difficult, with such a passion for science and education, to remain passive after reading creationist materials attacking the ethics of scientists and educators or after witnessing difficulties some students encounter as they attempt to balance evolution with their religious beliefs. Nevertheless, every effort to maintain objective clarity was made in an effort to prevent any bias from appearing in this study.

The Scope

This study is not intended to supply motives for creationists or the political and social causes of the creationism movement. Likewise, this study does not attempt to draw any connection between creationists and conservative religious groups that may influence society today.

CHAPTER 4

RESULTS OF SURVEY

The purpose of this study was to document instances of the teaching of creationism in Georgia public high schools. That creationism is being taught in Georgia is indicated by response from teachers who taught creationism or both creationism and evolution. Their reasons for doing so are summarized in Table 12.

A second purpose of the study was to survey teachers about creationist activity in their communities and about their opinions of creationism in the curriculum, and to investigate relationships between their attitudes towards creationism and various characteristics. The results of this part of the survey begin on page 56.

Response and Respondents

An invitation to the participate in the questionnaire was sent to 1948 certified science teachers of biology or biology sciences at 458 public high schools throughout the state of Georgia. Of the emails sent, 248 were returned or refused by the district or school proxy server leaving a total of 1701 emails received electronically. The email invitation requested teachers desiring to participate go to a third-party website hosting the survey; their email address served to gain entry to the site. The host company then generated a unique identification and password that would grant them access to the survey. A total of 147 responses were received giving a response percent rate of 8.64%.

Each participant's school email address was linked to their community size be it rural, small-town, suburban, or urban. The host company then linked the unique identification they

generated to the respondent’s community size. These processes ensured only invited participants could have access to the survey while maintaining anonymity.

Ninety-three percent of respondents had backgrounds primarily in life science, 64% had advanced degrees, and 61% had been teaching 10 years or more. Characteristics of the respondents are summarized in Table 5.

Education Level – Highest Attained	Percentage of Respondents	Years Experience	Percentage of Respondents
Bachelors	15.9	Less than 10	38.6
Masters	55.9	10 – 20	40.7
Specialist	20.0	More than 20	20.7
Doctorate	8.3		
Science Background	Percentage of Respondents	Age	Percentage of Respondents
Life Science	93.8	Under 25	0.7
Physical Science	6.2	26 – 35	32.4
		36 – 45	29.7
		46 – 55	18.6
		Over 55	18.6

Answering the Questions

Question 1: How many teachers are familiar with the creationist movement?

Results are shown in Table 6. Almost all (92%) of the teachers responding were familiar with the term creation-science; however, 3.4% of the teachers responding were unfamiliar with the term. It is of interest to note 15% of participants of this study examined creationist text in comparison to 45% of respondents participating in a similar study in 1983. Similarly, respondents familiar with articles about creation science decreased 44.5% in the same time frame. Of all questions, the one about familiarity with creation science had the highest positive response. It is possible some non-respondents were teachers unfamiliar with the controversy surrounding creation science.

Question 2: How many teachers approve of including creationism in science courses, and how many would refuse to teach it if it were required? Is any biographical factor related to their position?

Results are shown in Table 7. The majority (65.3%) of teachers disapproved of teaching creationism, 22.4% approved while 12.3% remained undecided. A summary of responses attitudes towards teaching creationism is given in Table 7. Although a majority of respondents disapproved of teaching creationism, only 25.8% claimed they would actively oppose including creationism in science courses as outlined in Table 8. This is a notable increase in respondents compared to the 1983 study where a minority of 8% actively opposed the inclusion of creationism in science courses. Community size was not significantly associated with this decision, nor was the area of scientific expertise or age of the teacher. Educational level was not related to the decision to teach creationism, although the percent of refusals to teach creationism was higher among those with advanced degrees.

Table 6			
<i>Respondents' Familiarity With Creation Science</i>			
Question	Percentage of Respondents		
	Agree	Undecided	Disagree
Familiar with the term 'creation science'	91.8	4.8	3.4
Familiar with articles about creation science	39.5	29.9	30.6
Have examined creationist text	15.0	38.8	46.3

Teaching experience was not related to who would refuse to teach creationism. Likewise, those who would present it as a religious concept were evenly distributed. The vast majority (62.5%) of teachers with less than 10 years experience would ignore the requirement to teach creationism. Only 10% of teachers with more than 20 years experience would teach it as required. The implication being inexperienced teachers were more inclined to ignore the

requirement of teaching creationism whereas experienced teachers were less likely to teach it as required.

Table 7			
<i>Respondents' Attitudes Toward Creationism</i>			
Statements Favoring Creationism	Percent of Respondents		
	Agree	Undecided	Disagree
Creation-science should be included in biology courses.	22.4	6.1	71.4
Creation-science should be included in any courses dealing with the origin of man.	28.6	4.8	66.7
Creation-science should be included in any courses dealing with the origin of the earth and the universe.	20.4	4.8	74.8
If teaching creation-science were favored by a majority in the school district, it should be included in the curriculum.	20.4	9.5	70.1
Statements Opposing Creationism	Percent of Respondents		
Creation-science is a means of introducing a sectarian religious doctrine in the public schools.	51.7	29.3	19.0
I am opposed to teaching creation-science in science courses	65.3	2.7	32.0
I am opposed to teaching creation-science anywhere in the curriculum.	49.0	6.1	44.9
I would oppose giving equal time to creation-science no matter what the consequences to myself.	48.3	12.9	38.8

Question 3: With what materials and to what extent do teachers believe creationism should be taught, if at all?

Results are shown in Table 9. This question was asked of those who agree that creationism should be taught. Of the 22.4% of teachers who responded, 71.9% believed it should be taught with creationist materials purchased by their district or school. These teachers also felt creationism should be presented in any course where the age of the earth, development of the universe, or origin of man are part of the curriculum. Of those who agree creationism should be

taught, 65.8% opted to include it in any course bringing up these discussion points; 34.2% desired to confine creationism to biology courses only. Additionally, 50.7% desired it to be covered once during the course while 49.3% desiring equal emphasis whenever origins of man or the universe is discussed.

Question 4: How many teachers are actually teaching creationism, and what size communities do they represent?

Results are shown in Table 10. The majority of teachers, 78.2%, taught only evolution, 17.0% taught both creationism and evolution, 3.4 % taught only creationism, and 1.4% taught neither. The tendency to teach creationism in this study was quite different than that of 1983. Although 3.4% stated they teach creationism not one respondent was from a rural setting or a suburban setting. Of those teaching creationism, 60% of respondents practice in an urban environment whereas 40% teach in a small town. The previous study also had no teachers from rural or suburban communities teaching creationism. The tendency to teach neither was evenly distributed among small town and suburban respondents.

The response to this question was not related to the area of science background of the teacher with the exception of those responding to teach neither. The science background of all respondents teaching neither evolution nor creationism was that of physical science.

Table 8					
<i>Factors Influencing Respondents' Reaction to a Creationism Requirement</i>					
Community Size					
	Percent of Respondents				
	Rural	Small Town	Suburban	City	All (Out of total population)
Distribution of community size in sample	31.1	25.0	15.0	29.0	
Would refuse to teach creationism	42.1	13.1	10.5	34.2	25.8
Would ignore the requirement	18.8	12.5	12.5	56.2	10.9
Would present it, but as a religious concept	24.4	37.8	17.8	20.0	30.6
Would teach it as required	50.0	20.0	15.0	15.0	13.6
Made no response	27.0	27.0	18.9	27.0	25.1 ^a
^a These teachers presumably agree creationism should be taught.					
Academic Degree					
	Percent of Respondents				
	Bachelors	Masters	Specialist or Doctorate		
Distribution of degree in sample	15.6	55.1	27.9		
Would refuse to teach creationism	10.5	52.6	34.2		
Would ignore the requirement	25.0	68.8	6.2		
Would present it, but as a religious concept	8.9	53.3	35.6		
Would teach it as required	10.0	50.0	40.0		
Made no response	27.0	59.4	13.5		
Science Background					
	Percent of Respondents				
	Life Science	Physical Science			
Distribution of science background in sample	93.8	6.2			
Would refuse to teach creationism	89.5	7.9			
Would ignore the requirement	100.0	0.0			
Would present it, but as a religious concept	91.1	6.7			
Would teach it as required	100.0	0.0			
Made no response	91.9	8.9			
Age					
	Percent of Respondents				
	Under 25	26 – 35	36 – 45	46 – 55	Over 55
Distribution of age groups in sample	0.7	32.4	29.6	18.6	18.6
Would refuse to teach creationism	0.0	23.6	28.9	13.1	31.5
Would ignore the requirement	0.0	68.7	0.0	18.7	12.5
Would present it, but as a religious	2.2	24.4	22.2	20.0	28.8

concept					
Would teach it as required	0.0	35.0	35.0	25.0	5.0
Made no response	0.9	31.8	25.4	18.1	21.8
Teaching Experience					
	Percent of Respondents				
	Less than 10 years	10 – 20 years	More than 20 years		
Distribution of experience levels in sample	39.4	40.1	20.4		
Would refuse to teach creationism	34.2	31.6	34.2		
Would ignore the requirement	62.5	25.0	12.5		
Would present it, but as a religious concept	31.1	37.7	31.1		
Would teach it as required	40.0	50.0	10.0		
Made no response	38.1	37.2	24.5		

Question 5: How many teachers have been faced with a local proposal that creationism be taught?

Results are shown in Table 11. Fifteen percent of respondents reported teaching creation science had been proposed in their community. Almost 40% of teachers reported believing creationists influential in the community, but fewer than 1.4% had seen creationist books purchased by their district. The proposals to teach creationism were more frequently reported by teachers in urban systems (Table 18); 40.9% of urban teachers with the remaining distribution being almost even amongst rural, small-town, and suburban teachers. This differs greatly from the 1983 study where 84% of suburban teachers reported the teaching of creation science had been proposed in their community. Although only 3.4% of teachers expected punitive actions from supervisors were they to oppose teaching creation science, 40.8% did not know what to expect if put in such a situation. More than half (55.8%) of respondents and all community groups felt safe from supervisory retaliation.

Table 9	
<i>Response to the Question: To What Extent Should Creationism Be Taught?</i>	
Method and Place of Presentation	Percent of Responses
With creationist materials	71.9
With no purchased instructional aids	28.1
Only in biology courses	34.2
In any course dealing with origins	65.8
Once during the course	50.7
With equal emphasis whenever origins of man or the universe is treated	49.3

Question 6: What reasons do teachers give for teaching or rejecting creationism? Are school board requirements or administrative decisions frequently reported, and if so, is this typical of any certain size community?

Results are shown in Table 12. The most common reason given for teaching or rejecting creationism or evolution was school board requirement at 26.5%. Other significant reasons included administrative decision and pressure from parents. This deviates from the 1983 study where the majority (75%) of respondents listed personal conviction being the reason for teaching or rejecting creation science.

Question 7: Is a teacher's approval of creationism related to any of the following factors: familiarity with creationism, self rated religiosity, liberal or conservative religious beliefs, perception of the place of evolution in the science curriculum, local activity by creationist supporters, age, length of professional experience, degree level attained, specialization (biological or physical science), community size?

These relationships were investigated in the testing of the hypothesis. The results are reported in the section beginning on page 64.

Practices by Community					
	Percent of Respondents				
	Rural	Small Town	Suburban	City	All
Distribution of community size in sample	31.3	25.1	15.0	28.5	
Teach evolution	35.0	22.0	15.0	28.7	78.2
Teach creationism	0.0	40.0	0.0	60.0	3.4
Teach both	24.0	36.0	16.0	24.0	17.0
Teach neither	0.0	50.0	50.0	0.0	1.4
Practices by Science Background					
	Percent of Respondents				
	Life Science	Physical Science			
Distribution of science background in sample	93.8	6.2			
Teach evolution	93.8	6.2			
Teach creationism	100.0	0.0			
Teach both	100.0	0.0			
Teach neither	0.0	100.0			

Proposal To Teach Creationism			
Question	Percent of Respondents		
	Agree	Undecided	Disagree
Teaching creation-science has been proposed in my community.	15.0	38.8	46.3
Creation-science advocates are influential in my community.	39.5	29.9	30.6
I have seen creationist textbooks purchased in my school district.	1.4	5.4	93.2
If I were to oppose teaching creationism, my supervisors might take punitive action against me.	3.4	40.8	55.8

Question 8: How many teachers have personal doubts about the validity of evolution, and does the area of the teacher's scientific training influence such doubts?

The results are shown on Table 13. The majority of respondents (68.4%) were convinced that Darwin's Theory of Evolution is a valid explanation of human development, while 18.4% disagreed with this statement. This is about a 10% increase in respondents believing Darwin's

theory valid when compared to the 1983 study of Georgia science teachers while those disagreeing remained consistent. No relationship between opinions on this question and the science expertise of the teacher could be determined; however, 29.6% of respondents with a bachelor’s degree disagreed with the statement compared to 12% that agreed. No relationship could be identified with respondents with advanced degrees in either discipline. Agreement with the statement was consistent across all age groups with respect to the distribution in the sample, although half of teachers age 26 to 35 were undecided about it. Disagreement with evolution was most prevalent in respondents in the 36 to 45 year age group at 55.5% (Table 15).

Table 12					
<i>Reasons For Teaching Or Rejecting Creation-Science</i>					
Reason Given	Number of Respondents				
	Rural	Small Town	Suburban	City	All
Personal conviction	100.0	0.0	0.0	0.0	0.7
School board requirement	38.5	25.6	7.7	28.2	26.5
Student request	100.0	0.0	0.0	0.0	0.7
Administrative decision	18.7	18.7	31.2	31.2	10.9
Pressure from parents	10.0	30.0	10.0	50.0	6.8
Pressure from peers	0.0	0.0	0.0	100.0	0.7
Other	31.6	26.6	16.4	25.3	53.7

Comparing answers to this question with community size, it was found that the percentage of teachers agreeing exceeded the percentage of teachers disagreeing in each community size with the exception of a small town (Table 16). Twenty-two percent of teachers from small-town communities agreed with the statement compared to 33.3% that disagree and 30% remain undecided.

Table 13			
<i>Respondents' Belief in the Validity of Evolution</i>			
Response to the question: 'I am convinced that Darwin's theory of evolution essentially describes the means by which man developed.'			
Response	Percent of Respondents by Background		
	All	Life Science	Physical Science
Agree	68.4	92.0	6.0
Undecided	13.6	95.0	5.0
Disagree	18.4	92.6	7.4
Distribution in sample		93.8	6.2

Table 14			
<i>Respondents' Belief in the Validity of Evolution</i>			
Response to the question: 'I am convinced that Darwin's theory of evolution essentially describes the means by which man developed.'			
Response	Percent of Respondents by Degree		
	Bachelor's Degree	Master's Degree	Specialist or Doctorate
Agree	12.0	57.0	29.0
Undecided	15.0	60.0	25.0
Disagree	29.6	44.5	25.9
Distribution in sample	15.6	55.1	27.9

Question 9: To what extent have students expressed doubts about evolution because it conflicts with their religious beliefs?

Results are shown in Table 17. Sixty-eight percent of the teachers claimed to have students expressing concern regarding evolution conflicting with their religious beliefs while 72% of biology teachers admitted they avoid making “dogmatic” statements about evolution. There was a slightly greater tendency for students to question evolution in rural areas (35%) and urban areas (27%) when compared to small towns, or suburban areas. This nearly 50% increase since 1983 demonstrates student questioning of evolution and their personal conflict between evolution and their religious beliefs continues across all geographical regions of Georgia.

Table 15					
<i>Respondents' Belief in the Validity of Evolution</i>					
Response to the question: 'I am convinced that Darwin's theory of evolution essentially describes the means by which man developed.'					
Response	Percent of Respondents by Age				
	Under 25	26 – 35	36 – 45	46 – 55	Over 55
Agree	1.0	29.0	26.0	19.0	23.0
Undecided	0.0	50.0	10.0	20.0	20.0
Disagree	0.0	29.6	55.5	14.8	0.0
Distribution in sample	0.7	32.4	29.2	18.6	18.6

Table 16				
<i>Respondents' Belief in the Validity of Evolution</i>				
Response to the question: 'I am convinced that Darwin's theory of evolution essentially describes the means by which man developed.'				
Response	Percent of Respondents by Community Size			
	Rural	Small Town	Suburban	Urban
Agree	34.0	22.0	15.0	29.0
Undecided	20.0	30.0	15.0	35.0
Disagree	29.6	33.3	14.8	22.2
Distribution in sample	31.3	25.2	15.0	28.6

Question 10: Is creationist activity, as reported by the teachers, stronger in any particular size community?

Results are shown in Table 18. Most of the activity for creationism was reported in urban communities, where 40.9% of respondents reported proposals to teach creationism. Eighty-four percent of suburban respondents in 1983 reported proposals to teach creationism compared to only 18.2% in this study. It should be noted that four school districts near Atlanta (Fulton, Cobb, DeKalb, and Gwinnett counties) have experienced significant increases in population since 1983. Rural and suburban areas reported the least activity. Although 40.9% of respondents in urban areas reported a proposal to teach creationism, only 27.6% felt the proponents were active and no teachers reported seeing creation science materials purchased by their school district.

In small-town school districts, 24.1% of the teachers reported creation advocates being influential in their community whereas 17.8% disagree. This is the only discrepancy in regards to community size for this question. It is concluded that creationist activity, as perceived by teachers, is strongest in the urban settings around Atlanta; however, creation-science advocates exert influence in all geographic areas in Georgia.

Table 17					
<i>Students' Objection To Evolution</i>					
Response to the question: 'I frequently have students who are troubled by a conflict between evolution and their religious beliefs.'					
Response	Percent of Respondents by Community Size				
	All	Rural	Small Town	Suburban	Urban
Agree	68.0	35.0	21.0	17.0	27.0
Undecided	28.6	40.0	40.0	0.0	20.0
Disagree	3.4	21.4	33.3	11.9	33.3
Response to the question: 'I try to avoid making dogmatic statements about evolution in my classes.'					
Response	Percent of Respondents by Community Size				
	All	Rural	Small Town	Suburban	Urban
Agree	72.1	30.2	22.6	13.2	33.9
Undecided	25.9	100.0	0.0	0.0	0.0
Disagree	1.4	31.6	34.2	21.0	13.1

Table 18					
<i>Creationist Activity In Georgia</i>					
Response to the question: ‘The teaching of creation-science has been proposed in my community.’					
Response	Percent of Respondents by Community Size				
	All	Rural	Small Town	Suburban	Urban
Agree	15.0	18.2	22.7	18.2	40.9
Undecided	46.3	24.5	33.3	14.0	28.1
Disagree	38.8	41.2	19.1	14.7	25.0
Response to the question: ‘The advocates of creation-science are influential in my community.’					
Response	Percent of Respondents by Community Size				
	All	Rural	Small Town	Suburban	Urban
Agree	39.5	29.3	24.1	19.0	27.6
Undecided	30.6	32.0	34.1	4.6	30.0
Disagree	29.9	33.3	17.8	20.0	28.9
Response to the question: ‘I have seen books on creation- science in the materials purchased by my school district.’					
Response	Percent of Respondents by Community Size				
	All	Rural	Small Town	Suburban	Urban
Agree	1.4	0.0	50.0	50.0	0.0
Undecided	93.2	62.5	12.5	12.5	12.5
Disagree	5.4	29.9	25.5	14.6	29.9

Testing the Hypothesis

Methods

Portions of the questionnaire were designed to survey six specific categories (familiarity with creationism, attitude toward teaching creationism, religiosity, liberal/conservative attitude toward religion, cognizance of importance of evolution in teaching science, community involvement in creation/evolution controversy). Teachers’ responses produced ordinal data requiring ranking prior to hypothesis testing via statistical analysis. Spearman rank correlation was the appropriate choice for testing hypotheses one through nine, in part, because respondents had three choices when addressing questions in surveyed areas. The Spearman rank correlation measures the strength of association between two ordinal variables and is preferred over the

Pearson correlation when numeric data are believed to be non-interval. The Spearman rank correlation assumes a monotonic relationship between variables, but does not require assumption of a linear relationship. A Spearman rank correlation rho value (ρ) of 0 indicates no association, whereas +1 indicates a perfect association of ranks and -1 a perfect negative association of ranks.

Each hypothesis concerned the relationship between teachers' approval of teaching creation-science and other opinions and biographical data. The responses to eleven selected statements were compiled as a score indicating approval or disapproval of creationism. The statements were:

1. Creation science should be included in biology classes.
2. Creation science should be included in any science courses dealing with the origin of man.
3. Creation science should be included in any science courses dealing with the origin of the earth or the universe.
4. Creation science is not a religion, since it provides scientific proof for the theory of origins set forth in its books.
5. I am opposed to teaching creation science in any science class.
6. I am opposed to including creation science anywhere in the curriculum.
7. Even if creation science proved to have a religious foundation, I would still approve its inclusion in science classes.
8. Creation science is a means of introducing a sectarian religious doctrine into the public schools.
9. I would oppose giving equal time to creation science along with evolution, no matter what the consequences to myself.

10. If teaching creation science is what a majority of the people on my school district want done, it should be included in the curriculum.

11. The issue of equal time for creation science does not concern me.

Each question allowed respondents to choose between three choices: agree, disagree, or don't know. Respondents were further directed to choose the third response if they neither agreed nor disagreed or if the question was not applicable. Because score totals for these eleven questions determine their attitude, a respondent choosing "unknown" would have a total score skewed low (towards disapproval). To prevent manipulation of data, each respondent's total was modified to a percent value based on the number of questions they either agreed or disagreed with. Analysis of the data indicated a bimodal distribution as seen in the histogram below (Figure 1). Therefore, a low score indicates approval for teaching creationism; a high score, disapproval; scores in the middle range indicates the respondent is undecided or indifferent. Further analysis of the scores revealed that 46.9% of the respondents disapproved and 26.5% approved of the teaching of creationism, while 26.5% were undecided or indifferent.

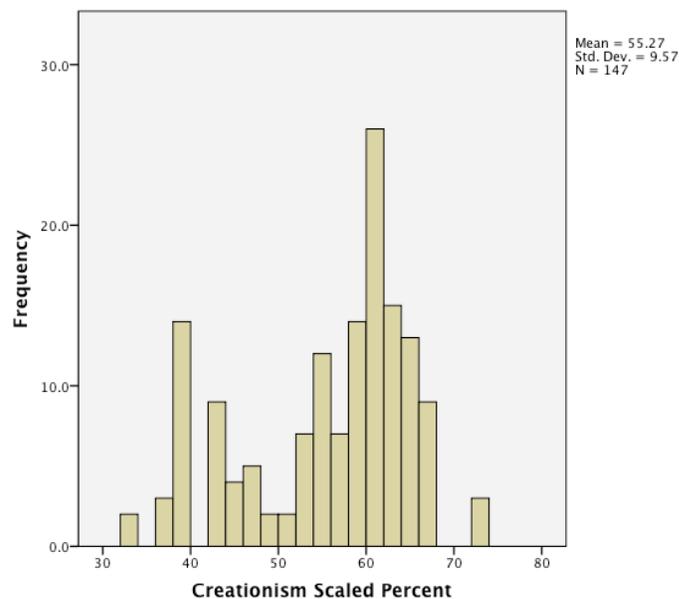


Figure 1. Histogram showing bimodal distribution of respondents' proclivity towards teaching creationism.

The Spearman rank correlation coefficient was used for hypothesis one through nine to determine whether approval of creationism was related to attitudes in other areas or biographical data. Chi-square test of independence was used for hypothesis ten. As a check on the chi-square analysis, the phi coefficient was also computed as a measure of association between variables. However, this test requires for inference that the population be normally distributed.

Hypothesis One

The attitude of Georgia biology teachers toward creationism is not related to the self-related religiosity of the teacher.

The questionnaire contained four questions designed to estimate the extent of religious beliefs of the respondent. These questions are:

1. I do not believe in God.
2. I regard myself as a religious person.
3. I belong to a church, synagogue, or other organized religious group.
4. I have been a church member since early childhood.

A teacher with a score of 4-5 was classified “more religious,” while a score of 6 indicated a respondent had religious faith, but was not a regular participant in organized religion. A score of 7-8 indicated a disinterest in religion.

Table 19			
<i>Approval of Creationism vs. Religiosity</i>			
	Number of Respondents		
	More Religious	Undecided	Less Religious
Approve of creationism	35	3	1
Undecided	31	11	26
Disapprove of creationism	24	7	9
<i>Note:</i> Spearman rank correlation coefficient $\rho = 0.339$: Correlation is significant at the 0.01 level.			

Approval of creationism was related to “more religious” respondents, with the “more religious” teachers being more likely to approve of creationism than “less religious” teachers. The 1983 study of Georgia science teachers was not able to draw this conclusion based on their data.

Hypothesis Two

The attitude of Georgia biology teachers toward teaching creationism is not related to the liberality or conservatism of the teacher’s religion.

There were six statements related to this area:

1. Statements that the Bible makes are never in error.
2. I believe that the Genesis version of the creation of the world is literally correct.
3. Darwin’s theory of evolution is compatible with a belief in God.
4. One cannot believe in evolution and also believe in a Creator.
5. The Bible is not intended to give a scientific description of the origin of the universe.
6. My religious background could be described as Fundamentalist.

A person with a score of 6-8 was designated conservative; one with a score of 10-12 was classified liberal in matters of religion for this study. The frequency distribution of respondents for this question concluded that 17.7% of the teachers were identified as liberal and 82.3% conservative.

Approval of creationism was related to conservatism in religion, with the “conservative” teachers being more likely to approve, and the “liberals” to disapprove. The results are shown in Table 20; these findings are consistent with the 1983 study of Georgia science teachers.

Table 20		
<i>Approval of Creationism vs. Liberality or Conservatism in Religion</i>		
	Number of Respondents	
	Conservative	Liberal
Approve of creationism	21	18
Undecided	63	5
Disapprove of creationism	37	3
<i>Note:</i> Spearman rank correlation coefficient $\rho = 0.356$: Correlation is significant at the 0.01 level.		

Hypothesis Three

The attitude of Georgia biology teachers toward teaching creationism is not related to the teacher's understanding of the relation of evolution in high school courses in science.

These six statements measured this factor:

1. I do not deal with origin of the earth or the universe in any course I teach.
2. I do not deal with the origins of man in any course I teach.
3. Creation-science is just as scientific as evolution.
4. I am convinced that Darwin's theory of evolution essentially describes the means by which man developed.
5. It is not necessary to teach evolution as part of the biology course.
6. Giving equal time to creationism is what science teachers have been doing for years.

A teacher convinced evolution is important in all science disciplines should have a high score (10-12). A teacher dubious in such understanding should score low (6-8). The relationship between approval of teaching creationism and the teacher's understanding of the relation of evolution the science courses was significant.

The findings from the 1983 study of Georgia science teachers were not significant according to chi-square analysis. However, that study was able to demonstrate a correlation

between the variables using the Spearman rank between variables. This could not be done in the same manner for this study, as chi-square analysis is not an acceptable test for correlational analysis of qualitative data.

Table 21		
<i>Approval of Creationism vs. Cognizance of the Importance of Evolution to Science</i>		
	Number of Respondents	
	Not Cognizant	Cognizant
Approve of creationism	7	32
Undecided	0	68
Disapprove of creationism	0	40
<i>Note: Spearman rank correlation coefficient $\rho = 0.300$: Correlation is significant at the 0.01 level.</i>		

Hypothesis Four

The attitude of Georgia biology teachers toward teaching creationism is not related to the teacher’s familiarity with the creationist movement and its literature.

These five statements related to the teacher’s familiarity with creationism.

1. I am familiar with the term “Creation Science.”
2. The teaching of creation science has been proposed in my community.
3. The advocates of creation science are influential in my community.
4. I am familiar with the text material on creation science.
5. I am familiar with articles written about creation science.

A teacher familiar with creationism scored low at 5 or 6; one unfamiliar scored high at 9 or 10; those undecided scored 7-8. Scores were subdivided three ways to allow for respondents who are familiar with the term that might not have been involved with it in their community.

Consequently, this breakdown resulted in a frequency of 45.6% of respondents being familiar, 38.4% being undecided, and 15.8% being unfamiliar.

It is concluded that, as in the 1983 study, the relationship between familiarity and approval is significant, the teachers more familiar with creationism being less approving of it. Further analysis is illustrated in Table 22.

Table 22			
<i>Approval of Creationism vs. Familiarity with Creationism</i>			
	Number of Respondents		
	Familiar	Undecided	Unfamiliar
Approve of creationism	24	11	4
Undecided	21	31	15
Disapprove of creationism	22	14	4
<i>Note: Spearman rank correlation coefficient $\rho = -0.275$: Correlation is significant at the 0.01 level.</i>			

Hypothesis Five

The attitude of Georgia biology teachers toward teaching creationism is not related to the amount of controversy creationism has generated in the community.

The statements that explored the controversy raised by creationism are:

1. The teaching of creation science has been proposed in my community.
2. The advocates of creation science are influential in my community.
3. I have seen books on creation science in the materials purchased by my school district.
4. Many people whose opinions I respect favor the teaching of creation science.
5. If I were to publicly oppose the teaching of creation science my supervisors might take punitive action against me.
6. I frequently have students who are troubled by a conflict between evolution and their religious beliefs.
7. I try to avoid making dogmatic statements about evolution in my classes.
8. The science teachers in my community would object to teaching creation science in their classes.

A score of 8-11 indicated little impact on the community; 13-16 indicated greater impact. Although 66% of respondents indicated the creationism controversy had greater community impact, the relationship between approval of teaching creationism and the amount of controversy creationism has generated in the community was not significant, according to Spearman rank correlation coefficient.

Table 23		
<i>Approval of Creationism vs. Impact on Community</i>		
	Number of Respondents	
	Little Impact	More Impact
Approve of creationism	19	20
Undecided	21	47
Disapprove of creationism	10	30
<i>Note: Spearman rank correlation coefficient $\rho = 0.102$: Correlation is not significant.</i>		

Hypothesis Six

The attitude of Georgia biology teachers toward teaching creationism is not related to the size community the school represents.

There was no significant relationship between respondents' approval of teaching creationism and the size of community represented, as shown in Table 24.

Table 24				
<i>Approval of Creationism vs. Community Size</i>				
	Number of Respondents			
	Rural	Small Town	Suburban	Urban
Approve of creationism	9	12	9	9
Undecided	11	9	4	16
Disapprove of creationism	26	16	9	17
<i>Note: Spearman rank correlation coefficient $\rho = 0.106$: Correlation is not significant.</i>				

Hypothesis Seven

The attitude of Georgia biology teachers toward teaching creationism is not related to the academic degree held by the teacher.

There was no significant relationship between respondents' approval of teaching creationism and academic degree, as shown in Table 25. Although these findings are consistent with the 1983 study with regard to significance and the chi-squared test for independence, the previous study determined a relationship between degree level and approval of creationism existed through the Pearson product-moment coefficient. Those findings indicated teachers with advanced degrees tended to disagree with the teaching of creationism.

Table 25			
<i>Approval of Creationism vs. Academic Degree</i>			
	Number of Respondents		
	Bachelor's	Master's	Specialist or Doctorate
Approve of creationism	9	21	9
Undecided	6	38	12
Disapprove of creationism	8	22	20
<i>Note: Spearman rank correlation coefficient $\rho = 0.084$: Correlation is not significant.</i>			

Hypothesis Eight

The attitude of Georgia biology teachers toward teaching creationism is not related to the age of the teacher.

The teacher's age was significantly related to the teacher's approval of creationism, according to the Spearman rank correlation coefficient. The 1983 study of Georgia science teachers did not find a correlation using chi-square analysis, but did calculate a Pearson product-moment coefficient and found a correlation. Spearman rank correlation analysis was conducted for this analysis due to its appropriateness. It is concluded that there is a relationship between the age of respondent and approval of creationism, those teachers with advanced age tending to disapprove. The data are shown in Table 26.

Table 26					
<i>Approval of Creationism vs. Respondent's Age</i>					
	Number of Respondents Age:				
	25 and under	26 – 35	36 – 45	46 – 55	Over 55
Approve of creationism	17	13	6	3	0
Undecided	15	12	5	8	0
Disapprove of creationism	15	18	16	16	1
<i>Note:</i> Spearman rank correlation coefficient $\rho = 0.203$: Correlation is significant at the 0.01 level.					

Hypothesis Nine

The attitude of Georgia biology teachers toward teaching creationism is not related to the length of the teacher's professional experience.

The length of teaching experience was not significantly related to the teacher's approval of creationism. Illustrating the results is Table 27.

Table 27			
<i>Approval of Creationism vs. Years of Teaching Experience</i>			
	Number of Respondents with Years of Teaching Experience		
	Under 10	10 – 19	20 or more
Approve of creationism	17	19	3
Undecided	17	27	10
Disapprove of creationism	24	17	27
<i>Note:</i> Spearman rank correlation coefficient $\rho = 0.087$: Correlation is not significant.			

Hypothesis Ten

The attitude of Georgia biology teachers toward teaching creationism is not related to the area of the teacher's specialization in science.

The teacher's degree of approval of teaching creationism was not related to the area of science preparation. Because of the preponderance of life science teachers in the sample the cell frequency is sufficiently low to disqualify chi-square analysis. However, the data on life science teachers alone appear firm enough to reject the existence of a relationship, as seen in Table 28.

Table 28			
<i>Approval of Creationism vs. Area of Science Background</i>			
	Number of Respondents with Backgrounds in		
	Life Science	Physical Science	Both
Approve of creationism	37	2	0
Undecided	40	0	0
Disapprove of creationism	59	7	0
chi square = 4.9 ^a ^a not significant		r (ϕ coefficient) = 0.18 ^a	

Influences of Standards and Standardized Testing

Respondents were asked six questions regarding what influence, if any, newly adopted State standards and State standardized exams had on their teaching of creationism and/or evolution. It should be noted that the state standardized exams require passage by the respondent's students prior to graduation from high school. Often, these tests are considered 'high-stakes' exams. For each question, statistical analysis was conducted against the measure of the respondent's approval of creation. Due to low frequencies of responses for some choices, no correlations could be concluded. However, insight into possible influences can be derived from the response frequencies.

When asked about the influence newly adopted State standards had on the instruction of creationism, 70% of respondents (103) stated they do not teach creationism in their biology class. The remaining percentage, 30%, is consistent with the 26.5% of respondents that support teaching creationism in their classroom. Eight teachers stated the standards influenced them to reduce instruction on creationism while two stated it stopped their instruction of creationism in the classroom. Considering only the teachers in the sample that may teach creationism (44), approximately 18.2% openly stated the standards influenced them to reduce instruction on

creationism while 4-1/2% stated it influenced them to stop instruction on creationism, as illustrated in Table 29.

Table 29			
<i>Perceived Influence State Standards/Exams on Creationism Instruction</i>			
	Percentage of Respondents		
	GPS	EOCT	GHS GT
Did not influence	32.6	40.1	40.8
Increased instruction	0.0	2.0	2.7
Reduced instruction	5.4 ^a	18.2 ^b	0.0
Stopped instruction	1.3 ^a	4.5 ^b	0.0

^a% of total respondents

^b% of those teaching creationism

Regarding the influence of state standards on the teaching of evolution, 59 respondents or 40.1% stated they increased their instruction on evolution while 1.3% stated they reduced their instruction on evolution. The responses regarding standardized testing were similar (Table 30).

Table 30			
<i>Perceived Influence State Standards/Exams on Evolution Instruction</i>			
	Percentage of Respondents		
	GPS	EOCT	GHS GT
Did not influence	57.8	54.4	57.1
Increased instruction	40.1	42.9	38.8
Reduced instruction	1.3	1.3	1.3
Stopped instruction	0.0	0.0	0.0

Georgia Biology Teachers and Biblical Literacy

Respondents views regarding biblical literacy, being a major component of creationism, is of necessary interest to this study. More than one in four respondents believed Genesis to be a literal interpretation of creation while nearly 80% find Darwin's theory of evolution compatible with belief in God. When asked if belief in evolution precluded belief in a creator, more than 90% disagreed. As summarized in Table 31, theological inconsistencies appear to exist when

evaluating responses in whole; though, teachers ascribing to a theistic evolutionary belief may account for these differences.

Table 31			
<i>Respondents' Belief in Scriptural Literalism</i>			
Statement	Percentage of Respondents		
	Agree	Undecided	Disagree
Statements that the Bible makes are never in error.	31.7	11.7	56.6
I believe that the Genesis version of the creation of the world is literally correct.	26.2	7.6	66.2
Darwin's theory of evolution is compatible with a belief in God.	78.9	3.4	17.7
One cannot believe in evolution and also believe in a Creator.	3.4	6.1	90.5
The Bible is not intended to give a scientific description of the origin of the universe.	79.6	6.8	13.6

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to document instances of the teaching of creationism in Georgia public high school biology and biological science courses; to investigate relationships between the science teachers' approval of creationism and their religious philosophy, understanding of evolutionary biology, community, academic degree, age, and teaching experience; to compare findings in these areas to a parallel study conducted in 1983 and to survey teachers opinions regarding the inclusion of evolutionary biology in state standards and graduation dependent exams.

Summary

The results of the study indicate creationism is being taught in biology and biology related courses in Georgia public high schools. Twenty-one percent of teachers responding claim to teach creationism or creationism and evolution together in their biology course. It is of interest 3.4% of respondents claimed to teach creationism without mention of evolution and 1.4% taught neither. Similar percentages are found throughout the survey. More than 21% of teachers responded affirmatively to teaching creationism when asked how many days they teach creationism, if at all, during the biology course. Nearly three decades ago, 27% of respondents claimed to teach both creationism and evolution. Although this may, at first glance, appear to indicate a 7% decrease in the teaching of creationism, it must be noted that only 70% of respondents to the survey indicated they did not teach creationism in their biology class.

A notable change between the findings of this and the 1983 study are in the area of teachers reporting seeing creation-science materials purchased by their school district. Only 1.4% of respondents claimed to have seen books on creation-science purchased by their school district compared to 20% in 1983. This indicates a greater than 18% decrease and may be attributed to the accountability districts have to their citizenry with clear state standards in the area of evolutionary biology compared to that of the early 1980's. Additional support the changes to Georgia's standards influenced classroom practice is evident as respondents claiming to teach evolution doubled from 39% to 78%.

However, this does not negate the reality that the frequency in which creationism is being taught in biology and biology related courses in Georgia public high schools has not significantly decreased in the same time period. Data collected in this study confirm personal conviction as influential in Georgia biology teacher's decision-making process and may be a primary reason for the discrepancy. Respondents indicated school boards as the most influential factor and interestingly student request carried more influence than administrative requirement

It is necessary and appropriate to consider a teacher's understanding of what constitutes teaching creation-science. It was assumed teachers, certified through Georgia's Professional Standards to teach high school biology, understood creation-science is not a variant of evolution or alternate explanation, but differentiates from normative views of science. This assumption is supported with 92% of respondents claiming to be familiar with the term creation-science. Additionally, it was assumed respondents appreciated that the creation-science movement was being evaluated in this study; introduction to the questionnaire was specific in this area. Therefore, this study maintains respondents claiming to teach creation-science present such material in a manner commensurate with the definition provided.

Clearly there is no educational standard in Georgia dictating teachers' present creation-science material in their biology classroom. However, a portion of Georgia public high school teachers continue to present creationism, due to personal conviction, and some remain reluctant to refuse to teach creationism even though district and state requirements dictate it.

Science teachers' approval of teaching creationism in biology or biology related classes were related to the teacher's familiarity with creationism, self-view on religiosity, conservatism in religion, and age. Consistent with the 1983 study, teachers more familiar with the creationist movement were more likely to approve of teaching creationism, as were teachers of conservative religious beliefs. This study found a correlation between teachers self-identifying themselves as more religious and approval for the teaching of creationism. Additionally, teacher's age was found to be significant with younger teachers more likely to approve of the teaching of creationism. Teachers' attitudes toward creationism were not significantly related to the teacher's understanding of the importance of evolution in science, community size, impact of creationist activity on the community, academic degree, teaching experience, or area of science background.

Conclusions

This study revealed no resurgence of a creationist movement in Georgia public high schools; however, in more than 20% of Georgia public high school classes, instruction on creationism continues to intertwine with the biology curriculum. Although the majority, 65%, of teachers oppose teaching creation-science in science courses, more than one-fifth of respondents consistently claimed to include creationism in some manner in their biology curriculum (see Table 10, page 59). Percentages consistent with these findings exist throughout the survey and are consistent, though slightly elevated, when compared to a national study.²⁶ Twenty-two

²⁶Berkman, M., & Plutzer, E. (2010). *Evolution, creationism, and the battle to control America's classrooms*. New York: Cambridge University Press.

percent agreed creation-science should be included in biology courses while 29% desired inclusion whenever a course deals with the origin of man (see Table 7, page 54). When asked to state how many days they teach creationism in a course, 27% of teachers responded they teach creationism; the majority spending one to five days on the material. These findings, being consistent with a 1983 study of Georgia science teachers, indicate no effective change in the number of teachers introducing creationism to their students and confirm greater acceptance for the teaching of creationism in Georgia than nationally.²⁶

Comments offered by teachers in open response areas of the questionnaire made clear their approval or disapproval of creationism, the majority of comments being very negative towards creationism. Areas of the survey demonstrate a shift in teachers' convictions away from the inclusion of creationism. Only 20% of teachers responding to this survey felt it appropriate for a majority of the community to make curriculum decisions regarding the inclusion of creationism compared to 39% in 1983 (see Table 7, page 54). Twenty-six percent of current teachers stated they would refuse to teach creationism, if required, compared to 8% in 1983; likewise, nearly 14% of this survey's respondents stated they would teach creationism, if required, compared to 29% (see Table 8, page 56). This deviation indicates a portion of Georgia educators are passionate in their stance there be no inclusion of creationism anywhere in biology curriculum. If faced with a requirement to include creationism in their curriculum, it is difficult to believe many educators would promote a doctrine they so strongly oppose. It is likely some educators may use their talents to discredit creationism through the manner in which the material is presented. As one respondent stated in open response, "I refer to it and debunk it." According to the results of this survey, the percentage of high school teachers including creationism has

remained stagnant while the remaining Georgia biology teachers are more resistant to the inclusion of creationism in the curriculum than teachers in 1983.

One goal of the creationist movement is that science teachers give creationism equal time to that of evolution. This was not supported by this survey and Georgia is trending away from this desired goal of the creationist movement. As mentioned previously, 22% of respondents believed creation-science should be included in science courses whereas 65% oppose its inclusion. Regardless, this study finds a portion of science teachers accept creation-science as scientifically valid. Nearly 18% agree creation-science has equal scientific validity as evolution and 10% agree creation-science presents valid evidence that the universe was created in six 24-hour days. Comments of several respondents make it further evident that creationism is being taught in Georgia classrooms. These include, “All forms of the earth formation are explored and creation being one of them. I do stress that this is my preferred choice,” and “Evolutionary science is not as complete as some would like us to believe. Perhaps a blend is a better approach.” Additionally, two respondents stated they spend 6 to 10 days covering creationism while another claimed to spend 11 to 20 days on it during their biology course. Whether indirectly through an instructor’s manner of instruction or openly stated personal convictions, this study finds a consistent portion of Georgia public high school biology teachers provides instruction on creation-science. A study conducted after this survey administration compared student and teacher perceptions on instruction when creationism was mentioned in the evolution unit. Although most biology teachers believed they emphasized evolution in their instruction, almost half of the students reported their high school biology teachers gave equal or greater weight to creationism.²⁷ All considered, creationism is not afforded equal time to that of

²⁷Moore, R. (2007). The differing perceptions of teachers & students regarding teachers' emphasis on evolution in high school biology classrooms. *The American Biology Teacher*, 69(5), 266-272.

evolution in Georgia. The findings indicate creationism's presence in Georgia's biology classroom has remained persistent over the past three decades, but cannot attest to students' perception of creationism inclusion in their biology classes.

Students too bring the subject of creationism into the Georgia biology classrooms, at times to the trepidation of their teacher. Creation-science may be unknown to a student and inquiry may be nothing more than an attempt to learn or students may express concern regarding evolution and their religious beliefs. Although student inquiry regarding creation-science is not a direct focus of this study, evidence indicating a change in the frequency in which creation-science is mentioned in the biology classroom is of specific interest. This study finds nearly a 50% increase in teachers stating they frequently have students troubled by a conflict between evolution instruction and their religious beliefs. Sixty-eight percent of current respondents agreed they frequently have students who are troubled by said conflict (see Table 17, page 63), a substantial increase from 46% of teachers in the previous study. No attempt is made to address possible reasons for the apparent increase in the number of students expressing concern over evolution and their religious beliefs; nonetheless, it is of interest to this study that such encounters increase the frequency to which creationism arises in Georgia public biology classrooms. The manner in which a teacher responds to such an inquiry certainly instructs students to some degree on the social aspect of the evolution/creation conflict, if not in some manner on creationism, evolution and science. The following statements, provided via open response, illustrate some of the variations in teacher responses to student inquiry in this area:

- “I do not teach Creationism; but when students ask for my opinions about evolution vs. creation theories, I offer them in regard to my personal convictions.”

- “I do still present creationism as a belief that some individuals hold.”
- “I mention it if my students ask, and I will discuss it with them individually, but I do not make it a part of my curriculum.”
- “I do mention that we do not know how God did his work, why not through evolution?”

According to the study, students more frequently express concern to their teachers regarding conflict between religious beliefs and evolution. This will necessarily increase the exposure of creationism and the creationism/evolution conflict to potentially more students making it essential that clearly defined guidelines be provided educators.

Georgia Performance Standards for high school biology detail “Evolution of Life” concepts (see Table 2, page 32). Georgia students must pass certain state administered exams to ensure the proficiency level set has been met; students must receive a passing score on the exam to receive a diploma from a Georgia accredited public high school. Exam questions arise from the aforementioned Georgia Performance Standards. This study maintains the implementation of standards that include evolution and the corresponding required exams impacted some Georgia public high school teachers’ instruction on creationism and evolution. Teachers were surveyed regarding the influence they perceived performance standards and required testing had regarding their instruction of creationism or evolution. At the time of this survey Georgia was transitioning from one standardized test format to another, so respondents were surveyed as to the influence each test had independently. Regarding the influence of state standards on the teaching of creationism, approximately 18% of teachers claiming to teach creationism in some manner stated the standards influenced them to reduce instruction on creationism while 4-1/2% stated the standards influenced them to stop instruction on creationism (see Table 29, page 76). More than

40% of respondents claimed the state standards and subsequent exams caused them to increase their instruction on evolution (see Table 28, page 75). One respondent elaborated, “Since I started teaching after the establishment of the ‘standards’, I never have taught creationism only evolution because evolution is the only theory discussed in the standards.” Another teacher added, “The standards, as written, simply tell me what specific components of evolution I am to cover. It doesn't tell me anything with regard to creationism.” This study indicates, from teachers’ perspective, the state standards and exams positively influenced evolution instruction for less than half of the teachers. This may be reflective of the lack of directed teacher training implemented for practicing teachers at the time standards and exams went into effect. The inclusion of evolution in standards alone has not moved Georgia away from the teaching of creationism in the public biology classroom. Taken in context with teacher’s comments, it brings to question whether teachers desire some guidance in assisting students balance evolution with their religious beliefs.

Areas of consistency between the findings of this study and that of 1983 illustrate how entrenched the underlying beliefs are that perpetuate the evolution/creation controversy. Teachers identifying themselves more conservative or fundamentalist in religion were more likely to approve teaching creation-science as were self-identified respondents with strong religious values.

Although Georgia biology teachers generally disapprove of teaching creationism, responses revealed that some teachers do not believe evolution to be necessary to biology curriculum (see Table 13, page 61). Teachers falling into this category may address creationism as an alternate explanation or diminish the importance of evolution when confronted with students’ concerns or sensibilities towards evolution.

Additionally, some respondents demonstrated misconceptions about the Genesis creation story indicating they may not appreciate the theological significance the literal interpretation this story has to the creation-science movement. A substantial number of teachers expressed belief in biblical inerrancy and literality of the Genesis creation story; notwithstanding, few respondents agreed the Bible was intended to give a scientific description of the origin of the universe (see Table 21, page 70). Consequently, for some respondents there is no conflict between scriptural literalism and scientific accounts of the origins of the universe. These findings imply some teachers may reconcile evolution and Genesis creation in their personal belief system, somewhere along Scott's continuum (2009). As such beliefs are supplemented into the curriculum, a quandary between science and religion may occur within some students while other students may become further grounded in their original position. As evident from the nearly 79% of teachers agreeing Darwin's theory of evolution compatible with the belief in God, many teachers accept to varying degrees both religious and scientific explanations. It is conceivable these teachers mistakenly believe their students too will be able to balance evolution and their religious beliefs.

Although 92% of respondents claim to be familiar with the term creation-science, responses indicate many were not aware of certain philosophies central to the creationist movement. Creationists reject arguments of evolution through divine interaction or theistic evolution. Teachers ignorant of this creationist position may be unaware the degree of conflict evolution causes to students of creationism. Teachers either never personally experiencing a conflict or those having reconciled years earlier the scientific and theological descriptions of origins, must appreciate the extremes of the creation-evolution controversy and the positions taken.

The spectrum of controversy ranges from a purely mechanical world-view, allowing for no divine creation or influence, to a belief where each event is governed by a deity who provided a set of scriptures to guide human life; rejecting any scientific findings perceived in conflict with scripture. As with previous generations, most encounter this controversy in science education and develop a personal harmony somewhere between the theological and scientific. Georgia's public high school biology teachers, as their predecessors, have found a personal balance between the intellectual and spiritual arguments (see Table 21, page 70). As with previous generations experiencing the evolution/creation controversy, today's high school students, too, will eventually find individual harmony between their religious beliefs and the scientific tenets of evolution. These conclusions, compounded with the appreciation that over the past three decades the teaching of creationism in Georgia public high school science classes has essentially remained stagnant, require a reassessment of the strategies science education implements to instruct future generations on the theory of evolution.

The creationist movement has long desired theological explanations, alongside the scientific, be presented to public school students. Given the increase in students professing concern regarding evolution and their religious beliefs, the understanding creationism is discussed in at least one in five Georgia public biology classes, and that younger teachers seem more likely to approve of the teaching of creationism, the question must be asked if teachers now have a duty, in some manner, to address the controversy in a guided manner. Some teachers already present creationism and "debunk it," whereas others openly express their personal beliefs explaining, "God did his work... through evolution." If students currently give more value to creationism when a science teacher makes mention of it than the teacher intended, the significant

room provided educators in this area currently must be re-examined. Can we expect different results if the status quo is maintained?

Influence being separate, the majority of respondents indicate they pay attention to the Georgia standards and required graduation testing their students must show mastery of. Additionally, a number of respondents indicated a desire for some authoritative direction regarding how to address theological controversies that exists within a biology classroom, whether verbalized or not, when the topic of evolution arises. Providing no direction, as evident from the findings, has given implicit permission for the range of responses Georgia's public high school teachers present their students. Guidelines presented educators must take into account the findings that many science teachers are not aware of the implications bringing creation-science discussions into the classroom can have on their students. To creationists, there is no middle ground, as only their position maintains compatibility with their religious belief. For this segment of the population, evolution and creationism cannot be reconciled. Educator guidelines on the creationism-evolution controversy should not be misinterpreted, as an attempt to bring the creationist toward accepting evolution, as doing so would clearly violate the boundaries set forth by the U.S. Supreme Court and the First Amendment. Direction should aid the teacher and overwhelming majority of students balance intellectual arguments of evolution with the theological belief system they brought into the classroom; perhaps through deeper investigations into the philosophy of science and comparisons to deductive and emotional reasoning.

Opportunities to improve teacher education in preparation for the evolution/creationism controversy may assist future students with this science content while helping them develop skills balancing emotional and deductive reasoning. Future teacher training may benefit from content classes specific to evolution as teachers not devoting time to evolution or creationism

had a content background other than life science. At a minimum, science teachers of all disciplines should complete an evolution specific course as part of their interdisciplinary science experience. Without improved teacher training at our universities in both evolution and techniques to address the evolution/creationism controversy, legislative bodies may follow the Louisiana Science Education Act allowing supplemental materials chosen by the personal convictions of teachers and administrators. Current Georgia teachers, too, may benefit from similar training through the University System of Georgia or from training specific to “Evolution of Life” standards through the Georgia Department of Education.

The lack of training specific to evolution standards essentially demotes it to a muted policy and results in significant variations in classroom instruction. Guidance should be afforded Georgia public high school teachers providing boundaries allowing for the discussion of creationism in terms of furthering students’ understanding of the philosophy of science and evolution. Without additional direction to current and future educators, the space afforded between written standards and classroom practice will continue to vary immensely, as this study demonstrates. Teacher training and the education of future teachers should include instruction on evolution content and address concerns of the evolution/creationism controversy that arise in a biology classroom whether vocalized or not. Post-secondary institutions have an opportunity to use this divide to differentiate between emotional reasoning and deductive reasoning and apply it to the teaching of evolution. Guidelines directing the manner in which creationism may be introduced during the teaching of evolution and improving teacher training regarding evolution and the differentiation between deductive and emotional reasoning may move Georgians closer to their stated educational goals.

The Georgia Performance Standards declared it appropriate and necessary to teach evolution and Georgia teachers responded, the numbers of instructors teaching evolution doubling. Evident though are the consistent numbers teaching creationism in a variety of unguided ways. As they become curriculum in practice, how will the Next Generation of Science Standards address these areas? Georgia teachers are listening. Policy matters!

Recommendations

The generalizations made in this study are based on a small portion (8.6%) of the approximated 1948 Georgia public high school biology teachers. The representation of schools extends to every area of the state across all demographic regions. There is no indication in the study that teachers opposing or favoring creationism were over-represented. A portion of teachers gave favorable responses to creationism as did others toward evolution and all but two teachers answered all questions related to religion.

This study used scores on groups of questions rather than a single question to prevent inconsistency regarding interpretation of results. The grouping of questions allows the appearance of inconsistency when two similar questions have differing results from the same respondent. The subtle difference in questioning, this study maintains, accounts for the apparent deviation. Additional reliability studies on the questionnaire would be helpful.

The survey solicited opinions on creationism and evolution and did not attempt to characterize teachers by their beliefs in evolution via divine intervention or theistic evolution. Some responses and statements made by teachers indicate that it may be of benefit to investigate Georgia's teachers' position on Scott's continuum (2009). Of interest to future educators may be a comparison of teachers' beliefs, teaching practices in microevolution, macroevolution & creationism and university science courses completed.

Empirical studies on teaching practices into evolution and creationism would benefit by implementation of policies and professional practices allowing teachers to discuss creationism in regards to inquiry, reasoning and the philosophy of science. Thereafter, teachers may be more comfortable during classroom observations or when interviewed by science education researchers into personal and professional beliefs and teaching practices in evolution/creationism improving the quality of research. No attempt was made to investigate teachers' positions on political topics, separation of church and state, school prayer, or legalities of teaching creation science. Each of these topics may be of interest to future educators.

The implementation of strategies to address issues presented, be it through education, compromise, persuasion or other, is a problem that continues to present itself to administrators from individual schools to statewide policy makers. This study provides insight into teachers' perceived influence of Georgia policies on their teaching practices and evolution, but does not represent itself as a policy study investigating Georgia Department of Education administrative decisions' impact on teacher practices in the Georgia public high school biology classroom. Such an investigation might be of interest to future researchers.

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APPENDIX A

SURVEY INSTRUMENT

As a science teacher, I am interested in your opinions, attitudes and familiarity with the current movement to provide equal time for the teaching of creationism in the science curriculum. I am surveying a randomly selected sample of high school science teachers in the Georgia public schools, and the results will be part of a study I am conducting for my dissertation as a doctoral student at the University of Georgia. Your knowledge, opinions, and experience as a science educator will be very valuable in assessing the extent of creationist and evolutionary teaching in Georgia schools. Will you agree to spend a few minutes of your time expressing an opinion on this matter?

Because creationism has religious overtones, I have also asked some questions regarding your beliefs on this subject. This questionnaire is completely anonymous, and no teacher, school or school system will be identified.

As a classroom teacher, I fully realize the value of your time. I have made this questionnaire as short as possible with this simple website interface. Please do not sign your name or identify your school or school system in your responses. If you wish to make comments, I would be delighted to have them and have included an opportunity at the end of the questionnaire that will separate your comments from your responses.

Your cooperation and assistance is greatly appreciated.

QUESTIONNAIRE ON CREATION SCIENCE

DIRECTIONS: If you AGREE with the statement, or if your answer is YES, please put a 1 in the square.	AGREE = 1
If you DISAGREE with the statement, or if your answer is NO, put a 2 in the square.	DISAGREE = 2
If you neither agree nor disagree, or if you don't know, or if the question is not applicable, please put a 3 in the square.	DON'T KNOW = 3

- 1) I am familiar with the term 'Creation Science.'
- 2) The teaching of creation science has been proposed in my community.
- 3) The advocates of creation science are influential in my community.
- 4) I am familiar with the text material on creation science.
- 5) I am familiar with articles written about creation science.
- 6) I have seen books on creation science in the materials purchased by my school district.
- 7) Creation science should be included in biology classes.
- 8) Creation science should be included in any classes dealing with the origin of man.
- 9) Creation science should be included in any science courses dealing with the origin of the earth or the universe.
- 10) Creation science is not religion, since it provides scientific proof for the theory of origins set forth in its books.
- 11) Many people whose opinions I respect favor the teaching of creation science.
- 12) I am opposed to teaching creation science in any science class.
- 13) I am opposed to including creation science anywhere in the curriculum.
- 14) Even if creation science proved to have a religious foundation, I would still approve its inclusion in science classes.
- 15) If I were to publicly oppose the teaching of creation science my supervisors might take punitive action against me.
- 16) I do not believe in God.
- 17) Statements that the Bible makes are never in error.
- 18) I regard myself as a religious person.
- 19) I belong to a church, synagogue or other organized religious group.
- 20) I believe that the Genesis version of the creation of the world is literally correct.
- 21) I have been a church member since early childhood.
- 22) Darwin's theory of evolution is compatible with a belief in God.
- 23) One cannot believe in evolution and also believe in a Creator.
- 24) The Bible is not intended to give a scientific description of the origin of the universe.
- 25) I frequently have students who are troubled by a conflict between evolution and their religious beliefs.
- 26) I do not deal with origin of the earth or the universe in any course I teach.
- 27) I do not deal with the origin of man in any course I teach.
- 28) Creation science is just as scientific as evolution.
- 29) I am convinced that Darwin's theory of evolution essentially describes the means by which man developed.

- 30) My religious background could be described as Fundamentalist.
- 31) I try to avoid making dogmatic statements about evolution in my classes.
- 32) The science teachers in my community would object to teaching creation science in their classes
- 33) Creation science is a means of introducing a sectarian religious doctrine into the public schools.
- 34) It is not necessary to teach evolution as a part of the biology course.
- 35) Creation science presents valid evidence that the universe was created in six 24-hour days.
- 36) It is entirely possible that the geologic strata and fossil record were caused by a world-wide flood approximately 6000--10,000 years ago.
- 37) Giving equal time to creationism is what most science teachers have been doing for years.
- 38) I would oppose giving equal time to creation science along with evolution, no matter what the consequences to myself.
- 39) If teaching creation science is what a majority of the people in my school district want done, it should be included in the curriculum.
- 40) The issue of equal time for creation science does not affect me.

PLEASE CHECK ONE OF EACH PAIR OR SET OF BOXES WHERE APPROPRIATE.

41) If you agree that creationism should be included in science classes, do you think it should be:

- Presented by the teacher with no purchased instructional aids, or
- Presented with the help of creationist books, filmstrips and other instructional material.

- Presented once during the course, or
- Presented with equal emphasis every time a course deals with the origin of man or the origin of the universe.

- Presented only in biology courses, or
- Presented in any course where the age of the earth, development of the universe or the origin of man are treated.

42) If you believe that creationism should not be presented in science classes, please respond to the following:

- If the school system required me to teach creationism, I would refuse.
- If the school system required me to teach creationism, I would ignore the requirement, but say nothing.
- If the school system required me to teach creationism, I would present it but point out that it

is a religious concept.

If the school system required me to teach creationism, I would teach it as required.

If you are teaching either evolution or creationism, both or neither, somewhere you may have made a decision, or had one made for you, about which to teach. It would be very helpful if you would answer these questions about this decision:

43) Do you teach:

- Evolution
- Creationism
- Both
- Neither

44) What forces have influenced your decision to teach in this manner?
(Please number in order of importance, adding more if appropriate.)

- School board requirement
- Administrative decisions
- Pressure from parents
- Pressure from peers
- Students requested it
- Personal conviction
- Other (state)

Other (state)

45) If you teach creationism, approximately how many days do you bring it up during each course?

<input type="checkbox"/> 1 to 5 days	(A course lasts:	
<input type="checkbox"/> 6 to 10 days		<input type="checkbox"/> 1 quarter
<input type="checkbox"/> 11 to 20 days		<input type="checkbox"/> 1 semester
<input type="checkbox"/> more than 20 days		<input type="checkbox"/> 1 year)

The following standards on evolution of life are part of the latest Georgia Performance Standards for High School biology classes and include the word evolution for the first time.

Evolution of Life

The basic idea of biological evolution is that the earth's present-day species developed from earlier, distinctly different species.	5b
Molecular evidence substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched off from one another.	5b
Natural selection provides the following mechanism for evolution: Some variation in heritable characteristics exists within every species, some of these characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.	4efg
Heritable characteristics can be observed at molecular and whole-organism levels-in structure, chemistry, or behavior. These characteristics strongly influence what capabilities an organism will have and how it will react, and therefore influence how likely it is to survive and reproduce.	5b
New heritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells. Changes in other cells of an organism cannot be passed on to the next generation.	2e 5b
Natural selection leads to organisms that are well suited for survival in particular environments. Chance alone can result in the persistence of some heritable characteristics having no survival or reproductive advantage or disadvantage for the organism. When an environment changes, the survival value of some inherited characteristics may change.	4ef
The theory of natural selection provides a scientific explanation for the history of life on earth as depicted in the fossil record and in the similarities evident within the diversity of existing organisms.	5bc
Life on earth is thought to have begun as simple, one-celled organisms about 4 billion years ago. During the first 2 billion years, only single-cell microorganisms existed, but once cells with nuclei developed about a billion years ago, increasingly complex multicellular organisms evolved.	5b
Evolution builds on what already exists, so the more variety there is, the more there can be in the future. But evolution does not necessitate long-term progress in some set direction. Evolutionary changes appear to be like the growth of a bush: Some branches survive from the beginning with little or no change, many die out altogether, and others branch repeatedly, sometimes giving rise to more complex organisms.	5bd

46) Please answer the following by checking the appropriate box or boxes:

- The new GPS did not influence my instruction on creationism.
- The new GPS influenced me to increase my instruction on creationism.
- The new GPS influenced me to reduce my instruction on creationism.
- The new GPS influenced me to stop my instruction on creationism.
- I do not teach creationism in my biology class.

Feel free to use the following space to add any additional comments:

47) Please answer the following by checking the appropriate box or boxes:

- The new GPS did not influence my instruction on evolution.
- The new GPS influenced me to increase my instruction on evolution.
- The new GPS influenced me to reduce my instruction on evolution.
- The new GPS influenced me to stop my instruction on evolution.
- I do not teach evolution in my biology class.

Feel free to use the following space to add any additional comments:

The biology end of course test (EOCT) can now include questions on evolution of life.

48) Please complete the statement by checking the appropriate box or boxes:

The inclusion of evolution of life questions on the biology EOCT

- did not influence my instruction on evolution.
- influenced me to increase my instruction on evolution.
- influenced me to reduce my instruction on evolution.
- influenced me to stop my instruction on evolution.
- I do not teach evolution in my biology class.

Feel free to use the following space to add any additional comments:

49) Please complete the statement by checking the appropriate box or boxes:
The inclusion of evolution of life questions on the biology EOCT

- did not influence my instruction on creation.
- influenced me to increase my instruction on creation.
- influenced me to reduce my instruction on creation.
- influenced me to stop my instruction on creation.
- I do not teach creationism in my biology class.

Feel free to use the following space to add any additional comments:

The science portion of the Georgia High School Graduation Test (GHGST) can now include questions on evolution of life. Passing this test is a requirement for graduation in Georgia.

50) Please complete the statement by checking the appropriate box or boxes:

The inclusion of evolution of life questions on the science portion of the GHSGT

- did not influence my instruction on creationism.
- influenced me to increase my instruction on creationism.
- influenced me to reduce my instruction on creationism.
- influenced me to stop my instruction on creationism.
- I do not teach creationism in my biology class.

Feel free to use the following space to add any additional comments:

51) Please complete the statement by checking the appropriate box or boxes:

The inclusion of evolution of life questions on the science portion of the GHSGT

- did not influence my instruction on evolution.
- influenced me to increase my instruction on evolution.
- influenced me to reduce my instruction on evolution.
- influenced me to stop my instruction on evolution.
- I do not teach evolution in my biology class.

Feel free to use the following space to add any additional comments:

Please supply the following data by checking the appropriate box:

52) My age is:

Under 25

26-35

36-45

46-55

over 55

53) My highest degree is:

Bachelors Masters Specialist Doctoral

54) I have been teaching for ____ years.

55) My science education is primarily in Biological Sciences Physical Sciences.

THANKYOU VERY MUCH FOR TAKING THE TIME TO RESPOND!

Also, 13 percent of these teachers advocate creationism in their classrooms. "The survey left space for [the teachers] to share their experiences. That's where we picked up a lot of a sense about how they play to the test and tell students they can figure it out for themselves," Michael Berkman, co-author of the study with Penn State University colleague Eric Plutzer, told Livescience. "The implications for us are very concerning, that there are teachers who are not teaching science, who are not teaching some of the core tenets of science," Francis Eberle, who was not involved in the study and serves as the executive director of the National Science Teachers Association, told LiveScience. The study of biological evolution constitutes one of the most active and far-reaching endeavors in all of modern science. The public controversies that swirl around evolution also have changed. "Others have argued that science teachers should teach the "controversies" surrounding evolution. But there is no controversy in the scientific community about whether evolution has occurred." The preparation of Science, Evolution, and Creationism was supported with funds from the Council of the National Academy of Sciences and from the Christian A. Johnson Endeavor Foundation, New York, N.Y. Representatives of this booklet's intended audiences informally reviewed this booklet prior to the final review process.