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ABSTRACT

COSMOLOGICAL BELIEFS ABOUT ORIGINS RELATED TO  
SCIENCE ACHIEVEMENT AMONG JUNIOR  
HIGH-SCHOOL STUDENTS IN  
SOUTH BEND, INDIANA

by

J. David Van Dyke

Chair: Duane Covrig

## ABSTRACT OF GRADUATE STUDENT RESEARCH

Dissertation

Andrews University

School of Education

Title: COSMOLOGICAL BELIEFS ABOUT ORIGINS RELATED TO SCIENCE  
ACHIEVEMENT AMONG JUNIOR HIGH-SCHOOL STUDENTS IN SOUTH  
BEND, INDIANA

Name of researcher: J. David Van Dyke

Name and degree of faculty chair: Duane Covrig, Ph.D.

Date completed: November 2010

### Problem

American high-school students score lower in science achievement tests than their peers in other developed nations. The Organization for Economic Cooperation and Development (OECD) ranked the scientific achievement of American high-school students as “very low” in comparison to high-school students in other industrialized nations—only 29th out of 57 developed countries.

Research has indicated that achievement declines as U.S. students progress to higher grades and take on more rigorous science courses. A variety of factors have been documented that may account for U.S. students’ lower science achievement rankings. These include socioeconomic status, race, and gender. One area only marginally explored

is the role of cosmological beliefs—such as New Earth Creationism—on science achievement. Some studies indicate that these cosmological beliefs correlate to low science achievement, while others show little to no correlation between cosmological beliefs and science achievement. Americans are unique in their high rate of belief in divine special creation, as opposed to origin by evolution through natural selection. This cosmological view of origins differs from mainstream scientific thought, research, and publications. Some wonder whether this view of creation might partially explain the lower science achievement reported in American students. This problem needs to be more thoroughly investigated. Research on cosmological beliefs has focused mostly on college students in biology courses, but this study sought to understand this problem at the junior-high level of science education.

### Research Design

A quasi-experimental design was used. The entire study took place at Clay Intermediate Center, a public school within the South Bend Community School Corporation (SBCSC) in South Bend, Indiana. A treatment group of 47 middle-school students participated in a three-session after-school science program. Their science achievement within the program was compared to their cosmological beliefs and other socio-demographic and instructional variables. Posttests were used to measure students' science achievement. The pretest and posttest were constructed using a test bank available from the publisher of the science unit. A control group of similar students took the pretest and posttest but did not participate in the after-school sessions.

The students' level of science achievement from the posttest scores were then compared to their responses to statements from Eugenie Scott's Spectrum of Creationism

scale, which measures cosmological beliefs related to origins (creationism to natural evolution). The quantitative data were represented in structural equation model(s). Students were debriefed with questions regarding their feelings of how their cosmological beliefs might affect their science achievement both within the course and in general.

## Results

The study found no significance between science achievement and cosmological beliefs, but very strong multiple correlations of socioeconomic status and previous science knowledge to science achievement, as well as evidence that the instruction was effective in raising posttest scores. Recommendations were made that: (a) The significance of poverty status to science achievement of SBCSC students be further studied, (b) the study be extended to other middle schools and high schools within SBCSC, (c) SBCSC recognize the efficacy of after-school programs and consider further funding for these programs, and (d) SBCSC consider a unit that emphasizes empirical evidence, how things evolve, and the process of science through guided inquiry upon its next science adoption.

Andrews University

School of Education

COSMOLOGICAL BELIEFS ABOUT ORIGINS RELATED TO  
SCIENCE ACHIEVEMENT AMONG JUNIOR  
HIGH-SCHOOL STUDENTS IN  
SOUTH BEND, INDIANA

A Dissertation

Presented in Partial Fulfillment  
of the Requirements for the Degree  
Doctor of Philosophy

by

J. David Van Dyke

November 2010

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Member: Sylvia Gonzalez

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External: H. Gordon Berry

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Date approved

Dedicated to

My heroes Paul H. Cofield

and

Eleanor V. Van Dyke —

and to my best friend

Dawn M. Van Dyke

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## LIST OF ABBREVIATIONS

AAAS	American Association for the Advancement of Science
AYP	Adequate Yearly Progress
ID	Intelligent Design
IC	Intermediate Center
ISTEP	Indiana Statewide Testing for Educational Progress
LESCP	Longitudinal Evaluation of School Change and Performance in Title 1 Schools
NRC	National Research Council
NSTA	National Science Teachers Association
NSES	National Science Education Standards
NE	New Earth Creationism
NCLB	No Child Left Behind Act (2001)
NISMEC	Northern Indiana Science, Mathematics, and Engineering Collaborative
NWEA	Northwest Evaluation Association
OE	Old Earth Creationism
OECD	Organization for Economic Cooperation and Development
SAT	Scholastic Aptitude Test
SBCSC	South Bend Community School Corporation
SEM	Structural Equation Modeling
ZPD	Zone of Proximal Development

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J. David Van Dyke

September 10, 2010



## CHAPTER I

### INTRODUCTION

This study began with and reflects my interest in a prescient topic to science education: Whether cosmological (creationist) beliefs of students are related to their science achievement. I have taught middle-school-level science for 12 years. Every year that I introduce how things evolve, I meet vehement confrontation from students. In 2007, a student even yelled “Baloney!” when I first used the word “evolution.” I had long known that creationism was more prevalent among Americans than in other industrialized nations. This led me to wonder: Does the disproportionate number of evolution-deniers in America correlate to the lowered science achievement levels that American students experience as they progress through middle and high school?

#### **Problem**

According to The Third International Mathematics and Science Study (TIMSS; Santapau, 2007) and the United States (U.S.) Department of Education (2007a), American high-school students score lower on science achievement tests than their peers in other developed nations. These studies (Santapau, 2007; U.S. Department of Education, 2007a) suggest that the science achievement levels of American students decline as students progress to higher grades and encounter more rigorous science standards. The Organization for Economic Cooperation and Development (OECD)

ranked the scientific achievement of American high-school students 29th out of 57 industrialized nations (Paulson, 2007).

Many factors have been documented that may explain this progressively lowered science achievement. These include socioeconomic status, race, and gender. One possible factor that has been only marginally explored is the role of cosmological beliefs on science achievement—and results have been mixed. Of the studies done (Burton, Kijai, & Sargeant, 2005; Findley, Linsey, & Watts, 2001; Ingram & Nelson, 2006; Lawson, 1983; McKeachie, Lin, & Strayer, 2002), some indicate that certain cosmological beliefs, such as New Earth Creationism, correlate to low science achievement, while others (Miller, 1999; Verhey, 2005) show little to no correlation between cosmological beliefs and science achievement. Little research has been done on junior high-school students, as most studies have involved college students.

The connections between science and cosmological beliefs about origins have long been established. Scientists, science writers, and teachers often link scientific processes, products, and facts to specific beliefs about cosmological origins (Miller, 2002). In science classes throughout the developed world, the process of adaptation leading to speciation is unquestionably attributed to natural causes, not acts of creation. At least a third, if not more, of all peer-reviewed articles published in biology journals address evolution (Shermer, 2006). Despite this, a large percentage of Americans do not believe that things evolve. Very little research has addressed whether or not acceptance or denial of this concept is connected to achievement in science.

### **Purpose of the Study**

The purpose of this study was to identify the relationship between junior high-school students' cosmological beliefs relating to origins and their science achievement in an after-school introductory biology program that includes a section on natural selection. The study also compared the scores from achievement measures to other measurable variables: Socioeconomic status, Ethnicity, Gender, Previous Knowledge, and Instruction.

### **Research Question**

This study asked the following question: To what extent, if any, are self-reported cosmological beliefs regarding origins, socioeconomic status, ethnicity, gender, previous science knowledge, and instruction predictive of science achievement among junior high-school students who participate in an after-school science program in South Bend, Indiana?

Based on the literature (in the following chapter), I expected to find significant ( $p > .05$ ) correlation between these variables, as represented in a hypothetical structural equation (SEM) model in Figure 1.

### **Research Design**

To test this hypothesized model, a quasi-experimental program design was used. A group of 47 junior high-school students participated in a three-session after-school science program, with three classes per session. Their science achievement was compared to their cosmological beliefs and other socio-demographic variables. A posttest from the unit was used to measure their science achievement. Their science achievement was then

compared to their responses on Scott’s Spectrum of Creationism scale, which measures cosmological beliefs related to origins (ranging from creationism to natural evolution). Socio-demographic variables included socioeconomic status, race/ethnicity, and gender. “Previous Science Knowledge” and “Instruction” were included as independent variables when it was discovered that these factors played a more significant role in achievement than was expected.

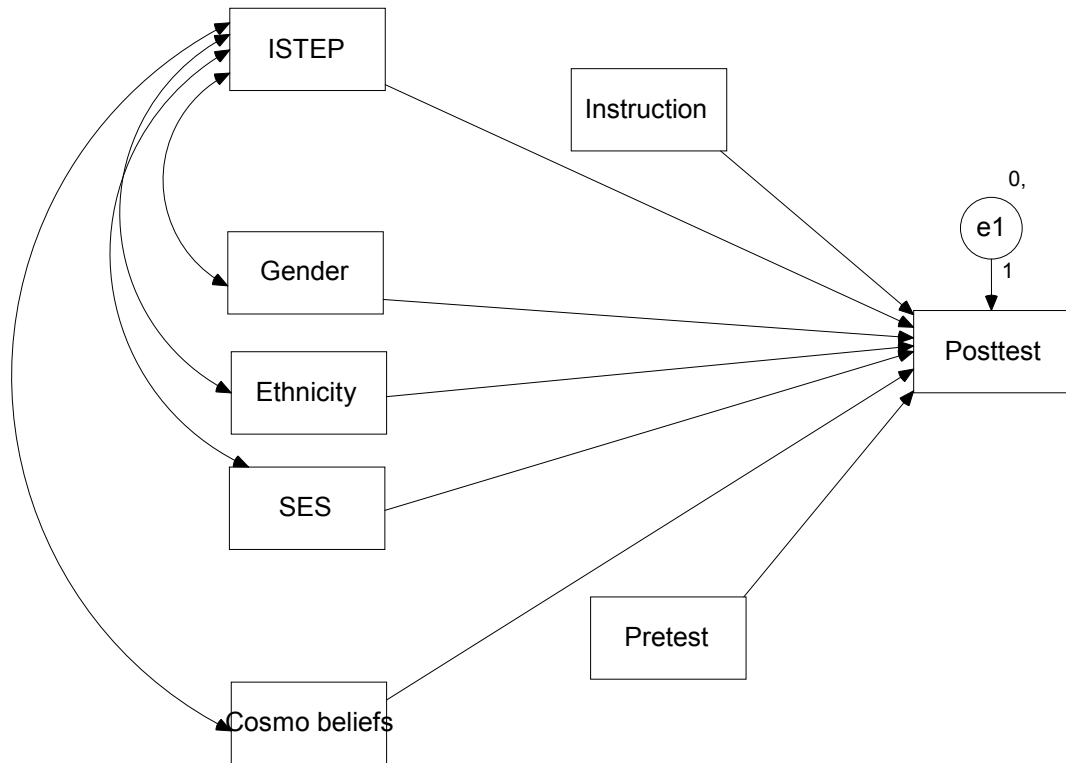


Figure 1. Hypothetical structured equation model.

An additional 33 similar students served as a control group. These students took the pretest and the posttest, as well as the ISTEP (Indiana Statewide Testing for Educational Progress-Plus), but they did not participate in the instruction.

The after-school program used Prentice Hall's *Cells and Heredity* unit (Padilla, Miaoulis, & Cyr, 1999). The unit remains part of an approved series of textbooks. Appendix G shows this unit in more detail. A debriefing session at the end of the course gauged students' views of how the cosmological variables they represent affected their personal science achievement.

Students were recruited to participate in the after-school program from Clay Intermediate Center, a public school in South Bend, Indiana. They were invited in several ways: email, telephone, and paper invitation/flyers. Students were encouraged to personally ask their parents for permission to participate. Parents were initially notified of the program during an open house in the fall of 2009.

Purposive sampling was intended to ensure that variability across the factors being studied was represented in the subjects. Parents completed an application specifying socioeconomic status, race/ethnicity, and gender in order to process placement. However, the final decision for participation within the program was based on convenience: Students who were available to participate were selected for treatment; students who were in after-school activities were placed in the control group.

Students completed the section addressing cosmological beliefs. From these applications, a stratified sample was generated that represented the composition of the South Bend junior high-school population. An incentive for participation was provided to students. Those who participated in the unit were given tickets to an age-appropriate film at a local theater. Chapter 3 addresses recruitment of all students.

## **Significance of the Study**

Science education has been and remains a policy concern for both national and state leaders. Since the launch of Sputnik in 1957, there have been calls for reform and extended research in order to make the U.S. scientifically competitive (Burton et al., 2005). Recent calls have been made for an increased understanding of science achievement and the factors that influence curriculum standards (Miller, 2002). More research may assist school administrators as they strive to develop programs and process the promise to improve their schools' science curriculum.

This study may provide significant assistance to the South Bend Community School Corporation (SBCSC), which began measuring science achievement 3 years ago. In 2007, SBCSC implemented science standardized testing in order to demonstrate adequate yearly progress (AYP) in accordance with the mandates set forth in the No Child Left Behind Act of 2001 (South Bend Community School Corporation, 2007).

The science standards for achievement in the state of Indiana specifically address evolution through natural selection in the seventh and eighth grades (Reed, 2004). The text used in this study was designed for the eighth-grade curriculum of SBCSC, while the unit was designed to accommodate Guided Inquiry recommendations.

Measuring students' beliefs about the concepts within this unit may inform future curriculum planning and policy. SBCSC is scheduled to adopt new science curriculum within the next 2 years, and there is currently a movement by the Northern Indiana Science, Math and Engineering Collaborative (NISMEC) to adopt units that emphasize Guided Inquiry over textbooks. This study may be helpful to administrators in making this choice.

## **Theoretical Framework for Curricular Analysis**

Although science education in United States public schools focuses on the study of natural phenomena, approximately 40% of students and adults across the U.S. hold cosmological (creationist) beliefs involving supernatural phenomena (Gallup, 2008). The majority of these students and adults are fundamentalist Christians (Hecht, 2006). A Gallup poll taken every year since 1982 consistently shows that a large portion of Americans believe that man was created in his present form and that evolution does not occur (Gallup, 2008). Americans are unique in this belief (Shermer, 2006).

While a large percentage of Americans include this supernatural causation in their personal belief systems about human origins, the scientific community simply does not support the inclusion of these belief systems as valid “theories” within the science classroom (Rennie, 2002).

As I shall examine, cosmological beliefs regarding origins may factor into a child’s environment and development (Piaget, 1928). To develop learning, Piaget argued, educators must first consider a child’s schema. A child’s belief about where people came from may be a central part of their schema that educators need to understand, examine, and apply to their pedagogy and curriculum.

A child from an environment that includes creationism likely has a different schema from a child who comes from a home of strict naturalism/empiricism. Children in public schools with “creationist” schemas are not offered material that includes supernatural causation, causing challenges to science teachers across the country. Measuring the effects of this “schema of beliefs” and its relationship to learning and understanding science is the underlying interest of this study.

Given the connection between these cosmological beliefs, children's schema, and science learning, it is not surprising that a heated debate between creationists and empiricists has occurred since the Scopes trial in 1925 (Linder, 2000). This "Great Debate" within the context of the classroom has evolved over the years into whether "equal time" should be provided to *both* evolutionary theory and creationism (Shermer, 2006).

The crux of the conflict centers on how scientific education can be delivered to students in two primary areas: (a) the standard of evidence that the scientific and creationist communities are willing to accept and (b) the definition(s) of the term *theory*. These two points of contention induce advocates from both sides who vigorously defend what should and should not be taught in publicly funded classrooms.

The standard of evidence accepted by scientists lies solely in natural, empirical evidence. Michael Shermer (2006), a scientist and strong opponent of teaching creationism, writes that one should not include "miracles" by a supernatural deity while operating under the rules of scientific debate. Shermer notes that supernatural miracles are, by their nature, a part of all creationist belief systems. Smith and Sullivan (2007) echo the empiricists in their argument that evolution is the only *naturally* testable, falsifiable, and observable explanation of origins, so it should be taught as the sole explanation of species' origination.

In contrast, creationists readily accept evidence of supernatural intervention (miracles) to supplement their explanation of natural processes. There are many arguments put forth by creationists, ranging from arguments about the nature of science (Sunderland, 1988), to probability (Johnson, 1993), to philosophy (Wallace, 2000).



For example, Sunderland (1988) has argued that it is antithetical to the nature of science to include only biological evolution because science should not assume to know the outcome of experimentation. Johnson (1993) argues that strict naturalism denies the probability of random mutation, leaving only the option of special creation. Wallace (2000) argues that creation should be taught because science itself is rooted in a belief system of “naturalism.” Since we teach the religion of “naturalism,” Wallace reasons, we should also teach the religion of “creation.”

Empiricists are quick to answer these arguments. They point out that, respectively, creationism holds no physical evidence to experiment upon (Sunderland’s argument), the mechanism of natural selection leading to evolution is wholly within the realm of probability (Johnson’s argument), and processing and testing natural phenomena is the nature of science (Wallace’s argument) (Pigliucci, 2002).

The term *theory* has subjective definitions that result in misunderstandings between the creationist and scientific communities. To the scientific community, the term *theory* is reserved for a well-substantiated explanation of natural causation that can be corroborated with facts, laws, inferences, and testable hypotheses. Topics that cannot be debated and tested as “theories” include pseudosciences that have an ideological, cultural, or commercial agenda. Metaphysical topics (immeasurable abstract concepts including divine special creation) are not empirically testable, so these topics fall outside the realm of science (Rennie, 2002).

The creationist definition of *theory* includes metaphysical topics like supernatural causation and philosophical reasoning. Supernatural causation and philosophical reasoning are ideas that cannot, by their own definition, be empirically tested by natural

means. Although many creationists use these concepts in their theories of origins, the empirical community dismisses these “theories” because they are neither empirically testable nor falsifiable.

Empiricists—and even some creationists—claim that creationism is not a natural theory but a metaphysical theory. Others, like Michael Behe (1996) and William Dembski (2002), have put forth arguments pushing for creationism to be classified as a natural theory, which should be provided “equal time” with natural selection in science classrooms (Behe, 1996; Dembski, 2002). The arguments made by Behe and Dembski are explored further in the literature review.

The debate between natural scientists and creationists is complex and unlikely to end soon. It is not the purpose of this study to discuss the merits of these arguments but, rather, to address one small aspect of the topic—whether belief in one of the varying levels of creationism predicts academic achievement in a science, especially in a program including evolution.

### **Assumptions, Guiding Beliefs, and Premises**

Several assumptions were made in this study. The honesty and accuracy of the students participating in the survey regarding their cosmological beliefs were assumed. The honesty and accuracy of the parents in reporting the other factors were likewise assumed. The study assumed that the students would not only understand the statements, but also identify and relate their beliefs in response to one of the statements. This assumption was also somewhat confirmed by experienced teachers during the process. The survey tool used to identify cosmological beliefs in this study utilized both biblical and scientific vocabulary, and it was assumed the statements were understood by middle-

school-aged children. For the purposes of this study, it was assumed “origins” referred to the origins of the earth and the earth’s inhabitants.

The concept of “equal time” remains a highly contested and controversial issue within American schools. Because of this, it was assumed that parents and students might have been exposed to the topic of creationism vs. evolution prior to the study. It was assumed that this exposure may have influenced their responses, even potentially encouraging them to alter their initial belief statement in defense of their beliefs. Their willingness to participate in the study was also uncontrolled.

As detailed later, upon analysis it was discovered that two variables, “previous science knowledge” and “instruction,” were more significantly predictive of science achievement than previously considered. The model was respecified to include these independent variables, as examined in the “Discussion of Results” section. It is assumed here, though, that the students’ ISTEP and pretest scores acted as the sole variable “previous science knowledge.” It is likewise assumed the variable “instruction” refers to the after-school course undertaken by students in the treatment group.

Finally, it is important to note that *scientific achievement* is a potentially subjective term. Due to the variability across the subjects, the students’ posttest scores were the most accessible, reliable, and valid measures of scientific achievement available.

### **Limitations of the Study**

One limitation to the study was that students within the study’s ethnic groups did not reflect the United States as a whole. For example, the students within the study contained a larger percentage of students of African-American descent than represent this demographic within the U.S. population. The reason for this limitation is simple: Clay IC

enjoys a plurality of Hispanics, Asians, African-Americans, and Caucasians, but has a near nonexistent population of students of Native American or Pacific Islander descent.

The study was limited to examining the relationship between science achievement and only four worldviews regarding origins: New Earth Creationism, Old Earth Creationism, Theistic Evolution, and Natural Evolution. Gap Creationism, Day-age Creationism, and Progressive Creationism are all catalogued under the worldview Old Earth Creationism, as per the literature review. Evolutionary Creationism is used synonymously with Theistic Evolution, again as noted in the literature review.

### **Delimitations of the Study**

The study was delimited to only middle-school students within Clay IC of the South Bend Community School Corporation (SBCSC) in South Bend, Indiana. Students from Clay IC were selected because I teach there and have an established relationship with the student body.

Another delimitation of this study included many unmeasured variables. Cosmological beliefs, socioeconomic status, race/ethnicity, gender, and previous science knowledge and instruction were the only observed variables within this study. Darling-Hammond (1999) and many others have argued that teacher quality is the most predictive factor of academic success, whereas Tuttle (2004) has argued that parent education is most predictive. Neither of these two variables was measured. Other factors, like teacher licensure, teacher quality, and IQ, for example, were also unconsidered.

## Definition of Terms

*Catastrophism:* The doctrine that explains the differences in fossil forms encountered in successive stratigraphic levels as the product of repeated cataclysmic occurrences and/or new creations.

*Cell theory:* The theory that (a) all living things are composed of cells, (b) cells are the basic unit and function in living things, and (c) all cells are produced from other cells.

*Creationism/creationist:* The doctrine that matter and all things were created, substantially as they now exist, by an omnipotent Creator, and did not gradually evolve or develop. A creationist is an individual who holds these beliefs.

*Cosmology:* The branch of philosophy dealing with the origin and general structure of the universe, with its parts, elements, and laws, and especially with characteristics such as space, time, causality, and freedom.

*Day-age Creationism:* The old-earth belief that each of the 6 days of creation outlined in the biblical book of Genesis represents a geological epoch and that the account of creation presented in Genesis roughly parallels the sequence of evolution.

*Diffusion:* The passive movement of molecules or particles along a concentration gradient, or from regions of higher to regions of lower concentration.

*Epistemology:* A branch of philosophy relating to the nature of knowledge, its presuppositions and foundations, and its extent and validity.

*Epoch:* A unit of geologic time that is a division of a period.

*Evolution:* A change in the gene pool of a population from generation to generation by such processes as mutation, natural selection, and genetic drift.

*Evolutionary Creationism:* A Protestant-based belief system that includes a divine creator using evolution to bring about life according to a preordained plan from the beginning.

*Falsifiability:* Something stated, argued, or claimed that has the character of something that can be shown to be false.

*Fundamentalism:* A conservative movement in theology among 19<sup>th</sup>- and 20<sup>th</sup>-century Christians. Fundamentalists believe that the statements in the Bible are literally true.

*Gap Creationism:* The old-earth belief that science has proven that the Earth is older than can be accounted for by adding up the ages of biblical patriarchs, as listed in Genesis.

*Gender:* The behavioral, cultural, or psychological traits typically associated with one sex.

*Inerrancy:* Incapable of erring; infallible; containing no errors; omniscient. This term is applied to the supposed inerrancy of the Bible assumed by some fundamentalist Christian denominations.

*Intelligent Design Creationism:* A belief system that includes the belief that the order, purpose, and design found within the universe are proof of a divine creator.

*Irreducible complexity:* A single system composed of several well-matched, interacting parts that contribute to the basic function of the system, wherein the removal of any one of the parts causes the system to effectively cease functioning.

*Metaphysical:* Of or relating to the transcendent or to a reality beyond what is perceptible to the senses; supernatural.

*Naturalist/naturalism:* The view of the world that takes account only of natural elements and forces, excluding the supernatural or spiritual.

*New Earth Creationism:* The belief that the earth and all life upon it were created within the last 10,000 years. Also known as “Young Earth Creationism.”

*Old Earth Creationism:* A belief system that acknowledges that the earth is ancient, all life was created by a divine creator, and species do not evolve into new species. Day-age Creationism, Gap Creationism, and Progressive Creationism are subsets of Old Earth Creationism.

*Origins:* The point at which something comes into existence or from which it derives or is derived.

*Path Diagram:* A graphical depiction of a theory relating measured (and possible latent) variables.

*Progressive Creationism:* The belief that the earth is billions of years old but that evolution has not and does not occur.

*Pseudoscience:* An activity resembling science but based on fallacious assumptions.

*Race:* A class or kind of people unified by shared interests, habits, or characteristics.

*Schema:* A pattern imposed on complex reality or experience to assist in explaining information, mediate perception, or guide response.

*Socioeconomic status:* The relative rank that an individual holds, with attendant rights, duties, and lifestyle, in a social hierarchy based upon honor or prestige.

*Species:* A fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding.

*Theistic Evolutionism:* A Catholic-based belief system that includes a divine creator using evolution to bring about life according to a preordained plan from the beginning.

*Theory:* (a) A doctrine, or scheme of things, which terminates in speculation or contemplation, without a view to practice; hypothesis; speculation; (b) an exposition of the general or abstract principles of any science, such as the theory of music; (c) the science, as distinguished from the art, such as the theory and practice of medicine; (d) the philosophical explanation of phenomena, either physical or moral, such as Lavoisier's theory of combustion or Adam Smith's theory of moral sentiments; and (e) as used in science, a theory is an explanation, or model, based on observation, experimentation, and reasoning, especially one that has been tested and confirmed as a general principle helping to explain and predict natural phenomena.

### **Summary**

This chapter outlined a problem—low science achievement of students in U.S. schools. It proposed a possible link to cosmological beliefs, an area that has not been fully researched as a predictor of science achievement. This chapter reviewed terminology used in the study and outlined the research design, including the limitations and delimitations of the study.

Chapter 2 includes a comprehensive and current review of the literature relating cosmological beliefs to issues of science achievement. It features an overview of Eugenie Scott's Creationism Spectrum as it relates to this study. It also contains a discussion of



the literature identifying some of the other factors that influence science achievement and examines testing measures used in Indiana.

Chapter 3 explains the research design used in this study. It includes a description of the population, as well as conceptual, instrumental, and operational variables. Chapter 3 also includes the hypothesis that was tested, data collection procedures, instrumentation, and measures of reliability and validity.

Chapter 4 includes the general and quantitative findings. Chapter 4 also includes descriptions of these statistics and addresses both the research hypothesis and the null hypothesis, including an explanation of structural equation modeling, which is used here to illustrate correlation between the study's variables.

Chapter 5 includes the qualitative and interpretive findings gained from the observations and debriefing sessions of the study. Chapter 5 also includes descriptions of these data.

Chapter 6 includes a discussion of the study and recommendations for future studies in the area of cosmological beliefs relating to science achievement. Chapter 6 also includes recommendations for SBCSC and a reflection of my interaction with the Chair of my committee, Dr. Duane Covrig, a committed New Earth creationist.

## CHAPTER II

### LITERATURE REVIEW

#### **Parameters of Relevant Literature**

The purpose of this literature review is to provide a comprehensive and relatively current review of the literature pertaining to the relationship between cosmological beliefs and science achievement. The goal is to look at both empirical research and scholarly material that can inform this study about the predictability of cosmological beliefs upon science learning. Because this study involves empirical, conceptual, and controversial issues, the following five main areas are reviewed:

1. The conflict between the natural and the supernatural in science education (The creation/evolution debate establishes the background for this study.)
2. An explanation of Scott's Spectrum of Creationism as it was used in this study
3. Other factors (socioeconomic status, race, and gender) that may influence science achievement
4. Peer-reviewed scientific studies that measure the correlation between cosmological beliefs and science achievement
5. Measurement of science achievement, the current educational emphasis upon the science process over acquiring knowledge of facts, and the methods used by the State of Indiana to measure science achievement.

## **The Conflict Between the Supernatural and Natural in Science Education**

Regarding science education in publicly-funded schools, there is an ongoing conflict between the scientific community and creationists. This clash has continued since 1925, when a biology teacher named John T. Scopes was found guilty of violating The Butler Act, which outlawed the teaching of evolution by natural selection. Since then, numerous similar high-profile court cases and studies have highlighted the battle between creationists and naturalists (Linder, 2000).

For example, in 1978 the New York Board of Regents attempted to answer the “equal time” argument from creationists. Creationists had long argued that the Genesis account of origins be taught alongside evolution through natural selection as a valid theory. The Regents surveyed curators throughout the world’s major natural history museums. They found that all curators fully accepted that things evolve naturally (Sunderland, 1988). In response to these results, the Regents maintained their position that curriculum be solely inclusive of natural evolution as the cause of origins.

In 1987, the case of *Edwards v. Aguillard* went to the United States Supreme Court. The court ruled that creationism-based curriculum was a violation of the Establishment Clause, which defined the separation of church and state (Shermer, 2006). In 2005, the case of *Kitzmiller et al. v. Dover Area School District* made newspaper headlines throughout the Western world (Forrest, 2005). The *Kitzmiller v. Dover* case was labeled “Scopes 2” by the press, as it concerned a school board replacing a standard science textbook with one that endorsed “intelligent design” (Forrest, 2005). The court sided with the parents, who were opposed to curriculum that included supernatural origins (Forrest, 2005).

While there is no common consensus among all creationists about the specifics of creation, creationists share a common belief: They believe the Abrahamic God of Judeo-Christian tradition created the world and the world's inhabitants. Creationists also believe natural evolution fails to explain species' origins. One of the ways creationists challenge natural selection is by providing alternate "theories" of supernatural intervention with different standards of evidence (Trott, 2004). Three of these alternate "theories" are used in my study: "New Earth Creationism," "Old Earth Creationism," and "Theistic Evolution/Evolutionary Creationism." They are examined below.

### **A Detailed Examination of Creationism**

The term *creationist* encompasses a wide range of belief systems, each of which accepts varying standards of evidence. There are creationist groups at the far end of Scott's spectrum that include Flat Earthism (Johnson, 2003) and Geocentricism (Sharp, 2004). There are also creationists who hold beliefs that are nearly consistent with natural biology, but include caveats in which a Supreme Being interfered with and/or guided the evolutionary process (Scott, 1997).

The Executive Director of the National Center for Science Education, Eugenie Scott, has outlined different positions on a creation-evolution continuum (Scott, 1997). Four of these positions were used in this study and so require detailed examination.

The four belief systems used include New Earth (sometimes called Young Earth) Creationism, Old Earth Creationism (which includes Gap Creationism, Day-age Creationism, and Progressive Creationism), Evolutionary Creationism/Theistic Evolutionism, and Natural Evolution (Scott, 1997).

“Intelligent Design” Creationism is also addressed within this section, primarily because of its frequent confusion with Theistic Evolution. Intelligent Design (ID) is not part of Scott’s Spectrum of Creationism. As I later review, ID is the result of political advocacy intended to challenge *Edwards v. Aguillard* (1987).

### New Earth Creationism

New Earth (NE) Creationists believe in a literal interpretation of the creationist story detailed in Gen 1 and 2 of the King James Bible. NE Creationists also believe in an extremely short natural history, encompassing a literal 6-day creation.

Not long before the Age of Enlightenment, Anglican Archbishop James Ussher and scholar John Lightfoot published studies which used biblical timelines and catastrophism to explain the earth’s age. Ussher (1581-1656) determined that biblical creation began on October 22, 4004 B.C.E. Ussher determined this date using the genealogies in the King James Bible. Later, biblical scholar John Lightfoot (1602-1675) expanded on Ussher’s work. Ussher’s and Lightfoot’s were the first studies done in order to determine the age of the earth based in biblical literalism, which NE Creationists continue to believe (Smith & Sullivan, 2007).

While not all New Earth (NE) Creationists agree when the exact moment of creation began, they do believe that earth and the earth’s life forms were created within a 6-day period and that this creation occurred recently, within the last 10,000 years. NE Creationists hold the cosmological belief that evidence of the earth’s age (radiometric-carbon dating, the ability of earth’s occupants to see stars that were formed millions of years ago, etc.) is based in flawed interpretation of empirical evidence (Stassen, 2005).

New Earth Creationists also believe that the writers of the Old Testament were inspired by a deity; consequently, their writing remains “infallible” and, thus, untenable. Most word-for-word translations of the Bible include a 6-day account of creation which, if interpreted literally, contradicts evolutionary theory and the scientifically accepted age of the earth. Due to this fundamentally literal interpretation, NE Creationists insist that large-scale evolution has not and does not occur (Ferrell, 2001).

The majority of NE Creationists are American, with small pockets residing in other parts of the world, most notably the United Kingdom. Approximately 40% of Americans and nearly 10% of those in the UK identify with these beliefs (Reiss, 2008).

Some NE defenders invoke non-empirical, pseudoscientific claims to support their belief system. For example, Gentry (1998) claims that “vacuum energy” alters the speed of light, forming the world-wide misconception that the universe is billions (as opposed to thousands) of years old.

NE Creationists also mislabel the “Cambrian explosion” within the fossil record as evidence of sudden, special creation. The Cambrian explosion is the period in natural history when life forms advanced beyond simple bacteria into multi-celled organisms (trilobites and brachiopods, for example) (Hoyt, 2008). New Earth Creationists explain this “sudden appearance” of life forms by (again) invoking the miraculous intervention of their supernatural deity, again as detailed in Genesis.

Additionally, some NE Creationists claim that the rate of radioactive decay in rocks is subjective, while others separate rock-age from life-age (Anderson, 1999). Some Seventh-day Adventists, in particular, believe that the earth itself is millions of years old, but *life* on earth has existed only for a few thousand of these years (Ferch, 1986).

## Old Earth Creationism

Like New Earth Creationists, Old Earth (OE) Creationists are biblical literalists, but they interpret the term *days* figuratively. OE Creationists believe the “six days” described in Genesis actually span a longer period of time. These believers accept the evidence of radiometric carbon dating and data from the fields of geology and astronomy in forming their belief that the earth is, in fact, billions (not thousands) of years old (Numbers, 1992).

According to the National Center for Science Education, the three forms of OE creationism are Gap Creationism, Day-age Creationism, and Progressive Creationism. What aligns these three groups is their collective rejection of the idea that species are genetically linked, thus descent with variation (evolution) does not occur. The three labels are all relatively synonymous for the purposes of this study, but a cursory explanation of the three OE creationism types follows (Scott, 1997).

### **Gap Creationism**

Gap Creationism (sometimes labeled “Restitution Creationism”) claims that there was a “gap” between the first two chapters of the creation account in the book of Genesis. Gap Creationism includes a pre-Adamic creation, destroyed before the second chapter of Genesis, when God recreated the world in 6 literal days. Then, according to Gap Creationists, God created Adam and Eve (Young, 1982). The time “gap” adhered to by Gap Creationists allows for evidence of the earth’s age. The two separate creations span a length of time that is consistent with the convergence of natural evidence, indicating that the earth is about 4.55 billion years old (Stassen, 2005).

## **Day-age Creationism**

Day-age Creationism assumes each “day” listed in Genesis accounts for extremely large amounts of actual time, rather than a literal 24-hour period. Biblical literalism is accommodated here because, in this view, earlier forms of life appear first, followed by animals, with human beings appearing last, etc. (Scott, 1997).

## **Progressive Creationists**

Progressive Creationists generally accept that the earth is billions of years old, but, like Gap Creationists and Day-age Creationists, they wholly reject evolution (Scott, 1997). Progressive Creationists note the “kinds” of animals that Noah placed within the ark during the Great Flood and Adam named while in Eden. These “kinds” are the animals within the different strata of the fossil record. This supports Progressive Creationists’ belief that the earth is billions, not thousands of years old. The fossil record accounts for these “kinds” by placing them at different taxonomic levels, each level representing an immense span of time (Archer, 1984).

## **Theistic Evolution/Evolutionary Creationism and Intelligent Design**

Theistic Evolutionists/Evolutionary Creationists believe that evolution has been—and continues to be—used as a tool for the higher purpose of human creation. With this one exception, virtually all empirical evidence from the fields of geology, astronomy, paleontology, and biology is accepted at various levels by Theistic Evolutionists/Evolutionary Creationists (Scott, 1997).

Scott argues that, from a scientific standpoint, Evolutionary Creationism is virtually synonymous with Theistic Evolution. The belief systems are similar in that each



includes believers who fully accept evolution, but both Evolutionary Creationists and Theistic Evolutionists believe that the Judeo-Christian God of Abrahamic tradition guided the process (Scott, 1997).

The difference between the two groups of believers lies in semantics and the number of believers within each belief system. *Evolutionary Creationism* is the label used by American Protestants, while *Theistic Evolution* is the label used by American Catholics (Morris, 1996). Morris (1996) notes that the number of Catholics who adhere to Theistic Evolution is considerably smaller than the number of Protestants who believe in Evolutionary Creationism. This was exemplified by a papal announcement made on October 23, 1996, when Pope John Paul II recognized that evolution occurs (Morris, 1996). The Pope further suggested his followers do the same, but added the caveat that God still works within the laws of biological science (Morris, 1996). As there is no single figurehead of American Protestantism, no blanket statement has been made that resembles the Pope's 1996 announcement. There is also a greater variety of creationist belief levels within the Protestant community (Scott, 1997).

The term *intelligent design* (ID) is often erroneously used in conjunction with Theistic Evolution/Evolutionary Creationism. Intelligent design is not part of Scott's Spectrum of Creationism, as ID resembles a political movement more than a belief system (Williams, 2006). Intelligent design is addressed in this proposal because of (a) its frequent mislabel for Theistic Evolution and (b) its relationship to the *Kitzmiller et al. v. Dover Area School Board* case in 2005.

The Kitzmiller case is the most high-profile case regarding the inclusion of creationist curriculum in public schools since the John Scopes trial in 1926 (Forrest, 2005). The case directly addressed public policy regarding science instruction.

Intelligent design is a political label for creationism. Intelligent design (ID) is the result of advocacy by the Discovery Institute Center for Science and Culture, a political action group whose aim is to implement creationism into school curriculum (Shermer, 2006). Intelligent design is embraced in varying degrees by both NE Creationists and OE Creationists, because of its relative success in implementing curriculum into America's public schools (Forrest, 2005).

The crux of the current intelligent design argument lies in the publication of Michael Behe's *Darwin's Black Box: The Biochemical Challenge to Evolution* (1996) and William Dembski's *No Free Lunch: Why Specified Complexity Cannot Be Purchased Without Intelligence* (2002). A very simplified summary of Behe's and Dembski's arguments lies in *irreducible complexity*, or the idea that there are organisms, or parts of organisms, that are too complex to not be "intelligently" designed (Behe, 1996; Dembski, 2002).

The concepts behind ID began with the publication of William Paley's *Natural Theology; or, Evidences of the Existence and Attributes of the Deity* in 1802 (Smith & Sullivan, 2007). Paley argues that the universe, like a watch, is "ordered." Paley extends his watch analogy to a "watchmaker" because, reasons Paley, the universe is so ordered that it requires a designer to construct it (Paley, 1802).

Hooykas (1972) preceded Behe and Dembski in noting these common "designs" found within nature and cite this as an example of "supernatural" evidence. Hooykas

included evidence from ancient Greek philosophers to back his argument that God and nature are intertwined. He argued that the universe must, by default, be a machine model that is made and fabricated by an omnipotent supernatural being (Hooykas, 1972).

As of this writing, there has been one peer-reviewed article endorsing intelligent design, titled “The Origin of Biological Information and the Higher Taxonomic Categories.” The author, Stephen Meyer, was a senior fellow at the intelligent design think-tank Discovery Institute and professor at Christian Palm Beach Atlantic University. The article was highly contested by the scientific community (Meyer, 2004). Soon after publication, a statement was issued by the publisher of the scientific journal in which the article appeared, *Proceedings of the Biological Society of Washington*. The article was quickly retracted by the journal. In the retraction, the publisher noted that the peer-review was completed by only one person, Richard Sternberg, an associate of Meyers. The Society also stipulated that ID holds no credible scientific evidence whatsoever (D. Smith, 2005).

### **Research on Cosmological Beliefs and Science Achievement**

In the last three decades, many studies have examined the correlation between cosmological beliefs and student learning, particularly in the area of science instruction. Most of these did find some level of correlation between cosmological beliefs and science achievement. Studies finding correlation between cosmological beliefs and science achievement include those by Lawson (1983), Findley et al. (2001), McKeachie et al. (2002), Ingram and Nelson (2006), and Burton et al. (2005). Of these, only Burton et al. (2005) included data suggesting that cosmological beliefs consistent with creationism might result in an increase in science achievement.

Lawson (1983) wanted to find out whether a student's belief in creationism (or disbelief in evolution) was in some way connected to achievement in science classes. Lawson's sample included undergraduate students with a large female-to-male ratio. The average age of these students was 22.8 years, and the sample included 11 males and 85 females.

Lawson asked individuals to agree or disagree with this statement: "All living things were created during a short period of time by an act of God." Lawson found that students who agreed with the statement above scored lower on science achievement tests. Although Lawson's study is pivotal in the research on cosmological beliefs, his use of only one statement/question limited the choice of his subjects and may have forced responses that fail to fully reflect the array of cosmological beliefs people hold (Lawson, 1983).

Findley et al. (2001) also found that cosmological belief in special creation is correlated to science achievement. They surveyed 155 college freshman biology students in Louisiana and found that about 70% of the students from rural areas had received little to no exposure to the theory of evolution. They found that the majority of these rural students did not believe in evolution and extrapolated that the lack of exposure led to this general disbelief. This study found a slight decrease in science achievement in those students within rural parishes, which (again) contained a higher percentage of creationists. Their findings also indicated that cosmological belief in creation acts as a detriment to science achievement, at least in the parishes of Louisiana (Findley et al., 2001).

McKeachie et al. (2002) found correlation between cosmological beliefs in creationism and science achievement. Their study, similar to the studies cited above, measured biology students' cosmological beliefs prior to a biology course and then compared these beliefs to their science grades.

The McKeachie et al. study used a more detailed instrument than the one used by Lawson (1983). Instead of using the blanket statement "All living things were created during a short period of time by an act of God," the researchers used a four-item survey with more specific beliefs about origins.

The four statements in McKeachie's study were consistent with the four different belief systems used in the present study: NE Creationism, OE Creationism, Theistic Evolution, and Naturalism. The specifics of these belief systems were described in greater detail earlier in this chapter.

A key limitation of the McKeachie study is the relatively low number (60) of randomly sampled undergraduate students in the pre-course survey. Compounding this problem is the fact that a disproportionate percentage (54%) of the subjects within the study did not complete the end-course survey. Only 28 of the subjects studied completed both the pretest and posttest required for the study's analysis. This means, essentially, that the data McKeachie et al. used were acquired from a single classroom-sized sample of 28 students.

Regarding achievement, the researchers found that students who accepted evolution as "fact" earned significantly higher grades than those who identified themselves as believing in creation or doubting evolution (McKeachie, 2002).

Ingram and Nelson (2006) also found correlation between cosmological beliefs and science achievement. Their study contrasted the other studies examined here, as the students sampled in their study were engaged in an upper-level (not introductory) biology course. The researchers found that students' attitudes towards evolution-acceptance were positively related to final grades, suggesting that cosmological beliefs do have some bearing upon science achievement. The study also utilized a more expansive instrument, containing 21 questions, and sampled hundreds more students than the other studies examined here (Ingram & Nelson, 2006).

All of the studies mentioned thus far took place in secular institutions. It is reasonable to assume that the nature of the curriculum taught within these institutions is limited to the confines of natural evidence. Burton et al. (2005) researched students' perceptions of the teaching and learning process and academic performance in a Seventh-day Adventist school. They used a sample of junior high students who were likely held predominately creationist schemas (Burton et al., 2005).

Seventh-day Adventists (SDA) are Protestants who tend to subscribe to New Earth Creationism, with many of their key beliefs including a literal 7-day creation week. SDA policy requires teachers in their privately funded SDA middle schools to be church members and to use a curriculum that emphasizes church beliefs in connection with the subjects studied (General Conference of Seventh-day Adventists, 2005).

The researchers used a student questionnaire with 27 questions, 24 of which related to student perceptions of science instruction. They list a variety of variables in their study, none of which specifically name "belief" as a variable. This is important to note, because the population of students studied by Burton and Kijai were attending an

Adventist school, in which the science curriculum does not generally contradict with the beliefs of the subjects' ideology (General Conference of Seventh-day Adventists, 2005).

Burton et al.'s (2005) findings indicate that those with creationist views may be more positively correlated with higher scientific achievement. This contrasts the other studies that found correlation with decreased achievement.

My study is similar to Burton et al. (2005) in that it studies attitudes (or beliefs) of students in the same age range. It differs from the Burton study in that it does not assume creationist beliefs of the students but, rather, inquires about the beliefs of the students beforehand and then compares these to the students' posttest scores.

Two other studies in the last 12 years (Miller, 1999; Verhey, 2005) found that cosmological beliefs in creationism do *not* correlate to science achievement. Like all the other studies excepting Burton et al. (2005), both Miller's and Verhey's subjects were college students in biology classes. A significant portion of Miller's study addressed the academic achievement of her subjects within the course. Miller's pre-course survey technique was similar in this aspect to the other studies, which found correlation between cosmology and science achievement. Miller notes that the students within the course passed successfully regardless of the students' individual cosmological beliefs of human origins (Miller, 1999).

Verhey (2005) also included data that found no correlation between cosmological beliefs and science achievement. Verhey's study addressed achievement in science but was more specific to cognitive development than previous studies. It acted upon the premise that students need to be introduced to evolution only after they are ready to embrace complex concepts. Verhey also acted on the premise that evolution contains

more complex subject matter than creation. Verhey placed a control group of students in a naturalism-only classroom. He then took a treatment group of students with belief systems varying from New Earth Creationism to Atheistic Naturalism and taught the arguments for both creationism and evolution. It is important to note that Verhey's study included an "equal time" curriculum for which creationists have been advocating since *Edwards v. Aguillard* (1987).

Verhey (2005) agreed with Miller (1999) in his findings that students who adhered to supernatural causes of human origins do not necessarily achieve lower grades than those who adhered to a natural evidence-based belief system.

### **Other Factors That Influence Academic/Science Achievement**

Science achievement of middle-school students (the population of this study) has been widely studied. Numerous studies exist that identify measurable factors that predict achievement. The majority of these studies measure achievement with standardized test scores for mathematics and language arts. As explored further, "science achievement" typically encompasses the disciplines of both mathematics and language arts. Three of the factors examined here have been shown to influence achievement: socioeconomic status, race/ethnicity, and gender.

#### Socioeconomic Status

Studies by Coleman (1966), Chall (1996), Biddle (1997), the U.S. Department of Education (2001), and Tuttle (2004) clearly identify socioeconomic status as a factor in science achievement. The first major study to address the effect of socioeconomic status was *The Equality of Educational Opportunity Study* (EEOS) in 1966. The EEOS was



commissioned by the U.S. Department of Health, Education, and Welfare. Its purpose was to assess how available equal opportunities were to children of different races, religions, and national origins (Coleman, 1966).

The Coleman (1966) study identified socioeconomic status as a predictor of academic achievement, including science achievement. Since then, the effect of socioeconomic status upon achievement has been re-identified in numerous studies.

In 1996, Chall conducted a study that attempted to catalogue the achievement scores of students from different socioeconomic backgrounds, ranging from those in affluent homes to those in extreme poverty. Chall conducted a massive analysis of standardized tests from the years 1910-1996. The researcher analyzed an array of different testing instruments, ranging from the National Assessment of Educational Progress (NAEP) test to the Scholastic Aptitude Test (SAT) (Chall, 1996).

Chall (1996) concluded that there were significant differences in academic achievement between children of higher and lower socioeconomic status. Chall found that children from affluent homes are far more likely to have academic success than those from homes in poverty.

Biddle (1997) studied the effect of socioeconomic status upon academic achievement, finding that the poverty and achievement correlation was  $r = .700$  ( $p < .001$ ), indicating strong correlation between science achievement and socioeconomic status. Biddle also concluded that the level of school funding and child poverty predict 55% of the variance in mathematics achievement between the states (Biddle, 1997).

In 2001, the U.S. Department of Education's *The Longitudinal Evaluation of School Change and Performance (LESCP) in Title I Schools* was released. It found that

individual and school poverty had a “clear, negative effect” upon achievement. The LESCO is most prescient to my study, as many of the students in the treatment group came from homes at or below poverty level (U.S. Department of Education, 2001).

Tuttle (2004) reported specifically on Indiana, the state in which this study took place. Tuttle used an OLS regression analysis of SAT scores with variables including income. Tuttle reported that, in addition to parental education, socioeconomic status is one of the two factors most closely linked to student achievement (Tuttle, 2004).

The number of American children in poverty is to be taken into consideration when these data are examined. The last census taken at this writing reveals that 16.2% of children within the United States live in households with an income below poverty level (DeNavas-Walt & Smith, 2007). Of these approximately 12 million children, about one-third live in extreme poverty with incomes below 50% of the official poverty line (Hoff, 2002).

### Race

The EEOS also identified race as a strong indicator of academic achievement, leading the federal government to the desegregation measures that were part of the Civil Rights Movement in the 1960s and 1970s (Thomas & Stockton, 2003). However, over 30 years later, research continues to find race/ethnicity to be predictive of academic/science achievement.

There have been studies both supporting and rejecting the findings by the EEOS, noting insignificant and significant correlation between race and academic achievement. Bankston and Caldas (1998) concluded that minority status was more highly related to achievement than were economic factors. In contrast, Harkreader and Weathersby (1998)

found that race was much less an influential factor in academic achievement than socioeconomic status. Considering the varied results from the research and the complexity of variables, it is reasonable to assume that race cannot be singled out as the sole factor in achievement. For example, according to Thomas and Stockton (2003), African-American children are far more likely to be living in poverty (33.1%) than Caucasian children (13.1%). Additionally, Caucasian children in America are more likely to be taught by teachers with higher qualifications, thus children of racial minority status are more likely to be taught by less qualified teachers (Darling-Hammond, 1999).

### Gender

Studies have been completed that both support and refute gender as a predictor of academic achievement. Two independent studies support correlation between higher academic achievement and female gender, and one study commissioned by the United States Department of Education indicates a relationship between higher achievement levels and males.

At least two studies within the last 10 years have been released that support the hypothesis that females score higher on standardized tests. Baharudin and Luster (1998) suggest that females are more likely to attain higher mathematics scores. Donahue, Voelkl, Campbell, and Mazzeo (1999) also found correlation between female gender and language arts achievement, as exhibited by slightly higher standardized test scores in that discipline.

Contrasting the findings above, a major study commissioned by the U.S. Department of Education found that males are more likely to have higher scores on academic achievement tests. The 2001 study, *The Nation's Report Card: Mathematics*

*Highlights*, suggested that males outperform females in mathematics skills on standardized mathematics assessments at a slightly higher rate in the 4th grade, but then made significant gains over girls in the 8th and 12th grades (Santapau, 2007).

All three studies examined here used data from standardized assessments taken by students in the 4th, 8th, and 12th grades. It is important to note, however, that the variance in scores between males and females in all of these findings was relatively small. This indicates that gender is not nearly as significant a factor as the other factors previously indicated by The Equality of Educational Opportunity Study (EEOS) (Coleman, 1966).

### **Measuring Science Achievement**

Currently, the scientific community and science educators emphasize the importance of teaching the process of science (National Center for Science Education, 2010). Unfortunately, standardized testing and evaluation measures in the United States tend to emphasize the accumulation of facts as opposed to evaluating the process of scientific inquiry (Michaels & Schweingruber, 2008). While uniformity in handling this variability has not been finalized, I review approaches to measuring science achievement.

The NRC has argued that, while it is relatively easy to set forth benchmarks in mathematics (and to a lesser extent, language arts), science is too broad to be contained in one subject area. Thus, the NRC has looked to another possible way to assess students: measuring their understanding of the process of science (Michaels & Schweingruber, 2008).

The State of Indiana uses the Northwest Evaluation Association (NWEA) and the Indiana Statewide Test for Educational Progress-Plus (ISTEP) assessments. These two

separate standardized science assessments are examined below. Each examination includes information addressing the extent to which the individual assessment adheres to the recommendations by the NRC.

### **Assessing Science Process Achievement**

The world's scientists and educators now overwhelmingly recommend that assessment of science be based in the process of science. According to those who advocate "process-based" assessment, the conventional multiple choice or short answer tests are too limited in their coverage, too shallow in reasoning skills, and too narrow in measuring outcomes (Michaels & Schweingruber, 2008).

This "process" of science includes observing, measuring, classifying, deducing, and inferring. One of the goals of this process, then, is to help students recognize the difference between personal opinion/belief and knowledge gained through scientific investigation, debate, and research (National Center for Science Education, 2010).

While this is important, the National Science Teachers Association (NSTA) notes the impracticability of testing the process of students without emphasizing the essential theories within natural sciences (National Science Teachers Association, 2010).

The current emphasis upon the process of science is reflected in science instruction stemmed from the findings of a study by Bransford, Brown, and Cocking (1999). Their study offered new ideas about the learning process and the assessment of competent performance. The researchers explored how learning actually changes the physical structure of the brain.

Bransford et al.'s (1999) research was founded in the theories of Vygotsky (1978) and Cole (Cole & Engestrom, 1993). Vytgotsky (1978) coined the term "zone of

proximal development” (ZPD). The ZPD, according to Vygotsky, is the difference between what a learner (in this case, a student in science class) can do without help and what he or she can do with assistance (Vygotsky, 1978).

Cole builds on Vygotsky’s findings in explaining that the world from which a child enters plays greatly into his or her processing skills. Successful science teachers, writes Cole, need to consider their students’ cultural background when adapting instruction. Cole points out the example of children from different cultures who perceive mathematics problems differently (Cole & Engestrom, 1993). Stremmel (1993) expands on Vygotsky’s work by explaining that the learning process is a social one; teaching (especially science teaching) must be a collaborative process. Teachers who are going to succeed in teaching the science process must engage in responsive teaching, argues Stremmel. The successful science teacher must also build bridges between the home environment (part of the child’s schema) and the curriculum (Stremmel & Fu, 1993).

The NRC has endorsed the findings of these theorists in the book *Inquiry and the National Science Education Standards* (2000). The NRC makes it clear that the successful educator (and assessor) must identify the ZPD in his or her students and be aware of cultural differences before proceeding to their ideal model for instruction, “Guided Inquiry.”

The emphasis in Guided Inquiry is on allowing the student to “discover” empirical evidence. Guided Inquiry was chosen for the unit because it involves open-ended, student-centered hands-on activities. In the Guided Inquiry Model, all science (and thus, science instruction) should be approached using only empirical evidence (Olson, 2000).

It is also imperative, according to the NRC, that previously identified theories serve as a foundation to exploration. As science is based in theories, it is necessary for the teacher to provide these theories and then allow the student to “explore” the concept within set parameters. For example, the American Association for the Advancement of Science (AAAS) stipulates that a common understanding among scientists about what is evidentiary should constitute a scientifically valid investigation (Olson, 2000). This is especially prescient to widely accepted theories of science, which are typically too complex for younger learners to master (Olson, 2000). One of these widely accepted theories, the theory of evolution through natural selection, directly relates to this study.

This literature review has explored the following independent variables: cosmological beliefs relating to origins, race/ethnicity, socioeconomic status, and gender. Measurement of the dependent variable, science achievement, is examined in detail below.

### **Standardized Assessments**

The federal No Child Left Behind Act of 2001 (NCLB) stipulated that public school districts across the country are required to show adequate yearly progress (AYP) or else face measures that include withdrawal of federal funds or school choice vouchers (U.S. Department of Education, 2007b). Clay Intermediate Center (IC), a public school, is subject to this mandate. The initiation of NCLB required schools to report scores from different sources based upon standards set forth by each state’s education department (U.S. Department of Education, 2007b).

The Northwest Evaluation Association (NWEA) is one of the two standardized assessment tools used by the State of Indiana. The NWEA was specifically designed to

prepare students for mandates within No Child Left Behind (Northwest Evaluation Association, 2009). The NWEA is divided into two categories—“General Science” and “Concepts and Processes” (Northwest Evaluation Association, 2009).

The NWEA assessment tool includes questions involving the process of science, collecting, recording, interpreting data, and measurement, all of which reflect the current emphasis on process-based science instruction. The test also includes commonly accepted knowledge among the scientific community, such as the water system and changes within nature (Northwest Evaluation Association, 2009).

The Indiana Statewide Test for Educational Progress—Plus standardized test (ISTEP) is also taken annually by students within Indiana’s public schools. The ISTEP was designed by the Indiana Department of Education rather than a nationwide testing company. The science portion of the ISTEP is administered only to students in third and seventh grades. The remainder of the test measures language arts and mathematics skills for students in primary grades through high school (Indiana Department of Education, 2008).

The ISTEP also contrasts the NWEA in that it holds the student more accountable for successful completion. The 10<sup>th</sup>-grade-level ISTEP serves as a graduate qualifying exam: If students do not pass the ISTEP by the 10<sup>th</sup> grade, they fail to receive a high-school diploma (Indiana Department of Education, 2008).

While the ISTEP is based in the standards of what each child is supposed to know, it has been criticized by process-based instruction advocates. The science portion of the ISTEP falls within a “multiple choice/short-answer” format, which is antithetical to the recommendations put forth by the NRC (2000).



It is worth noting that the South Bend Community School Corporation, the corporation for which this study was designed, has recently adopted the science portion of the ISTEP. It is also pertinent to note the findings concerning the State of Indiana by the National Assessment of Educational Progress (NAEP), part of which addressed science achievement (National Center for Education Statistics, 2005). In the NAEP, the State of Indiana recorded a higher-than-average score for eighth-graders in science achievement when compared to other states (IBJ Staff and Associates Press, 2009).

### **Summary**

This chapter reviewed the conflict between creationists and empiricists, beginning with the trial of John T. Scopes in 1925 and continuing through today. This chapter also reviewed four distinct positions on the creation-evolution continuum, developed by Eugenie Scott, Director of the National Center for Science Education (Scott, 1997), which was used in this study. The concepts behind intelligent design were also reviewed.

This chapter also reviewed the research on correlation between cosmological beliefs and science achievement. Studies by Lawson (1983), Findley et al. (2001), McKeachie et al. (2002), and Ingram and Nelson (2006) have indicated that cosmological beliefs are correlated with science achievement. In contrast, studies by Miller (1999) and Verhey (2005) indicated that cosmology has little to no effect upon science achievement. A single study by Burton et al. (2005) included data that indicated creationist cosmological beliefs might contribute to student achievement in science.

This chapter also reviewed other factors in science achievement: socioeconomic status, race, and gender. The research indicates that these factors vary in the degree of their effect upon academic (and specifically science) achievement.

Finally, this chapter reviewed the current emphasis on the science process and standardized testing measures in Indiana.

## CHAPTER III

### METHODOLOGY

#### **General Introduction**

This study's aim was to ascertain whether cosmological beliefs act as a predictor of science achievement within an after-school program, as compared to other factors—socioeconomic status, race, gender, previous science knowledge, and instruction. The entire study took place at Clay Intermediate Center, a public school in South Bend, Indiana, during the first 3 weeks of May 2010.

#### **Type of Study**

This study was of quasi-experimental research design, making use of ordinal, nominal, and dummy scales. Appendix A (Table 8) explores the conceptual, instrumental, and operational variables in depth.

A survey measuring cosmological beliefs was part of the study. The survey was quantitative, using a nominal scale for each belief statement within the instrument ("Nominal Scale," n.d.). The instrument also included a section measuring ethnicity; it was quantitative, using a nominal scale for each ethnicity within the survey ("Nominal Scale," n.d.).

A section measuring gender was quantitative, using a dummy scale for both genders ("Dummy Variable," n.d.). A section measuring socioeconomic status was

quantitative, using an ordinal scale for each level of income within the survey ("Ordinal Scale," n.d.). A section measuring science achievement was quantitative, scaling science achievement percentages between the pretest scores and the posttest scores ("Ordinal Scale," n.d.). The variable "previous science knowledge" included both students' pretest scores and ISTEP scores. The pretest scores were gauged for percentage gain, whereas the ISTEP ("passing," "not passing," "failing to take") was nominally scaled.

### **Population and Sample**

Data were gathered from an initial sample of 97 students and their parents from Clay Intermediate Center in South Bend, Indiana. Students were initially selected as participants initially based on purposive sampling, but ultimately convenience served as the deciding factor: Students who were available were allowed to participate and placed in the treatment group. Students in the control group were involved in after-school activities. Students were recruited by communication to parents at an Open House in 2009 and by announcements sent home to parents. A total of 80 students were selected for study. A collection of 33 students was placed in the control group, whereas 47 were placed in the treatment group.

Clay Intermediate Center is an urban public Intermediate Center within the South Bend Community School Corporation (School Snapshot: Clay Intermediate Center, 2008). Clay IC varies in student enrollment from 600 to 750 students (*School Snapshot: Clay Intermediate Center*, n.d.). The fluctuation in enrollment at Clay Intermediate Center is due to a sizable portion of Clay's students who are transient (Center for the Homeless, 2010). More than half (54%) of the students enrolled at Clay IC receive either free or reduced lunch (*School Snapshot: Clay Intermediate Center*, n.d.). Approximately

40% of the students are African American, 45% Caucasian, 10% Hispanic, and the remaining 5% are of other ethnicities (*School Snapshot: Clay Intermediate Center*, n.d.).

Like most public schools in the United States, Clay IC was deeply affected by passage of the No Child Left Behind Act (NCLB) in 2002. When NCLB was adopted by the federal government, it stipulated that public schools be held accountable to high-stakes testing and must meet “adequate yearly progress” (AYP) or face federal funding limits (Indiana Department of Education, 2008).

As examined, Clay IC’s standardized test scores are retrieved from the ISTEP (Indiana Department of Education, 2008). Clay students also take the NWEA (Northwest Evaluation Association, 2009), but these scores were not made available for analysis. Clay IC’s ISTEP scores are consistently higher than that of other Intermediate Centers within the greater South Bend Community School Corporation, but fall below Indiana’s average (*School Snapshot: Clay Intermediate Center*, n.d.).

### **Hypothesis**

Research Hypothesis: Self-reported cosmological beliefs regarding origins, ethnicity, socioeconomic status, gender, previous science knowledge, and instruction are significant predictors of science achievement among junior-high students.

Null Hypothesis: Self-reported cosmological beliefs regarding origins, ethnicity, socioeconomic status, gender, previous science knowledge, and instruction are not significant predictors of science achievement among junior-high students.

## Variables Defined

Appendix A (Table 8) explores the conceptual, instrumental, and operational variables used in depth. The study utilized the following variables: self-reported cosmological beliefs regarding origins, science achievement, ethnicity, socioeconomic status, gender, previous science knowledge, and instruction. The conceptual variable measuring cosmological beliefs was reported by the student. The instrumental variables were as follows:

*Cosmological beliefs:* The students were given a survey with four statements consistent with New Earth Creationism, Old Earth Creationism, Theistic Evolution/Evolutionary Creationism, and Natural Evolution. The survey is as follows:

1. “The earth and all of the earth’s inhabitants were made in a relatively short period of time, thousands of years ago, by a Supreme Being (i.e., God).”
2. “Each ‘day’ listed in Genesis assumes extremely large amounts of time. Scientific evidence is strong that the earth is 4.5 billion years old. The fossil record indicates different kinds of animals that are described in the book of Genesis. Evolution has not and does not occur.”
3. “All plants and animals on earth (including humans) evolved from a single-celled ancestor, but a Supreme Being (i.e., God) began, observed and guided the process.”
4. “Over billions of years, all plants and animals on earth (including humans) evolved from a single-celled ancestor.”

*Science achievement:* The instrumental variable of science achievement was addressed through a posttest (Appendix F) from a unit titled *Cells and Heredity* (Padilla et al., 1999). It was taken from the publisher's test bank of materials.

*Previous science knowledge:* The instrumental variable of previous science knowledge was addressed through a pretest (Appendix E) and the child's ISTEP score. The pretest was taken directly from the test bank of materials provided by the publishers. The ISTEP scores used in the study were the most recent available.

*Instruction:* The "instruction" variable refers to the treatment itself, in which daily notes were taken, detailed under "Data Collection Procedure."

The instrumental variables of socioeconomic status, race/ethnicity, and gender were addressed through questions on the survey instrument taken from the U.S. Census Bureau.

The operational variables of cosmological beliefs and ethnicity were nominally scaled, assigning unranked number codes to each belief/ethnicity. The operational variable for previous science knowledge relating to the ISTEP was assigned a number on a dummy scale, with students assigned a "1" for passing, a "0" for not passing, and a "3" if the ISTEP was not taken by the student. The operational variables addressing socioeconomic status were placed on ordinal scales, assigning a ranked number code to each level of income. The operational variable addressing gender used a dummy scale, assigning a number code to each gender.

## Instrumentation

There were five instruments used in the study. The first instrument was the survey measuring race/ethnicity, gender, and socioeconomic status. It was given to consenting parents.

The second instrument was a questionnaire gauging cosmological beliefs regarding origins. It was given to students prior to the three-session (nine classes) course. The third instrument was the pretest score from the *Cells and Heredity* unit. The fourth was the students' ISTEP score. The fifth and final instrument was the students' posttest scores. Instruments are attached in Appendices B, C, E, and F.

To ensure validity of the cosmological beliefs questionnaire, an expert panel was consulted. Three professionals from various fields of science, with varying worldviews, reviewed the statements. The three professionals listed below each approved the statements listed as being connected to the worldviews described in the study.

1. Greg Snider, Ph.D., University of Notre Dame Electrical Engineering Dept.
2. Tom Goodwin, Ph.D., Andrews University, Professor of Paleobiology
3. Tom Mailloux, B.A., Clay Intermediate Center, Science Dept. Chair

Two of the survey items were taken from previous studies exploring the subject. The statement aligned with NE Creationism was identical to that used by Lawson in the 1983 study. The statement aligned with Theistic Evolution/Evolutionary Creationism was taken verbatim from the 2002 study by McKeachie et al.

The remaining two statements were taken verbatim from two renowned experts within the field of the evolution/creation controversy. The statement aligned with OE Creationism was taken directly from Eugenie Scott's Creationism Spectrum, found in her



article “Antievolution and Creationism in the United States” (1997). The statement aligned with Natural Evolution was taken directly from Michael Shermer’s *Why Darwin Matters: The Case Against Intelligent Design* (2006).

The four statements identifying cosmological views are also very similar to those found within a Gallup poll measuring creationist beliefs of Americans, which has been taken every 2 years since 1982 (Gallup, 2008).

As to the reliability of the parental responses, the questions measuring ethnicity, gender, and socioeconomic status were taken verbatim from the 2000 Census (United States Census Bureau, 2000). The scale determining socioeconomic status was also taken from the United States Census Bureau’s Housing and Household Economic Statistics Division (United States Census Bureau, 2008).

The questions used in the ISTEP have undergone rigorous tests for reliability and validity. The ISTEP is accepted by the federal government from the State of Indiana in accordance with No Child Left Behind.

The pretest and posttest have undergone rigorous tests for validity and reliability. The principal author of *Cells and Heredity*, Michael J. Padilla, personally, in a telephone conversation, suggested that the pretest and posttest be taken from the test bank of materials provided by the unit’s publishers. An eighth-grade science teacher, Tom Mailloux, also approved both the pretest and the posttest.

Both the pretest and the posttest were comprised of 12 multiple-choice questions and one essay question. The multiple-choice questions measured knowledge gained from theories based in natural evidence (cell theory, genetics, and evolution). The questions for these tests were chosen because of their alignment with the recommendations from the

American Association for the Advancement of Science (emphasis upon evidence in established theories of science) and the National Research Council (2005) (emphasis on process and inference).

Four separate units were evaluated for their applicability to the course's objectives. The units are located in Appendix D (Table 9).

### **Data Collection Procedure**

I first contacted John Ritzler, SBCSC's director of research and evaluation, who confirmed that I needed to acquire IRB approval and my principal's written permission to conduct a study at an SBCSC school. I then contacted my principal, James Knight, who agreed to the conditions of the study and provided written permission. After this, approval from the Andrews University Institutional Review Board (IRB) was authorized.

An application was sent to 150 students, but only 97 were returned. This application included an informed consent form, an explanation of the study which provided criteria for participation in the after-school program, and a short demographic and cosmological viewpoint survey to help with the initial goal of purposeful sampling. A total of 17 parents refused consent. Of the remaining 80 students, 50 were selected for the program (although 3 did not participate) and 33 were assigned as a control group. These groups were matched based on gender, SES, cosmological views, and ISTEP scores to ensure similar variability between the groups.

Students for both groups were selected that identified themselves as NE Creationists, OE Creationists, Theistic Evolutionists, and those that accepted natural evolution. Students were also selected that represented a variety of ethnicities, socioeconomic statuses, and genders. The students were chosen using a screening tool

(Appendix H) which placed each student's cosmological belief, ethnicity, socioeconomic status, and gender in a grid. The final 10-25 students in the treatment group were chosen because of convenience: Students who were not in after-school activities were more likely to participate in the treatment. As an incentive to participate, all students who attended 2 or more days received a ticket to an age-appropriate film at a local theater.

The treatment consisted of three sessions over 3 days, each session lasting at least 2½ hours. There were three classes per day. Attendance was taken at the beginning of each session. On Monday, May 3, 2010, three classes took place at Clay IC. A group of 32 students attended. Students were placed in heterozygous learning groups named for different organelles of the animal cell. The students enjoyed a scavenger hunt with different questions from the chapter from the unit *Cells and Heredity*. The students then measured the diameter of four eggs as part of the lab "Eggsperiment with the Cell." In following the recommendations of guided inquiry, I did not specify that diffusion of the vinegar into the eggs would take place. Rather, I instructed the students to record predictions about what would happen to the eggs after the eggs were submerged in vinegar for the week.

Tuesday, May 4, 2010, was the second day of instruction. Three classes took place on this day, and 42 students attended this session. The students measured the eggs, "discovering" that the vinegar had diffused into the eggs. The information from the cell was reviewed from the previous day.

The students were then placed into two random heterozygous groups. One group reviewed the chapter outlining how traits are passed from one generation to another. This group also reviewed the corresponding material via the internet. The remaining half of

the class predicted what hypothetical offspring would look like with Mendelian traits. I wanted the students to “discover” how traits were passed from one generation to the next, through two heterozygous gene carriers. A trait could “skip” a generation and then reappear. Using illustrations, I asked the students to hypothesize how a child could have red hair if both her parents had brown hair. The entire class switched instructional methods at the half-way mark.

After regrouping, the class participated in a Punnett Square activity called “Trait Bingo.” This required students to examine their physical traits passed through a single paternal allele and a single maternal allele. Students who possessed random traits (determined by Punnett squares) were awarded corresponding letters on their “Trait Bingo” cards. Using themselves as examples, the students were “guided to discover” that a recessive allele can be passed through a generation.

On Wednesday, May 5, 2010, three classes took place, and 43 students were in attendance, the largest group of the week. After measuring the eggs that were diffusing in vinegar, the group reviewed the information on genetics from the previous day. The students were split into two groups. The first group explored physical examples of fossils: casts, molds, and imprints. I asked students to hypothesize the order in which these fossils were made. These students constructed Venn diagrams of their “fossil hypotheses.” The students were “guided to discover” that the fossils of the simpler life forms (those from the Cambrian stratum, for example) were formed earlier than those of more complex organisms (those from the Triassic, for example).

The second group of students used the unit’s CD-ROM to go through the simulated “Biological Change Over Time.” The groups switched activities after 1 hour.

The students began asking questions, unprompted, about evolution vs. creation during the session. I asked the students to hold their discussion until the following Friday (May 7, 2010) when we would have a formal debriefing session. More will be reported on this discussion in chapter 5.

On Friday, May 7, 2010, the final three treatment sessions occurred. Attendance for this session (28) was much lower than the previous classes. The probable cause(s) of the lower attendance was: (a) a large thunderstorm occurred in South Bend on that afternoon and (b) the sessions took place on a Friday. There was a staff meeting on Thursday, May 6, 2010, so classes did not take place on that day. Dr. Duane Covrig observed the Friday session and took additional notes. The students began by recording observations on the four eggs that had been diffusing in vinegar for the last 5 days. The students determined the mean egg growth (approximately 5 c.) of the (by now translucent) eggs. The students “discovered” that the process of diffusion had taken place.

The entire group played a review game, "Biology Jeopardy." The categories corresponded with the three concepts taught: “The Cell,” “Heredity,” and “Biological Change Over Time.” The posttest questions were rewritten as questions for the game. The majority of the answers given by the students were correct, with each team getting at least two questions right.

The group then participated in a debriefing session under the topic "My Cosmological Beliefs & Learning Science." I placed a copy of the four cosmological beliefs on the overhead projector. I told the students that they would not be asked to reveal their beliefs regarding human origins as part of the debriefing. The students were then reminded that each of the four cosmological beliefs was represented by several

students in the group and, furthermore, that everyone was able to work and learn cooperatively despite these differences. As an example of this, I told the students that Dr. Covrig and I held different belief systems regarding human origins. The students were reminded that approximately one third of the after-school sessions that had been taught conflicted with three-fourths of the cosmological belief statements.

A “yes/no” vote was subsequently taken in response to the following question: *“Do you think your answer to the questions given to you about evolution and creation had any effect on how well you did during this course?”* The exchanges (taken by myself and Dr. Covrig) are noted in Appendix J. A second debriefing took place on May 17, 2010 (Appendix J). Both debriefings are detailed and analyzed in chapter 5.

### **Data Analysis Procedure**

Based upon the factors examined within the literature, a hypothesized structural equation model was constructed. Pertaining to the cosmological beliefs independent variable, the studies by Lawson (1983), Findley et al. (2001), McKeachie et al. (2002), Ingram and Nelson (2006), and Burton et al. (2005) indicate that a model correlating cosmological beliefs to science achievement with an acceptable “Goodness of Fit” measure ( $p > .05$ ) would result (see Figure 1).

The model hypothesized that significant correlation ( $p = > .05$ ) to science achievement (posttest scores) would be found in these variables: (a) cosmological beliefs pertaining to origins, (b) socioeconomic status, (c) ethnicity, (d) gender, (e) previous science knowledge (the student’s pretest and ISTEP scores), and (f) instruction.

Studies by Coleman (1966), Chall (1996), Biddle (1997), the U.S. Department of Education (2001), and Tuttle (2004) would support a similar model correlating

socioeconomic status to academic achievement. Studies by Coleman (1966) and Bankston and Caldas (1998) would support race/ethnicity significantly correlated to academic achievement. Studies by Baharudin and Luster (1998) and Donahue et al. (1999) and Santapau (2007) suggest that gender would be significantly correlated to academic achievement. This hypothetical model has been drawn and appears in the first chapter (Figure 1).

The SEM is to be read from left to right, chronologically. Each rectangular box in the SEM represents a variable, the single-head arrows indicate the direction of the regression, and the score over the arrow is the correlation coefficient. The variables “cosmological beliefs relating to origins,” “socioeconomic status,” “race/ethnicity,” and “gender” were pre-determined, followed by the pretest and ISTEP scores (representing the variable “previous science knowledge”), followed by placement of the treatment group (representing the “instruction” variable), ending with “posttest,” representing our dependent variable, “science achievement” (Figure 1).

To accommodate for the 16 students who did not take the ISTEP (which could have acted as an outlier), the pretest scores were used to predict these students’ ISTEP results.

The students’ ISTEP scores, gender, ethnicity, socioeconomic status, and cosmological beliefs of origins were determined prior to the treatment. “Treatment group” indicates participation in the after-school sessions. “Pretest” indicates the pretest score. The final variable, “posttest score,” acts as the dependent variable, “science achievement.”

This hypothetical model was analyzed for “Goodness of Fit” after data were obtained. It was found that correlation only partially existed within the acceptable parameters ( $p = >.05$ ) of “Goodness of Fit.” To remedy this, a respecified structural equation model (Figure 2) was constructed.

### **Summary**

The research design reported in this chapter was used to identify correlation between cosmological worldviews regarding origins, socioeconomic status, race/ethnicity, gender, previous science knowledge, and instruction to science achievement in middle school students within Clay Intermediate Center. The study used a questionnaire to identify self-reported student cosmological worldviews aligned with creationism and naturalism. Students in a treatment group participated in a three-session course of nine classes studying the unit *Cells and Heredity*, which included a chapter explaining natural selection (Padilla et al., 2006). Students in the control group took the pretest, ISTEP, and posttest, but did not participate in the science course. Science achievement was measured using the posttest provided by the unit’s publisher. Parents identified race, socioeconomic status, and gender of each student. A hypothetical SEM was constructed showing correlation to science achievement from the identified variables, though upon analysis it was found that this model did not fit within acceptable “Goodness of Fit” parameters. A respecified model was constructed showing only significantly correlated variables.



## CHAPTER IV

### FINDINGS: GENERAL AND QUANTITATIVE

#### **Introduction**

This chapter presents the quantitative analysis of the data of this study. It reviews descriptive statistics of the sample and descriptive statistics of the variables. The chapter also reviews inferential statistics, addresses the study's hypothesis, and discusses the results.

#### **Descriptive Statistics**

A total of 80 (100%) students were in the study. The treatment group was composed of 47 (58.7%) students, while 33 (41.3%) students were in the control group (Table 1). As noted previously, 50 students had initially been recruited for the treatment group, but 3 of the students did not attend the sessions.

Table 1

*Treatment Group and Control Group*

<b>Group</b>	<b><i>N</i></b>	<b>Percentage</b>
Total Group	80	100.0
Treatment	47	58.7
Control	33	41.3

There were 36 seventh-graders and 11 eighth-graders in the treatment group. There were 18 seventh-graders and 15 eighth-graders in the control group. There were more than twice as many seventh-graders in the treatment group as there were in the control group, although eighth-graders were relatively evenly matched. The probable reason for this is because I taught seventh grade during the 2009-2010 school year and more eighth-graders are involved in after-school activities (Table 2).

Table 2

*Grades Levels Within the Treatment Group and Control Group*

<b>Group</b>	<b><i>N</i></b>	<b>Percentage</b>
Total Group	80	100.0
Treatment	47	58.7
Seventh-Graders	36	76.6
Eighth-Graders	11	23.4
Control	33	41.3
Seventh-Graders	18	54.5
Eighth-Graders	15	45.5

There were 20 (42.5%) males in the treatment group and 27 (57.5%) females in the treatment group. There were 19 (57.6%) males and 14 (42.4%) females in the control group. There were approximately 15% more females in the treatment group than in the control group (Table 3).

Table 3

*Genders Within the Treatment Group and Control Group*

<b>Group</b>	<b><i>N</i></b>	<b>Percentage</b>
Total Group	80	100.0
Treatment	47	58.7
Males	20	42.5
Females	27	57.5
Control	33	41.3
Males	19	57.6
Females	14	42.4

Students identifying as “White/Caucasian” numbered 19 (40.4%) in the treatment group and 23 (69.6%) in the control group. Students identifying as “Black/African American” numbered 16 (34.04%) in the treatment group and 7 (21.1%) in the control group. Students identifying as both “White/Caucasian” and “Black/African American” numbered 6 (12.76%) in the treatment group, and 1 (3.1%) in the control group. There were 4 (8.5%) students who identified as “Hispanic/Latino” in the treatment group, and 2 (6.2%) students identified as “Hispanic/Latino” in the control group. Two (2.12%) students identified as “Other Indian” within the treatment group.

The most significant differences between the two groups were among the “Biracial,” “Caucasian,” and “African American” designations. Students in the treatment group whose parents indicated “biracial” ethnicity outnumbered the control group by a ratio of 6:1 (approximately 84%). There were considerably more African Americans in the treatment group (approximately 14%) than in the control group. Approximately 30%

more Caucasians were in the control group. One possible reason for this is because more Caucasian students were involved in other after-school activities and were unavailable. Another reason for this might be because, as the literature reveals, African American students are more likely to be from homes of poverty or near-poverty status, and our treatment was free. As expected, students representing Asians, American Indians, and Pacific Islanders were, in keeping with the population of the school, low or non-existent (Table 4).

Table 4

*Race/Ethnicity Within the Treatment Group and Control Group*

<b>Group</b>	<b><i>N</i></b>	<b>Percentage</b>
Total Group	80	100.0
Treatment	47	58.7
White/Caucasian	19	40.4
Black/African American	16	34.0
Biracial	6	12.8
Hispanic/Latino	4	8.5
Other Asian	2	4.2
Control	33	41.3
White/Caucasian	23	69.6
Black/African American	7	21.2
Biracial	1	3.1
Hispanic/Latino	2	6.2
Other Asian	0	0.0

There were 10 (21.2%) students in the treatment group who identified as “New Earth Creationists” and 7 (21.2%) in the control group. Nine (19.1%) students in the treatment group and 7 (21.2%) students in the control group identified as “Old Earth Creationists.” The number of students identifying as believers in “Theistic Evolution.” numbered 14 (29.8%) in the treatment group and 13 (39.3%) in the control group. The number of students identifying as believers in “Natural Evolution” within the treatment group was 14 (29.8%), whereas 6 (18.3%) students identified as believers in “Natural Evolution” within the control group. The groups were relatively even, with the exception of those believing in “Natural Evolution” and those believing in “Theistic Evolution.” The treatment group had approximately 10% more believers in Natural Evolution than in the control group. The control group had approximately 10% more believers in “Theistic Evolution” than in the treatment group (Table 5).

There were 15 (31.9%) students who passed the ISTEP within the treatment group, and 7 (42.4%) within the control group, resulting in an approximate 10% difference. Students who failed to pass the ISTEP numbered 17 (36.1%) in the treatment group, and 5 (15.1%) in the control group, or an approximate 20% difference. There were 2 (4.25%) students who exceeded the maximum passing level and attained “pass plus” status within the treatment group, while 10 (30.3%) students attained “pass plus” within the control group. This was the largest difference between the two groups: The control group had a 25% larger “pass-plus” sample than the treatment group. Students within the treatment group who did not take the ISTEP when it was last administered at Clay IC numbered 13 (27.7%), and 4 (12.1%) students within the control group did not take the ISTEP.

Table 5

*Cosmological Beliefs Within the Treatment Group and Control Group*

<b>Group</b>	<b>N</b>	<b>Percentage</b>
Total Group	80	100.0
Treatment	47	58.7
New Earth Creationist	10	21.2
Old Earth Creationist	9	19.1
Theistic Evolution	14	29.8
Natural Evolution	14	29.8
Control	33	41.3
New Earth Creationist	7	21.2
Old Earth Creationist	7	21.2
Theistic Evolution	13	39.3
Natural Evolution	6	18.3

The treatment group had an approximate 13% larger “not taken” sample than the control group. As previously explored, Clay IC has a substantial student population from transient home environments. This accounts for the large percentage of students who did not take the ISTEP when it was last administered (Table 6).

Parents indicated that the household yearly income of students within the treatment and control groups range from less than \$10,000 to between \$125,000 and 149,999. In the treatment group, 9 (19.14%) students came from households earning less than \$10,000 annually, while 2 (6.1%) households in the control group earned less than \$10,000. Three (6.38%) students’ parents reported incomes from \$10,000 to \$14,000 within the treatment group, while zero students (0%) within the control group represented

Table 6

*ISTEP Results Within the Treatment Group and Control Group*

<b>Group</b>	<b>N</b>	<b>Percentage</b>
Total Group	80	100.0
Treatment	47	58.7
Passed ISTEP	15	31.9
Failed ISTEP	17	36.1
Pass-Plus ISTEP	2	4.3
Not Taken	13	27.7
Control	33	41.3
Passed ISTEP	7	21.2
Failed ISTEP	5	15.1
Pass-Plus ISTEP	10	30.3
Not Taken	4	12.1

this demographic. Four (8.5%) students' parents reported incomes from \$15,000 to \$19,000 within the treatment group, while zero (0%) students within the control group represented this demographic. Eight (17.02%) students' parents reported incomes from \$20,000 to \$24,999 within the treatment group, while 4 (12.1%) students within the control group fell into this income bracket. Reporting \$25,000 and \$29,999 were 5 (9.4%) students' parents from the treatment group and 4 (12.1%) from the control group. There were 3 (6.38%) students in the treatment group whose parents reported incomes between \$30,000 and \$34,999, while 2 (6%) students in the control group came from households within this income range. Reporting annual incomes of between \$35,000 and \$39,999 were 3 (6.38%) in the treatment group and 1 (3.1%) in the control

group. Students' parents in the treatment group reporting incomes of between \$40,000 and \$44,999 numbered 2 (4.25%), while 2 (6%) also represented this income bracket in the control group. The treatment group held 2 (4.25%) students' parents reporting incomes of between \$45,000 and \$49,999, while the control group held 4 (12.1%). Reporting between \$50,000 and \$59,999, there were three (6.38%) in the treatment group and 4 (12.1%) in the control group. In the \$60,000 to \$74,999 income bracket, 1 (2.12%) student represented the treatment group and 1 (3.1%) student represented the control group. Households reporting incomes of between \$75,000 and \$99,999 numbered 3 (6.38%) from the treatment group and 6 (18.3%) from the control group. There were 2 (6%) students in the control group who represented incomes of between \$100,000 and \$124,000, while zero (0%) students in the treatment group reported this level of income. Finally, there was 1 student from the treatment group (2.12%) and 1 (3.1%) student from the control group from the highest income bracket, reporting between \$125,000 and \$149,999 annually (Table 7).

Table 7 reveals the treatment group had a larger sample of students from homes in the lower five socioeconomic statuses (under \$30,000). This is probably because after-school activities require fees for insurance, uniforms, etc. Another factor might be because children of poverty are more likely to benefit from a safe, stable environment, which the after-school session provided.



Table 7

*Socioeconomic Status Within the Treatment Group and Control Group*

<b>Group</b>	<b>N</b>	<b>Percentage</b>
Total Group	80	100.0
Treatment	47	58.7
<\$10,000	9	19.1
\$10,000-\$14,999	3	6.4
\$15,000-\$19,999	4	8.5
\$20,000-\$24,999	8	17.0
\$25,000-\$29,999	5	10.6
\$30,000-\$34,999	3	6.4
\$35,000-\$39,999	3	6.4
\$40,000-\$44,999	2	4.3
\$45,000-\$49,999	2	4.3
\$50,000-\$59,999	3	6.4
\$60,000-\$74,999	1	2.1
\$75,000-\$99,999	3	6.4
\$100,000-\$124,999	0	0.0
\$125,000-\$149,999	1	2.1
Control	33	41.3
<\$10,000	2	6.1
\$10,000-\$14,999	0	0.0
\$15,000-\$19,999	0	0.0
\$20,000-\$24,999	4	12.1
\$25,000-\$29,999	4	12.1
\$30,000-\$34,999	2	6.1
\$35,000-\$39,999	1	3.0
\$40,000-\$44,999	2	6.1
\$45,000-\$49,999	4	12.1
\$50,000-\$59,999	4	12.1
\$60,000-\$74,999	1	3.0
\$75,000-\$99,999	6	18.2
\$100,000-\$124,999	2	6.1
\$125,000-\$149,999	1	3.0

## Hypothesis Testing

This study presented the following hypothesis:

Research Hypothesis: Self-reported cosmological beliefs regarding origins, ethnicity, socioeconomic status, gender, previous science knowledge, and instruction are significant predictors of science achievement among junior-high students.

Null hypothesis: Self-reported cosmological beliefs regarding origins, ethnicity, socioeconomic status, gender, previous science knowledge, and instruction are not significant predictors of science achievement among junior-high students.

My hypothetical model correlating the variables thus far examined was evaluated via AMOS 7.0 (Arbuckle, 2006). The following indexes were found: Chi square: 76.532,  $df: 17, p = .000$ , Comparative Fit Index (CFI): .537, Incremental Fit Index (IFI): .574, Normed Fit Index (NFI): .511, and Root Mean Square Error of Approximation (RMSEA): .211 (Low 90: .164 – High 90: .260). These indexes are out of the parameters of a fitted model.

Therefore, a new model was respecified, removing correlation considered insignificant (Arbuckle, 2006). The respecified SEM (Figure 2) should be viewed as the new hypothesized model. Each rectangular box again represents a variable; the single-head arrows indicate the direction of the regression, and the score over the arrow is the correlation coefficient. The boxes without arrows (cosmological beliefs, ethnicity, gender) were not significantly correlated. The “.60” over the dependent variable, “posttest score,” represents the combined effect from the independent variables.

Upon evaluation under AMOS 7.0 (Arbuckle, 2006), an acceptable Chi-square of 23.599 was found. The value  $p = .260$  is significantly higher than that of  $p \Rightarrow .05$ , the initial set  $p = \text{limit}$ . This supports a fitted model.

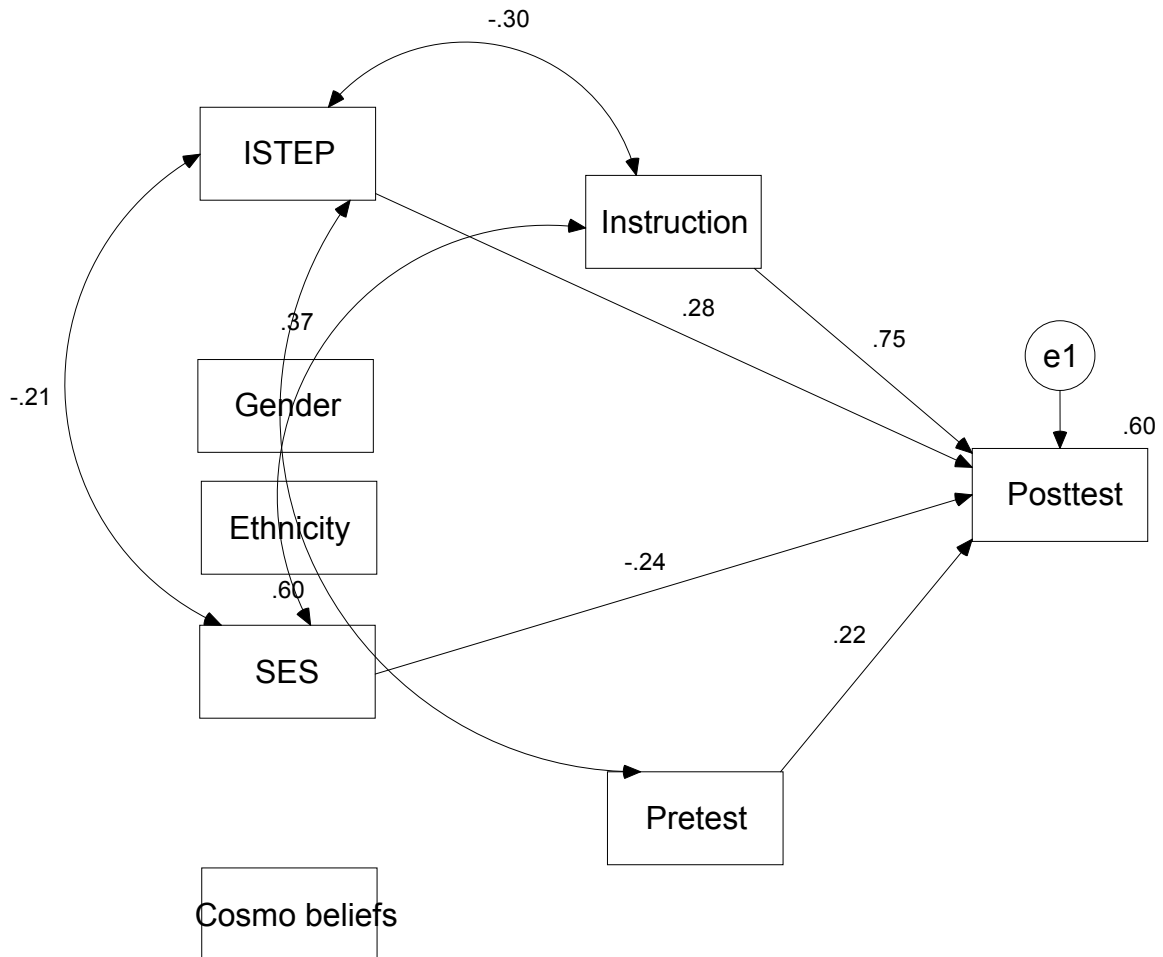


Figure 2. Respecified structured equation model of the data.

The respecified model also underwent a variety of “Goodness of Fit” measures, as recommended by researchers Marsh and Hau (1996). “Goodness of Fit” measures evaluate the expected values to the actual values. All the following measures of “Goodness of Fit” confirmed that this model was a significant representation of the data.

The Comparative Fit Index (CFI) level is .972, which exceeds .93, the level suggested by Byrne (1998). The Incremental Fit Index (IFI) is .974, exceeding .95, as suggested by Schumacker and Lomax (2004). The Root Mean Square Error of Approximation (RMSEA) measures .048 (Low 90: .000 – High 90: .112), or less than .05, the level recommended by Steiger (1990).

### **Discussion of Results**

The chi-square and fitting indexes indicate that the modified hypothesized model is supported by the results. Correlation between the variables “previous science knowledge,” “socioeconomic status,” and “instruction” to “posttest score” was found (see Figure 2).

The individual variables are addressed below:

#### **Previous Science Knowledge**

It was the original intention of this study to address only the independent variables “cosmological beliefs,” “socioeconomic status,” “race/ethnicity,” and “gender.” However, upon evaluation, it was found that significant correlation (.28,  $r\text{-squared} = .078$ , 7.8%) occurred between ISTEP scores and scores on the posttest, as well as significant correlation between the pretest and posttest scores (.22,  $r\text{-squared} = .048$ , 4.8%).

A new variable was therefore included in the analysis, titled “Previous Science Knowledge.” This variable was chosen because both the ISTEP and the pretest measured science information held by the students prior to the study. The independent variable “previous science knowledge” to the dependent variable “posttest achievement” revealed

significant correlation. The value correlating “ISTEP” to “posttest” was .28 ( $r$ -squared = .078, 7.8%). “Pretest” correlated to “posttest” at a value of .22 ( $r$ -squared = .048, 4.8%).

This indicates that previous knowledge gained by the students altered the results; essentially, a student who knew information about cells, heredity, and evolution before taking the course typically did better than a student who did not.

As previously noted in “Descriptive Statistics,” there was a substantially larger percentage (30.3%,  $N=10$ ) of students within the control group who attained “pass-plus” status on the ISTEP than those who were in the treatment group (4.3%,  $N=2$ ). This increase in “pass-plus” status probably increased the correlation between the variable “ISTEP” (acting as part of the independent variable “previous science knowledge”) to “posttest” (acting as the dependent variable, “science achievement”).

The treatment group also had a larger percentage of students (27.7%,  $N=13$  students) who did not take the ISTEP than the control group (12.1%,  $N=4$ ). ISTEP scores for these “not taken” students were predicted using the pretest score. This discrepancy might have played a larger role than appears on the surface: The ISTEP scores were analyzed on a dummy scale (“Pass,” “Did Not Pass,” etc.), while the pretest was scaled for percentage gain on the posttest.

The connection I found between “previous science knowledge” and “posttest scores” also indicates that students have had some level of exposure to the concepts prior to the unit. This was noted as a possibility in “Assumptions, Guiding Beliefs, and Premises.” Cell theory, genetics, and evolution are not introduced to SBCSC students

until they reach middle school, though it appears students have learned at least part of these concepts before my study took place.

### Socioeconomic Status

The variable measuring socioeconomic status is shown to be significantly correlated to science achievement. The direct correlation of socioeconomic status to the posttest is  $-.24$  ( $r\text{-squared} = .057$ , 5.7%).

As previously noted, children from homes with incomes under the poverty level (those receiving free or reduced lunch) encompass over 40% of the student body at Clay IC. The data indicating socioeconomic status are predictive of academic achievement within this study and are consistent with the previous studies by Coleman (1966), Chall (1996), Biddle (1997), the U.S. Department of Education (2001), and Tuttle (2004). Each of these found socioeconomic status (specifically poverty status) to be a factor in negative academic performance.

### Instruction

The value correlating “instruction” to “posttest” is  $.75$  ( $r\text{-squared} = .562$ , 56.2%) and is, by far, the most significant correlation within the analysis. This indicates that the treatment was effective; essentially, that the units taught helped increase the posttest scores of the students within the treatment group.

The data strongly indicate that the treatment itself was effective. Teaching a unit that emphasized Guided Inquiry and established theories resulted in significantly higher scores. This is consistent with the previous studies’ findings of Harkreader and Weathersby (1998), Darling-Hammond (1999), and Stremmel (1993), among many

others. It is also consistent with the recommendations by the NRC and the AAAS (Olson, 2000).

### Gender, Race/Ethnicity, and Cosmological Beliefs of Origins

Significant correlation of gender, race/ethnicity, and cosmological beliefs to posttest scores (achievement) was not found. It is evident that race/ethnicity, gender and cosmological beliefs of origins are not predictive of science achievement within this study. This is consistent with the mixed findings of the literature.

### Summary

This chapter presented results of the data analyses of the quantitative portion of the study and addressed the study's hypothesis. This chapter reviewed descriptive statistics of the sample and descriptive statistics of the variables. It also reviewed inferential statistics and presented these in a hypothetical SEM (with all hypothetical correlations) and a respecified SEM (limited to significant correlations) after "Goodness of Fit" measures were applied. The chapter included a discussion of the results, which revealed strong correlation of socioeconomic status, previous science knowledge, and instruction to achievement, and no significant correlation of achievement to the other independent variables.

## CHAPTER V

### FINDINGS: QUALITATIVE AND INTERPRETIVE

#### **Introduction**

This chapter presents results from the qualitative data collected from this study. The chapter includes my observations taken throughout this study, with special focus on the intervention.

The goal of my study was to understand the links, if any, between student cosmological views of origins and science achievement. To partially meet this goal, I kept anecdotal records and notes throughout the research process. This was done from the early planning stages with Andrews University faculty to final presentation of this report to faculty and colleagues.

#### **Observations During Interventions**

Early on in the process, it became evident that the topic of cosmological views and science remained a personal and controversial issue for participants. Many people responded passionately when introduced to my dissertation topic, including my dissertation committee, school administrators, students, and parents. This was surprising to me, as I had assumed acceptance of evolution had become moot among educated people. As I soon discovered, I was wrong in this assumption.



All three members of my dissertation committee were (and remain) Creationists. They felt strongly that one could believe in special divine creation (and deny evolution), while remaining competent in science. Two of the members had graduated from public high schools with high honors in science (one in physics and another in biological sciences). One member even held credentials to be a public school science teacher. (My relationship to my committee Chair is detailed later in chapter 6).

When I started to talk to administrators about conducting my study on students' views of evolution, I received comments like "Why not pick something less controversial?" One administrator flatly told me, "No, we can't approve a study like that during the school day." Another suggested I study how a student's home environment relates to achievement instead of something relating to religion. These overwhelming "turn-downs" from administrators were unexpected.

One district, the South Bend Community School Corporation, eventually approved my study. John Ritzler, SBCSC's director of research and evaluation, told me I needed to acquire internal review board approval from Andrews University and my principal's written permission. Mr. Ritzler confirmed that approval was part of SBCSC's administrative policy of allowing principals to decide if studies were appropriate for individual schools. The study was finally approved for Clay Intermediate Center by James Knight, my principal, to whom I remain grateful. I believe if I had not established a decade-long professional relationship with Mr. Knight, my study would not have been accepted.

When I sent the form out requesting participation from parents I received several email and phone calls indicating my study would provoke controversy. The following portion of an email is indicative of the responses (Appendix K):

*“Lastly, if we do not agree completely with any of the four Cosmological Questions as phrased, but we do find agreement with portions of more than one of these statements, (Or to phrase it another way we find disagreement with all or portions of each) can you provide insight as to how we may provide a valid response?”*

A total of 17 students returned their packets with their parents indicating that they did *not* consent to have their middle-school-aged child in the study, in neither the control nor the treatment group. This is significant as *just not returning the packet in the first place* would have achieved the same outcome. The parents wanted to let me know they disapproved of my study’s topic. The number of “returned but declined” envelopes (17) is comparatively high. Had this study measured acceptance of another widely accepted scientific theory (atomic or heliocentric theory, for example), I believe there would have been fewer “returned but declined” envelopes.

### **Student Debriefing**

There were two debriefing sessions as part of the treatment. The first was held on Friday, May 7, 2010. The second was held 10 days later, Monday, May 17, 2010. The notes from these debriefings are located in Appendix J.

At the first debriefing, 28 students were in attendance, far fewer than had been in attendance for the previous days. The reasons for this were twofold: (a) The initial debriefing took place on a Friday and (b) a severe thunderstorm took place in South Bend, Indiana. An amendment for the second debriefing was approved by the Andrews

University Internal Review Board. These logs were transcribed and are located in Appendix J.

At the initial debriefing, I placed a copy of the four surveyed cosmological beliefs on an overhead projector and asked the students to raise their hands if they agreed their belief statement affected achievement in science class. A group of 24 students raised their hands, agreeing that cosmological beliefs *do* affect achievement in science class, while only 4 students raised their hands in agreement that beliefs *do not* affect science achievement.

One student noted that students were tested only over theories and evidence, while another flatly claimed, “In science class you shouldn’t be allowed to learn about religious beliefs.” This led to a short discussion among four students about whether religion and/or beliefs should be taught in science class.

The students were clearly interested in the topic, and it was obvious that they held opinions on this issue. One student provided an insightful comment in support of her belief that cosmological beliefs *do* affect performance: “If you believe a teacher influences your grade then if we put something down we believe but [the teacher doesn’t] believe it, it [your answers] will be graded wrong.”

This student was one of the four students recruited to participate in a second debriefing (addressed below). For the second time, she voted in favor of cosmology affecting achievement.

Taking her statements at face value, she believed there was a connection between cosmological beliefs and achievement. Despite this, the way she explained herself leaves at least two ways to interpret her responses on *how* the connection occurs.

One interpretation is *ideological* differences between the teacher and student may lead the teacher to grade a response as incorrect. The student might intentionally answer a question differently than what they know the teacher would grade as “correct” to assert their ideological differences.

Another possible interpretation would be more based on content. In this view, the student was using the (somewhat incoherent) example of turning in an answer that she doesn’t believe in. This then places the onus upon the teacher to determine right or wrong answers. If the teacher believes something that the student doesn’t, the answer from the student might be graded “wrong.”

Many other students seemed to agree with this student. One of the students claimed that “doing your homework” is much more important. It is worth noting that completion of homework/assignments was found to be the most significant factor in science achievement in the Burton et al. study (2005).

The second debriefing occurred 10 days later. A group of 19 attended, 4 of whom were at the first session. As in the first debriefing, I placed a copy of the four cosmological beliefs on the overhead projector. I told this second group of students that I would not be asking them to reveal what their beliefs were, and I reassured them they could believe anything they wanted to believe. I also reminded the students that about one-third of the after-school sessions that were taught conflicted with the belief statements.

I again asked for a quick vote as to the following question: “*Do you think your answer to the questions given to you about evolution and creation has any effect on how well you did during this course?*” This time the vote was 12-7, again in favor of the “does

affect” group. On the overhead, I transcribed statements made by the students. The notes from this second debriefing are also located in Appendix J.

One student claimed that doing the assignments (homework) is all it takes to get a good grade. This student’s claim joins another in agreeing with the Burton et al. (2005) study: Completion of assignments is a much greater indicator of school success than whether one agrees with the curriculum or likes the subject matter.

The students’ interest in whether “religion” should be taught in the science classroom reflects the current national debate among creationists and the scientific community concerning curriculum. While this study explores science achievement by creationists, the word “creation” remained unspoken in both of the student discussions. In lieu of the word “creation,” the students used the term “religion” or “religious.” This is prescient, as 1987’s *Edwards v. Aguillard* Supreme Court decision ruled specifically that *religion* could not be taught in public school science classes. It is reasonable to assume that “intelligent designers” (Behe, Dembski, etc.) would object to the students’ use of the term “religion.”

The students substituted the word “grade” for “achievement.” They did not speak of the ISTEP, but rather their letter grades in science classes. The students’ ISTEP scores are held to much higher standards than their letter grades in science class (with higher stakes for the school as well).

One student mentioned that his beliefs did not change at all. This study did not measure whether beliefs change or not, but rather whether these beliefs affect achievement using a syllabus which directly challenges these beliefs. Whether beliefs change or not was addressed in some of the studies within the literature review.

## **Intervention Explanation and Participant Observation Data**

There were several things I learned from observations during the intervention.

These include:

1. Cosmological beliefs neither inhibited nor increased academic performance in my study. Despite this, a majority of students believe differently.

2. “Evolution vs. creation” remains a contentious and controversial issue at Clay IC (and not just for those families who had declined to allow their children to participate).

3. Students from lower socioeconomic incomes are more likely to participate in greater numbers than students of affluence.

4. The treatment (although short-lived) was effective.

I learned that cosmological beliefs that contradict with curriculum neither inhibit nor assist a student’s academic performance, and this was the focus of my study. While the majority of the students within the debriefing session felt differently, the statistics are clear: Cosmological beliefs regarding origins were not predictive of achievement within the course.

The second thing I learned was that those who participated in the treatment were better versed in (and more passionate about) the “evolution vs. creation” debate than expected. The student responses, the reactions from administrators when I sought approval, and the 17 “returned but declined” envelopes from parents all indicate that the “Great Debate” has not ended in South Bend, Indiana. As noted in the “Assumptions, Guiding Beliefs, and Premises” section in chapter 1, this issue is highly controversial in American schools, and some exposure to the issue was expected. The extent to which the

students, parents, and administrators adhered to their attitudes regarding natural selection and religion was, however, alarming.

As detailed in chapter 5, the students immediately began debating whether creationism should be taught alongside evolution as soon as I introduced the topic. I was used to this, as every year that I had introduced natural selection, at least one student would object. The debate among these students was unprompted. I had to ask them to table their discussion until the following session, when debriefing would take place. This almost assuredly would not have been the case were I to teach biological science in another industrialized country, as American students are unique in their disbelief in evolution.

As has been examined, Darwin's theory of evolution through natural selection is one of the most important scientific theories ever put forth in the history of Western civilization, and is considered the most important theory in all biological sciences (Shermer, 2006). Despite this emphasis by the scientific community, it is clear this issue remains contentious.

I also learned that students from homes of lower socioeconomic incomes are more likely to take advantage of free after-school activities. From the start, it was evident that the majority of the students involved in the treatment group came from homes earning less than \$24,999 annually. As noted previously, Clay IC has a student body with more than 40% of the students coming from homes at or below the poverty level. The percentage of students within the treatment group (51%) exceeded a Title I designation by 11%. The probable reason(s) for this include: the treatment was free, the treatment

occurred in a safe and stable environment, and the treatment offered incentives for participation.

Finally, it was evident the treatment was successful, and this affirmed my life-long goal to be an effective educator. On the final day of the treatment, I played a review game with the students, in which nearly every rewritten test question was answered correctly within the groups. Effective teaching was also confirmed by the posttest results, in which nearly every student in the treatment group made a substantial gain. The strongest correlation between any of the variables was clearly that of “instruction” to “posttest” ( $.75$ ,  $r\text{-squared} = .562$ ,  $56.2\%$ ). All the findings in this study plainly indicate that good teaching counts and reminded me that all children can learn regardless of the variables they represent.

### **Summary**

This chapter presented the results of the data analyses of the two debriefing sessions used in this study. This chapter also included my personal observations of these interventions. It included an explanation of the intervention and a summary of what I’ve learned from the study.



## CHAPTER VI

### CONCLUSION/RECOMMENDATIONS

#### **Introduction**

This chapter presents the conclusion of this study. It also contains a discussion of the study and recommendations for further professional research by teachers, administrators, and policy makers. The chapter ends with a description of the dialogue between myself, a committed Natural Empiricist in the classroom, and my committee chair, a NE Creationist.

#### **Discussion**

This study originally asked the following research question: To what extent, if any, are self-reported cosmological beliefs regarding origins, socioeconomic status, ethnicity, and gender predictive of science achievement among junior high-school students who participate in an after-school science program in South Bend, Indiana?

To address this, the following hypothesis was constructed:

Hypothesis: Self-reported cosmological beliefs regarding origins, ethnicity, socioeconomic status, and gender are significant predictors of science achievement in junior-high students.

Null hypothesis: Self-reported cosmological beliefs regarding origins, ethnicity, socioeconomic status, and gender are not significant predictors of science achievement in junior-high students.

Upon analysis, however, it was evident that two variables had been overlooked. Significant correlation was found between students' pretest scores and students' posttest scores, as well as ISTEP scores and posttest scores. Therefore, the research question and hypothesis were modified to include the variables "Previous Science Knowledge" and "Instruction."

The modified research question now reads:

To what extent, if any, are self-reported cosmological beliefs regarding origins, socioeconomic status, ethnicity, gender, previous science knowledge, and instruction predictive of science achievement among junior high-school students who participate in an after-school science program in South Bend, Indiana?

The modified hypothesis now read:

Research Hypothesis: Self-reported cosmological beliefs regarding origins, ethnicity, socioeconomic status, gender, previous science knowledge, and instruction are significant predictors of science achievement among junior-high students.

Null hypothesis: Self-reported cosmological beliefs regarding origins, ethnicity, socioeconomic status, gender, previous science knowledge, and instruction are not significant predictors of science achievement among junior-high students.

The quantitative findings for this study indicated that cosmological beliefs regarding origins do not, in fact, act as a predictor of science achievement within a Guided Inquiry/Established Theories after-school unit. Significant correlation was not

present in posttest scores for students of varying cosmological beliefs of human origins. The data indicate that students who held creationist belief systems achieved no more than those who fully accepted natural evolution.

These findings contrast, however, student attitudes about whether connections exist between cosmological beliefs and achievement. In both debriefing sessions, the majority of the students plainly felt that what they believed would result in achievement differences.

As examined in detail earlier, however, significant correlation *was* found within some of the variables. Socioeconomic status, previous science knowledge, and placement within the treatment group were clearly more predictive of achievement than cosmological beliefs or the other independent variables.

There were four major complications within this study. These complications should be addressed before anyone attempts a similar study involving children's beliefs relating to human origins and achievement. The difficulties included (a) the relatively small sample size, (b) the original exclusion of the variables "previous science knowledge" and "instruction," (c) the failure to include poverty status as a specific variable, and (d) the narrow intervention.

1. The size of both the treatment group (47) and the control group (33) was smaller than desired. The sample was not as small as the McKeachie et al. (2002; 28 students) study, but not as large as Findley et al. (2001; 155 students). The reasons these limited numbers were available include:

- a. I had access to only seventh- and eighth-graders within Clay Intermediate Center.

b. As previously explored, the “creation/evolution” topic is highly controversial and a large number of parents (17) did not consent to have their child participate.

c. Many students were involved in after-school extracurricular activities. Students in after-school activities expressed an interest in the participation, but were placed in the control group because they would have been forced to abandon cheerleading/softball/track, etc., by doing so.

d. The study took place near the end of the school year, when students were more focused on summer vacation than on biology class.

e. The treatment group was comprised of as many students (47) as Clay IC’s media center could hold and that I could instruct at one time. An initial treatment group of 50 students was chosen to participate in the treatment, but 3 failed to attend at least two of the sessions.

2. The variables “previous science knowledge” and “instruction” should have been considered prior to analysis. As examined, significant correlation was found between ISTEP scores (.28) and pretest scores (.22) to the posttest score. These were easily observed variables and should have been included in the original hypothesis.

3. “Poverty status” should have been included as a separate variable from “socioeconomic status.” As examined, “socioeconomic status” was significantly correlated to science achievement. However, the descriptive statistics within chapter 4 (Table 7) show that poverty status should have been addressed separately. There were far more students within the treatment group ( $N=12$ , 25.53%) than the control group ( $N=2$ , 6.06% of the total) from homes reporting less than \$14,999 per year.

4. The intervention was not long enough. Concepts like cell theory, heredity, and evolution are complex and require more in-depth inquiry. Measuring achievement after only nine classes was not sufficient, and the students' final posttest scores (though gains were made) confirm this.

### **Recommendations**

There are recommendations to be made for further professional research. Researchers, science teachers, administrators, and policy makers may wish to consider these recommendations when the topics of cosmology and science achievement are explored. In addressing the four major complications detailed above:

1. The sample size for further study should be increased. Ways to accomplish this might include conducting the study in the middle of the school year, when students do not have as many after-school options. Researchers might also be able to increase the sample size if the course were co-taught within two classrooms.

2. Researchers should consider the amount of previous science knowledge and exposure to the material students have had before any intervention takes place. This can easily be accomplished by including pre-assessment measures prior to analysis.

3. Students from homes of poverty or near-poverty should be addressed as a separate variable when conducting research with those who receive publicly funded education. At this writing, the percentage of Americans in poverty has risen to 15%, an alarming figure that will almost certainly reveal significance upon analysis in future studies (Yen & Sidoti, 2010).

4. A longer and more detailed intervention is needed if this study is repeated. The curriculum was simply too wide in scope to address in nine classes. The study could be

improved if it were to take place over an entire semester. Students within some of the other studies examined in the literature review were involved in semester-long biology courses, ideal for this topic.

There are other recommendations to consider. Researchers who wish to conduct research in this area should consider doing so with students at the high-school level. There is much research regarding cosmology and science achievement at the collegiate level, but very little for students in high school. Natural selection is typically introduced prior to college-level courses, and further research about the level of acceptance of this theory may benefit science education research. Researchers should especially consider exploring cosmological beliefs and achievement in *American* high-school students, as the majority of evolution-disbelievers are from the United States.

Researchers may also consider measuring the *amount* of exposure students have had in the “creation/evolution within the classroom” debate. As discussed, it was evident that the students (and their families) held strong opinions on the subject. It would be interesting to measure how much students knew about this controversy before any treatment took place.

Examining religious beliefs and their relationship to content knowledge in science raises the issue that this study might also be extended to other academic disciplines. Creationist belief systems predicted neither failure nor success within my course, but they could be shown to be predictive within other disciplines. Another research topic might include examining what mechanisms creationist students use to find academic success in other subjects they find disagreeable. I have had many creationist students over the years, and it might be interesting to see how these students process other material.

For example, could there be a disconnect between creationist views and written history? Hypothetically, a NE Creationist might have difficulty achieving academic success in an ancient civilizations course that presented ideas that differed from their chronological view of human history. This may be evident in the historical studies on Sumerians (a polytheistic pre-Abrahamic civilization) which predates NE Creationists' belief systems regarding recent origin of humans (Sadler, 2010).

The literature review within this study might also benefit curriculum writers in addressing the roles that science and religion have played in public education. The trials of *The State of Tennessee v. Scopes* (Scopes v. State, 1925), *Edwards v. Aguillard* (1987), and *Kitzmiller v. Dover Area School District* (2005) garnered national headlines and may be influential in forming educational policy.

There are specific recommendations for the South Bend Community School Corporation. Administrators at SBCSC should consider extending this study to other middle schools. As previously explored, research on this topic is almost nonexistent at this level. This is significant because the concept of natural selection is first introduced in the seventh grade for students in the South Bend Community School Corporation, and then expanded upon throughout life-science classes in high school.

It would also serve SBCSC to recognize the validity of after-school programs. The number of children who participated indicates that providing structured learning environments after the school day ends is beneficial. At this writing, SBCSC offers programs throughout the Corporation, including those that offer math tutoring and art-based education (South Bend Community School Corporation, 2009). Extending these programs should be strongly considered.

SBCSC should strongly consider the recommendations of the National Research Council when adopting new science curriculum. For the past three years, science teachers within SBCSC have been trained through the Northern Indiana Science, Mathematics, and Engineering Collaborative (NISMEC) at the University of Notre Dame. The training sessions have been devoted to developing lesson plans for Guided Inquiry. It would serve SBCSC well to recognize the validity of these recommendations and adopt units that emphasize guided inquiry based in empirical evidence, as opposed to a new unit of textbooks.

SBCSC should also consider these findings when addressing standards with their science educators. Indiana's academic standards very clearly support teaching the concept that things evolve, but the curriculum does not reflect this emphasis. The current *Prentice Hall* textbooks used by SBCSC dedicate less than one-third of one chapter to natural selection, and one sidebar article to Eldredge and Gould's Theory of "Punctuated Equilibrium" (1972). The text used was published in 1999, and thus does not include Margulis and Sagan's theory of "Acquiring Genomes (through symbiotic relationships)" (2002). Policy makers for SBCSC should consider including the major theories of how things evolve (phyletic gradualism, punctuated equilibrium, acquiring genomes, etc.) upon their next adoption.

Further recommendations for research may include measuring other variables that this study did not include such as teacher effectiveness within the classroom, IQ, teacher licensure, or the student's home environment.



## Dialogue With Dr. Covrig

This study did not take place under conventional circumstances. Andrews University is a Seventh-day Adventist institution grounded in biblical fundamentalism, a tenet of which includes New Earth Creation.

From the start, I made it very clear that I am not a creationist. I believed (and continue to believe) that natural science gained from empirical evidence and inquiry should be the only science taught to students. My belief-system proved to be a challenge, however, as the chair of my committee, Dr. Duane Covrig, adhered (and continues to adhere) to a 6-day literal creation as described in the book of Genesis. This includes, as he describes, “a seventh day of rest that was to allow God and humans to enjoy uninterrupted dialogue and enjoyment of nature.”

Dr. Covrig and I have many things in common: We are passionate educators, fathers, husbands, musicians, runners. We both have experience teaching middle-school-level science. We are both interested in ethics in education, history, and cosmology. We each express a belief and wonderment in the Abrahamic God of Judeo-Christianity.

For many hours, Dr. Covrig and I have debated the nature of science, beliefs and inquiry, echoing the arguments made by creationists and empiricists. Among the interesting points of these discussions: I have told Dr. Covrig that he could falsify Darwin’s theory simply by finding any evidence that disproves it, and he has asked me to supply the gaps within the fossil record. In response, I have explained that filling one gap simply makes two more gaps, etc. I have challenged Dr. Covrig to explain why people see light made millions of years ago, and he has responded that he believes only earthly *life* began about 6,000 years ago. Dr. Covrig has questioned me as to why his tax dollars

should go toward curriculum that he doesn't believe in, and I have responded that science isn't democratic.

During the course of our debate, neither Dr. Covrig nor I have relinquished our belief systems. Dr. Covrig affirmed that he has expanded on his knowledge base of origins, science, and religion. I, in turn, have learned more about the different world views held within the SDA Community. Above all, though, I have been challenged.

Throughout all this, we have forged a solid professional friendship, and for this I am thankful. It is hoped that our 3 years' of "agreeing to disagree" can serve as an example to others engaged in this "Great Debate" about science and religion.

### **Summary**

This chapter presented a conclusion of this study. It reviewed the original and modified research question and hypothesis. The chapter included a discussion of the study and recommendations for further professional research by teachers, policy makers, and administrators at SBCSC. It also included a reflection of my interaction with Dr. Duane Covrig, a committed NE Creationist and the Chair of my committee.

## APPENDIX A

### VARIABLES CHART TABLE

Table 8

*Variables Chart Table*

Variable	Conceptual	Instrumental	Operational
Cosmological beliefs regarding origins.	Student-reported response	<p>The students were given the following four statements, in which they were asked to select the statement of which they would “most agree.” The four statements were:</p> <p>1. The earth and all of the earth’s inhabitants were made in a relatively short period of time, thousands of years ago, by a Supreme Being (e.g. God). Human beings were created by God as whole persons and did not evolve from earlier forms of life. <i>This statement is consistent with New Earth Creationism.</i></p> <p>2. Each “day” listed in Genesis assumes extremely large amounts of time (millions of years). Scientific evidence is strong that the earth is 4.5 billion years old. The fossil record indicates different “kinds” of animals that are described in the book of Genesis. Evolution has not and does not occur. <i>This statement is consistent with Old Earth Creationism.</i></p> <p>3. Over billions of years all plants and animals on earth (including humans) evolved from a single-celled ancestor, but a Supreme being (e.g. God) observed and guided the process. <i>This statement is consistent with Theistic Evolution /Evolutionary Creationism.</i></p> <p>4. Over billions of years all plants and animals on earth (including humans) evolved from a single-celled ancestor. <i>This statement is consistent with Naturalistic Evolution.</i></p>	<p>Nominal scale, assigning a number code (but not rank) to each statement:</p> <p>NE Creationism: 1  OE Creationism: 2  Theistic Evolution: 3  Naturalistic Evolution: 4</p>
Science Achievement	Post-test instrument	Students took a post-test within the teaching materials provided by Prentice Hall’s <i>Cells and Biology</i> unit.	Student scores from the pretest and post-test were determined. Student percentage gains from both the control and treatment groups are used.
Previous Science Knowledge	ISTEP (Indiana Statewide Testing for Educational Progress)	Students’ science scores from the fall of 2009.	Nominal scale, assigning a number code : Pass: 1 Did not Pass: 0 Not taken: 3
Previous Science Knowledge	Pretest Instrument	Students took a pretest within the teaching materials provided by Prentice Hall’s <i>Cells and Biology</i> unit.	Student scores from the pretest and post-test are determined. Student percentage gains from both the control and treatment groups are used.

Table 8—*continued.*

Ethnicity	Parent-reported response	Parents were given a question (#6) from the long form of the United States Census Bureau: “What is this [your middle school student’s] race? Mark one or more races to indicate [your middle school student] considers himself/ herself to be. Hispanic/Latino: ____ White /Caucasian: ____ Black, African American: ____ Asian Indian: ____	Nominal scale, assigning a number code (but not rank) to each ethnicity:  Hispanic/Latino: 1 White /Caucasian: 2 Black, African American: 3 Biracial: 4 Asian Indian: 5
Gender	Parent-reported response	Parents were asked to indicate the gender of their middle-school aged child.  “Please indicate the gender of your middle-school aged child with a mark:  ____ Male ____ Female	Dummy variable  0=Male 1=Female
Socioeconomic Status	Parent-reported response	Parents were given a question #(31) from the US Census Bureau:  What was [your family’s] total income in 2008? None OR \$ _____.00 The amount indicated will be measured on the scale provided by the Census: Less than \$10,000 \$10,000 to \$14,000 \$15,000 to \$19,999 \$20,000 to \$24,999 \$25,000 to \$29,999 \$30,000 to \$34,999 \$35,000 to \$39,999 \$40,000 to \$44,999 \$45,000 to \$49,999 \$50,000 to \$59,999 \$60,000 to \$74,999 \$75,000 to \$99,999 \$100,000 to \$124,999 \$125,000 to \$149,999 \$150,000 to \$199,999 \$200,000 or more	Ordinal scale, ranking each level of income: NONE = 1 Less than \$10,000 = 2 \$10,000 to \$14,000 = 3 \$15,000 to \$19,999 = 4 \$20,000 to \$24,999 = 5 \$25,000 to \$29,999 = 6 \$30,000 to \$34,999 = 7 \$35,000 to \$39,999 = 8 \$40,000 to \$44,999 = 9 \$45,000 to \$49,999 = 10 \$50,000 to \$59,999 = 11 \$60,000 to \$74,999 = 12 \$75,000 to \$99,999 = 13 \$100,000 to \$124,999 = 14 \$125,000 to \$149,999 = 15 \$150,000 to \$199,999 = 16 \$200,000 or more = 17
Qualitative questions	Student Responses	Students placed in a focus group were asked the following question: Do you think your answer to the questions given to you about evolution and creation has any effect on how well you did during this course?	Student responses were summarized on an overhead transparency. They were asked the students if what their responses were summarized correctly on the overhead. The responses were color coded for themes found within the responses.
Instruction	Intervention	Students participated in nine classes, studying three sections on the Unit Cells and Heredity.	Daily notes were taken.

APPENDIX B

PARENT SURVEY INSTRUMENT

Parent Name(s) \_\_\_\_\_

Middle School Child's Name(s) \_\_\_\_\_

Question 1) What was [your family's] total income in 2008? Please mark only ONE of the following items:

- Less than \$10,000 \_\_\_\_\_
- \$10,000 to \$14,000 \_\_\_\_\_
- \$15,000 to \$19,999 \_\_\_\_\_
- \$20,000 to \$24,999 \_\_\_\_\_
- \$25,000 to \$29,999 \_\_\_\_\_
- \$30,000 to \$34,999 \_\_\_\_\_
- \$35,000 to \$39,999 \_\_\_\_\_
- \$40,000 to \$44,999 \_\_\_\_\_
- \$45,000 to \$49,999 \_\_\_\_\_
- \$50,000 to \$59,999 \_\_\_\_\_
- \$60,000 to \$74,999 \_\_\_\_\_
- \$75,000 to \$99,999 \_\_\_\_\_
- \$100,000 to \$124,999 \_\_\_\_\_
- \$125,000 to \$149,999 \_\_\_\_\_
- \$150,000 to \$199,999 \_\_\_\_\_
- \$200,000 or more \_\_\_\_\_

Question 2) Please indicate the gender of your middle-school aged child with a mark:

Male \_\_\_\_\_

Female \_\_\_\_\_

Question 3) "What is this [your middle school student's] race? Mark one or more races to indicate [your middle school student] considers himself/ herself to be.

- Hispanic/Latino: \_\_\_\_\_
- White /Caucasian: \_\_\_\_\_
- Black, African American: \_\_\_\_\_
- American Indian or Alaska Native: \_\_\_\_\_
- Native Hawaiian: \_\_\_\_\_
- Guamanian or Chamorro: \_\_\_\_\_
- Samoan: \_\_\_\_\_
- Other Pacific Islander: \_\_\_\_\_
- Asian Indian: \_\_\_\_\_
- Other Asian : \_\_\_\_\_

APPENDIX C

STUDENT SURVEY



Name \_\_\_\_\_  
Grade \_\_\_\_\_

Please indicate which statement you would most agree with:

A) “The earth and all of the earth’s inhabitants were made in a relatively short period of time, thousands of years ago by a supreme being (e.g. God). Evolution has not and does not occur.” \_\_\_\_\_

B) “Each ‘day’ listed in Genesis assumes extremely large amounts of time. Scientific evidence is strong that the earth is 4.5 billion years old. The fossil record indicates different ‘kinds’ of animals that are described in the book of Genesis. Evolution has not and does not occur.” \_\_\_\_\_

C) “All the plants and animals on the earth evolved from a common single-celled ancestor, but a supreme being (e.g. God) began, observed and guided the process.” \_\_\_\_\_

D) “Over billions of years all plants and animals on earth (including humans) evolved from a common single-celled ancestor.” \_\_\_\_\_



Table 9

*Textbook Unit Evaluation*

Unit name	<i>Inside the Earth</i>	<i>Cells and Heredity</i>	<i>Biology</i>	<i>Investigating Environmental Science</i>
Publisher	Prentice Hall	Prentice Hall	Vernier	Vernier
Grade Appropriate	Yes (7 <sup>th</sup> grade)	Yes (8 <sup>th</sup> grade)	No (9+)	No (AP High school)
Cosmological Link	Some. Includes the fossil record.	Yes. Chapter 5 “Changes over Time” covers natural selection/ adaptation/ the fossil record, etc. There is even a section addressing punctuated equilibrium vs. phyletic gradualism.	Some. Includes human physiology.	No.
Pre- assessment	Yes.	Yes.	No.	No.
Posttest	Yes.	Yes.	Yes.	Yes.
Manageable within 2-3 weeks	Yes.	Yes.	Yes.	Yes.
Access Multidimensional	Yes. (There is a CD ROM with manipulatives included in the unit.) Contains lesson plans, experiments, overheads, etc.	Yes. (There is a CD ROM with manipulatives included in the unit.) Contains lesson plans, overheads, experiments, etc.	Yes. Notre Dame purchased the Vernier probes for Clay IC. All equipment is accessible.	Yes. Notre purchased the Vernier probes for Clay IC. All equipment is accessible.
Connection to Indiana standards	Provided in the web link.	Provided in the web link.	Provided in the web link.	Provided in the web link.
Possible difficulties	Most students take this unit in 7 <sup>th</sup> grade, so it would be redundant.	The 8 <sup>th</sup> grade teacher (Tom Mailloux) does not teach this unit during the school year. He recommended <i>Cells and Heredity</i> when I described the study to him.	It’s not as applicable as Cells and Heredity. It’s also designed for grades the students haven’t achieved yet.	Not grade appropriate.
Cost	None.	None.	None.	None.
Accessibility	Clay IC has access to this unit.	Clay IC has access to this unit.	This unit would need to be ordered and purchased, though the probes are already in purchased.	This unit would need to be ordered and purchased, though the probes are already purchased.
Web link	<a href="http://openlibrary.org/b/OL7332434M/Inside_Earth_(Prentice_Hall_Science_Explorer)">http://openlibrary.org/b/OL7332434M/Inside_Earth_(Prentice_Hall_Science_Explorer)</a>	<a href="http://openlibrary.org/b/OL10084363M/Prentice_Hall_Science_Explorer-Cells_and_Heredity-Teacher's_Edition">http://openlibrary.org/b/OL10084363M/Prentice_Hall_Science_Explorer-Cells_and_Heredity-Teacher's_Edition</a>	<a href="http://www.vernier.com/cmat/bwv.html">http://www.vernier.com/cmat/bwv.html</a>	<a href="http://www.vernier.com/cmat/esi.html">http://www.vernier.com/cmat/esi.html</a>

APPENDIX D

TEXTBOOK UNIT EVALUATION TABLE

## APPENDIX E

### PRETEST

Name \_\_\_\_\_

PART 1 THE CELL

1. Which of the following is NOT made of cells?
  - a. Mushroom
  - b. Sand
  - c. Dog
  - d. Leaf
  
2. A structure that is found in plant cells but not animal cells is:
  - a. Cell wall
  - b. Nucleus
  - c. Cell membrane
  - d. Nuclear membrane
  
3. Which organelles are more numerous in active cells than in less active cells?
  - a. Ribosomes
  - b. Mitochondria
  - c. Vacuoles
  - d. Golgi bodies
  
4. The movement of molecules from an area of greater concentration to an area of lesser concentration is called:
  - a. Forced transport
  - b. Diffusion
  - c. Engulfing
  - d. Active transport
  
5. Draw a Venn diagram, interlocking passive transport and active transport

## PART 2 GENETICS

1. An example of a human trait that is controlled by more than one gene is:
  - a. Blood type
  - b. Skin color
  - c. Widow's peak
  - d. Dimples
  
2. A person who has one recessive and one dominant allele is called a:
  - a. Homozygote
  - b. Carrier
  - c. Clone
  - d. hybrid
  
3. The crossing of two individual that have identical or similar sets of alleles is called:
  - a. Selective breeding
  - b. Hybridization
  - c. Inbreeding
  - d. Cloning
  
4. In a pedigree, a square is used to represent a(n)
  - a. Female
  - b. Male
  - c. Carrier
  - d. Clone
  
5. Smile dimples are controlled by a dominant allele on a single gene. Whitney has smile dimples, but her husband Alberto and son Pedro do not. What is the chance that Whitney and Alberto's next child will have smile dimples? Draw a pedigree to show how you arrived at your answer:

### PART 3 BIOLOGICAL CHANGE OVER TIME

1. Which of the following is considered a scientific theory?
  - a. Absolute dating
  - b. Fossil record
  - c. Evolution
  - d. Overproduction
  
2. A fossil made of hardened minerals in the shape of the original organism or one of its parts is called a(n):
  - a. Mold
  - b. Variation
  - c. Amber
  - d. Cast
  
3. Which of the following is used by scientists to determine evolutionary relationships?
  - a. The locations of an island in an ocean.
  - b. The order of amino acids in protein.
  - c. Similarities in fossil formation.
  - d. Decay of potassium-40.
  
4. An adaptation is any trait that helps an organism:
  - a. Survive and reproduce.
  - b. Fight better.
  - c. Overproduce variation.
  - d. Become larger and stronger.
  
5. What do these structures [skeletons of human, bird, and sloth appendages] provide evidence of?  
What can you infer about sloths, birds, and humans from these structures?



APPENDIX F

POSTTEST

Name \_\_\_\_\_

PART 1 THE CELL

1. Which of the following is NOT made of cells?
  - a. Mushroom
  - b. Dog
  - c. Sand
  - d. Leaf
  
2. A structure that is found in plant cells but not animal cells is:
  - a. Nucleus
  - b. Cell wall
  - c. Nuclear membrane
  - d. Cell Membrane
  
3. Which organelles are more numerous in active cells than in less active cells?
  - a. Vacuoles
  - b. Ribosomes
  - c. Golgi bodies
  - d. Mitochondria
  
4. The movement of molecules from an area of greater concentration to an area of lesser concentration is called:
  - a. Active transport
  - b. Forced transport
  - c. Engulfing
  - d. Diffusion
  
5. Draw a Venn diagram, interlocking active transport and passive transport:

## PART 2 GENETICS

6. An example of a human trait that is controlled by more than one gene is:
  - a. Skin color
  - b. Blood type
  - c. Widow's peak
  - d. Dimples
  
7. A person who has one recessive and one dominant allele is called a:
  - a. Clone
  - b. Carrier
  - c. Homozygote
  - d. Hybrid
  
8. The crossing of two individual that have identical or similar sets of alleles is called:
  - a. Selective breeding
  - b. Inbreeding
  - c. Cloning
  - d. Hybridization
  
9. In a pedigree, a square is used to represent a(n)
  - a. Clone
  - b. Female
  - c. Carrier
  - d. Male
  
10. Ears connected at the lobe are controlled by a dominant allele on a single gene. Whitney has ears connected at the lobe, but her husband Alberto and son Pedro do not. What is the chance that Whitney and Alberto's next child will have ears connected at the lobe? Draw a pedigree to show how you arrived at your answer:

### PART 3 BIOLOGICAL CHANGE OVER TIME

11. Which of the following is considered a scientific theory?
- Overproduction
  - Evolution
  - Absolute dating
  - Fossil record
12. A fossil made of hardened minerals in the shape of the original organism or one of its parts is called a(n):
- Amber
  - Variation
  - Mold
  - Cast
13. Which of the following is used by scientists to determine evolutionary relationships?
- Decay of potassium-40.
  - The locations of an island in an ocean.
  - Similarities in fossil formation.
  - The order of amino acids in protein.
14. An adaptation is any trait that helps an organism:
- Overproduce variation.
  - Become larger and stronger.
  - Fight better.
  - Survive and reproduce.
15. What do these structures [skeletons of sloth, bird and human appendages] provide evidence of?  
What can you infer about sloths, birds, and humans from these structures?

## APPENDIX G

### STUDY OUTLINE

## Appendix G. Study Outline

### Session I

The students will take a pretest with items from the test materials bank. (Appendix E).

### Session II **THE CELL**

#### Cell Processes and Energy

The students will read pages 15-21 of *Cells and Biology*. The students will participate in the CD-ROM Study Guide and Exploration activities for the chapter “The Cell Theory.” The students will record the three main ideas of **cell theory**.

LAB: “Eggsperiment with a Cell”

### Session III **THE CELL**

The students will read pages 23-31 of *Cells and Biology*. The students will participate in the CD-ROM Study Guide and Exploration activities for the chapter “Looking Insides Cells.”

The students will draw the organelles of both plant and animal cells, labeling each organelle with its function.

LAB: “Eggsperiment with a Cell” cont.

### Session IV **THE CELL**

The students will read pages 61-68 of *Cells and Biology*. The students will participate in the CD-ROM Study Guide and Exploration activities for the chapter “Cell Division.”

The students will construct posters of The Cell Cycle, as described on page 64-65.

LAB: “Eggsperiment with a Cell” concluded.

### Session V **GENETICS**

The students will read pages 80-85 of *Cells and Biology*.

LAB: “Dominant and Recessive Alleles.”

### Session VI **GENETICS**

The students will read pages 88-93 of *Cells and Biology*. The students will participate in the CD-ROM Study Guide and Exploration activities for the chapter “Probability and Genetics.”

The students will construct Punnett squares. The students will take these squares home and test their siblings and /or family members for specific traits, then determine probability.

LAB: “Dominant and Recessive Alleles” continued.

### Session VII **GENETICS**

The students will read pages 96-106 of *Cells and Biology*. The students will participate in the CD-ROM Study Guide and Exploration activities for the chapter “The Cell and Inheritance.”

The students will construct DNA chains out of paper and string the chain through the hallway.

LAB: “Dominant and Recessive Alleles” concluded.

**Session VIII BIOLOGICAL CHANGE OVER TIME**

The students will read pages 140-150 of *Cells and Biology*. The students will participate in the CD-ROM Study Guide and Exploration activities for the chapter “Darwin’s Voyage.”

LAB: “Nature at Work.”

**Session IX BIOLOGICAL CHANGE OVER TIME**

The students will read pages 151-158 of *Cells and Biology*. The students will participate in the CD-ROM Study Guide and Exploration activities for the chapter “The Fossil Record.”

LAB: “Nature at Work” continued.

**Session X BIOLOGICAL CHANGE OVER TIME**

The students will read pages 159-163 of *Cells and Biology*. The students will participate in the CD-ROM Study Guide and Exploration activities for the chapter “Other Evidence for Evolution.”

LAB: “Nature at Work” concluded.

**Session XI BIOLOGICAL CHANGE OVER TIME**

The students will take a posttest with items from the test materials bank. (Appendix F).

**De-briefing session.**

APPENDIX H

SCREENING TOOL



## SCREENING TOOL

**Codes:**

Cosmological Belief

- NE:** NE Creationism
- OE:** OE Creationism
- TE:** Theistic Evolution
- Nat E:** Natural Evolution

Socioeconomic Status:

- <10:** Less than \$10,000
- 10-14:** \$10,000 to \$14,000
- 15-19:** \$15,000 to \$19,999
- 20-24:** \$20,000 to \$24,999
- 25-29:** \$25,000 to \$29,999
- 30-34:** \$30,000 to \$34,999
- 35-39:** \$35,000 to \$39,999
- 40-44:** \$40,000 to \$44,999
- 45-49:** \$45,000 to \$49,999
- 50-50:** \$50,000 to \$59,999
- 60-74:** \$60,000 to \$74,999
- 75-99:** \$75,000 to \$99,999
- 100-124:** \$100,000 to \$124,999
- 125-149:** \$125,000 to \$149,999
- 150-199:** \$150,000 to \$199,999
- 200>:** \$200,000 or more

Ethnicity:

- H/ L:** Hispanic/Latino
- W/C:** White /Caucasian
- B/A:** Black, African American
- AI:** American Indian or Alaska Native
- NH:** Native Hawaiian
- G/C:** Guamanian or Chamorro
- S:** Samoan
- OPI:** Other Pacific Islander
- Asa I:** Asian Indian
- OA:** Other Asian

Gender:

- M:** Male
- F:** Female

Student ID	Cosmological Belief	Socioeconomic Status	Ethnicity	Gender	Treatment Group	Control Group

APPENDIX I

PARENT LETTERS

Control Group Letter  
April 24, 2010

To Parent or Guardian of \_\_\_\_\_,

Thank you for participating in my study. Your child has been chosen as part of the “control” group. Your student will take the pretest and the posttest from the unit *Cells and Heredity* and their score will be compared and contrasted to the scores of students within the treatment group.

Thank you again for your willingness to participate.

Sincerely,

David Van Dyke

Treatment Group Letter  
April 24, 2010

To Parent or Guardian of \_\_\_\_\_,

Thank you for participating in my study. Your child has been chosen as part of the “treatment” group. Your student will take the pretest from the unit *Cells and Heredity* and their score will be compared and contrasted to the scores of students within the “control” group.

Your student will begin the after-school biology session studying the unit *Cells and Heredity* on Monday, May 3, 2010 in Room 201. Students will remain after school for the next 3 days, ending Thursday, May 6. Class sessions last 44 minutes at Clay IC, meaning that we can easily accommodate three 44-minute sessions per day.

The activity bus will transport your student home each day, unless you indicate to me that you will provide transportation for your student.

You are welcome to attend any session, at any time.

Sincerely,

David Van Dyke  
(574) 220-8263

APPENDIX J

DEBRIEFING NOTES

May 7, 2010

24 students raised their hands, agreeing that cosmological beliefs do affect achievement in science class, while 4 students raised their hands in agreement that beliefs do not affect science achievement.

On the overhead, I transcribed the following statements made by students who believe science achievement is not affected by cosmological beliefs (“NA”):

NA: “You’re only getting tested over theories.”

“You’re only getting tested over evidence.”

“In science class you shouldn’t be allowed to learn about religious beliefs.”

I transcribed the following statements from the “does affect” group (“DA”)

DA: “Some people believe in certain things and they might not retain the information because they don’t want to listen to it.”

“When someone is teaching something that the person doesn’t want to believe, they won’t listen.”

“Why would anything need to evolve into humans?”

The following exchange took place between two students, representing the two groups:

NA: “If students don’t want to believe what’s being taught in public school, they should be in religious school or home school.”

DA: “What if they can’t?”

The notes recorded by Dr. Covrig, May 7, 2010:

You started with a return to the cosmological view of earth and went over those four areas very briefly with a short question about rather they understood this. Then you said you wanted to get more details, of their views of this. Then you pointed out the fact you covered lots of dates, old dates and date claims that dominated this section of biology and disagreed with the New earth views. You said something like, “about a third of what we covered all week doesn’t agree with two or three of these views. And a whole bunch of what we covered doesn’t agree with A [I think that was the new earth one].

Then you asked them about this. That was a wonderful question to ask, but then I was expecting you to wait more to hear them respond. But you didn’t wait long. I think this was because you were tired at the end of a long week, but also I felt you needed to really listen to what they were saying. This is good research and good teaching to allow space, time, quietness for ideas to be expressed.

Then you asked the next best question, does what you believe influence your science knowledge.

You did get responses and the first girl’s response was clear and concise:

Yes, she said, because if what you believe as a teacher influences how you grade then if we put something down we believe but you don’t believe it you will grade it wrong.

I thought that was extremely insightful. She was reversing question. How does belief affect the teachers view of the student not just the students view of the teacher.

Then you formalized this question for the whole group. You created Does Affect and Not Affect categories and 18 said it did and 4 said not affect. Then when a boy up front said You when only 4 voted for Not Affect, you said it wasn’t a vote one can lose. I thought that was insightful of you to say that. It created a more discussion oriented environment

for those who disagree.

Then another Girl (#2)

Science should be about learning religious stuff and beliefs. We shouldn't ask questions about God in science.

Then a girl named Casey (I think she was the first girl to speak) started to speak about living and non-living things, and started to say "If we believe something... (but then she stopped...I am not sure why.) it would have been nice to have helped her keep talking as she seemed to have something crucial to say.

Teacher or someone made a comment on only learning evidence; teacher states we are only tested on

Boy (Avery I think)—If you teach them something else but they don't believe they won't want to listen, or they don't want to learn or pay attention, then they won't know. So that will affect it.

Girl (#3)—what if they don't want to learn what they are teaching and won't listen because they don't want to believe what the teacher says). Then they only write down what they think.

Then you illustrated about Australia. If you said over and over it doesn't exist, that doesn't make it not exist.

Girl #2—if they are that concerned about what is taught, they should go to a religious school.

Girl #3-What if you can't. Then what. Should you have to learn it.

Girl #2—you don't need to be rich to go to a religious schools

Girl #3-what if you can't go, what then.

Girl #2—if they don't like what is taught they should go to religious school

Girl#3- what if there aren't any in their area

[then the disagreement died out]

Then the research-teacher said they were running out of time.

Then a boy (teacher's main assisting student) asked "do you want me to ask the question that will make you look smart" "Why would anything need to evolve into a current state of a human being?"

Teacher-are you asking why anything would need to adapt?

Teacher discusses the idea that some believe evolution is about having a common ancestor and he states about the common ancestor of man and apes and lists those in that common area.

Someone stresses [not sure who] why would we NEED to adapt to this or why did we adapt to that—to being human—and having superiority over all animals.

Teacher notes that having brain helped us adapt, the superiority allowed us to survive better.

Student [unsure if it was girl or boy] How come other animals not as sophisticated as us and why is there not other creatures with similar smartness. Why are they not as evolved?

Then I moved into final test. Noted when your done with the test, you can go.

The first person walked up with less than 2 minutes to turn in the test. The others soon followed and all were done within 5-6 minutes.

Two girls exchanged some clarification about a question [near me the observer] but they didn't seem to cheat as much as clarify the question.

The teacher repeatedly said thank you to the group and through the program promised to

make up for them missing their dodge-ball and was going to take them out of their classes the next week for that.

On May 17, 2010, an amendment was approved for a second debriefing session as described above.

I placed a copy of the four cosmological beliefs on the overhead projector. I told this second group of students that I would not be asking them to reveal what their beliefs regarding human origins were, and I wanted to reassure them they could believe anything they wanted to believe.

I reminded the kids that about 1/3 of the after-school sessions that were taught conflicted with the belief statements. I asked for a quick vote as to the following question: "Do you think what you believe regarding human origins affects how well you do in science class?"

Twelve students raised their hands, agreeing that cosmological beliefs *do* affect achievement in science class, while 7 students raised their hands in agreement that beliefs *do not* affect science achievement.

On the overhead, I transcribed the following statements made by students who believe science achievement is not affected by cosmological beliefs ("NA"):

NA: "I'm good in science, but I learned a little bit more than what I did know in Biology Club. It doesn't change my beliefs at all. I just write down what the teacher says and I get a good grade."

NA: "To get a good grade, you just have to remember what the book says, whether you agree with it or not."

NA: "I think that doing your homework is more important than what you believe."

Then I transcribed statements from the students who voted that cosmological beliefs "do affect" science achievement (DA):

DA: "Yes, because you know more about evolution and how plants and animals on earth evolved and how things survived and reproduced."

DA: "It does affect the way I learn in Science. I believe that when we talk about the way everything started it differs from my beliefs. I believe that God made everything. It does affect my learning. I believe in God, but I don't think teachers in science class should talk about it."

DA: "It think it does because the teacher has a different belief than the students and he puts their belief into the lessons. Also, a student may not agree with the same lessons because of their beliefs, which may cause conflict."



APPENDIX K

EMAIL EXCHANGE

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From: \_\_\_\_\_@aol.com [\_\_\_\_@aol.com]  
Sent: Thursday, April 15, 2010 9:54 AM  
To: David J. VanDyke  
Cc: covrig@andrews.edu  
Subject: Ed.D in Educational Administration Study

Mr. VanDyke, we have a "couple" of questions concerning this study contents and requirements. Please clarify paragraph 5 of the Andrews University Study outline. This paragraph seems to infer both groups will be control groups? Also, paragraph 7 states there are "no" minimal risks to involvement in the study. Are there any risks either minimal or major? We understand there will be 12 after school course sessions. These sessions are to be held over what period of time, i.e. daily, bi-weekly, weekly, etc.? Lastly, if we do not agree completely with any of the four Cosmological Questions as phrased, but we do find agreement with portions of more than one of these statements, (Or to phrase it another way we find disagreement with all or portions of each) can you provide insight as to how we may provide a valid response? Thank you

\_\_\_\_\_ - grandparent, \_\_\_\_\_ - parent, \_\_\_\_\_

RE: Ed.D in Educational Administration Study  
David J. VanDyke

Sent: \_\_\_\_\_ Thursday, April 15, 2010 11:41 AM  
To: \_\_\_\_\_@aol.com  
Cc: covrig@andrews.edu

Attachments:

Hello Mr. \_\_\_\_\_,

Thank you very much for your timely response.

1. Please clarify paragraph 5 of the Andrews University Study outline. This paragraph seems to infer both groups will be control groups? Also, paragraph 7 states there are "no" minimal risks to involvement in the study. Are there any risks either minimal or major?

There are two groups, one treatment (the group participating in the study) and the other control (the group who will take to pretest). There are no more risks in involvement in the study than what K\_\_\_\_\_ experiences at school every regularly scheduled school day.

2. These sessions are to be held over what period of time, i.e. daily, bi-weekly, weekly, etc.?  
The study will begin the week following the week I get enough surveys turned in to establish both groups. I would like to do two sessions a day (a classroom session lasts 40 minutes) with a free-time activity in the middle, Mondays through Thursdays. As the activity bus doesn't leave until 5:30 p.m., this gives us an ample amount of time & the entire treatment session should be completed within two weeks.

3. Lastly, if we do not agree completely with any of the four Cosmological Questions as phrased, but we do find agreement with portions of more than one of these statements, (Or to phrase it another way we find disagreement with all or portions of each) can you provide insight as to how we may provide a valid response?

I would choose the statement you "most agree" with, then feel free to add any comments and /or caveats to your response.

Again,  
Thank you very much,  
David Van Dyke

## APPENDIX L

### HYPOTHESIZED STRUCTURAL EQUATION MODEL DATA

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Postest<--- Instruction	37.880	3.673	10.314	***	
Postest<--- Pretest	.338	.110	3.067	.002	
Postest<--- SES	-14.089	4.346	-3.242	.001	
Postest<--- Cosmobeliefs	1.576	1.672	.942	.346	
Postest<--- Gender	3.929	3.642	1.079	.281	
Postest<--- ISTEPb	.098	.025	3.967	***	
Postest<--- Ethnicity	1.627	2.183	.745	.456	

Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
Postest<--- Instruction	.676
Postest<--- Pretest	.201
Postest<--- SES	-.221
Postest<--- Cosmobeliefs	.062
Postest<--- Gender	.071
Postest<--- ISTEPb	.280
Postest<--- Ethnicity	.050

Means: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
ISTEPb	512.838	8.852	57.937	***	
Gender	.513	.056	9.113	***	
SES	.250	.049	5.132	***	
Cosmobeliefs	2.525	.122	20.710	***	
Pretest	35.900	1.844	19.473	***	
Instruction	.588	.055	10.607	***	
Ethnicity	2.475	.096	25.847	***	

Intercepts: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Postest	-43.049	16.570	-2.598	.009	

Covariances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
SES <--> ISTEPb	-9.134	3.847	-2.374	.018	
ISTEPb <--> Gender	-4.305	4.169	-1.033	.302	
ISTEPb <--> Cosmobeliefs	5.090	8.952	.569	.570	
ISTEPb <--> Ethnicity	-14.793	7.387	-2.003	.045	

Correlations: (Group number 1 - Default model)

	Estimate
SES <--> ISTEPb	-.268
ISTEPb <--> Gender	-.109
ISTEPb <--> Cosmobeliefs	.060
ISTEPb <--> Ethnicity	-.221

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Instruction	.242	.039	6.285	***	
Pretest	268.490	42.720	6.285	***	
SES	.188	.030	6.285	***	
ISTEPb	6189.846	979.515	6.319	***	
Gender	.250	.040	6.285	***	
Cosmobeliefs	1.174	.187	6.285	***	
Ethnicity	.724	.115	6.285	***	
e1	258.234	41.088	6.285	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Postest	.661

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	27	76.532	17	.000	4.502
Saturated model	44	.000	0		
Independence model	16	156.610	28	.000	5.593

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.511	.195	.574	.238	.537
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.607	.310	.326
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	59.532	36.077	90.531
Saturated model	.000	.000	.000
Independence model	128.610	93.017	171.720

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.969	.754	.457	1.146
Saturated model	.000	.000	.000	.000
Independence model	1.982	1.628	1.177	2.174

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.211	.164	.260	.000
Independence model	.241	.205	.279	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	130.532	137.475		
Saturated model	88.000	99.314		
Independence model	188.610	192.725		

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.652	1.355	2.045	1.740
Saturated model	1.114	1.114	1.114	1.257
Independence model	2.387	1.937	2.933	2.440

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	29	35
Independence model	21	25

## APPENDIX M

### RESPECIFIED STRUCTURAL EQUATION MODEL DATA

	Estimate	S.E.	C.R.	P	Label
Postest<--- Instruction	39.060	4.207	9.283	***	
Postest<--- Pretest	.345	.145	2.375	.018	
Postest<--- SES	-14.267	4.607	-3.097	.002	
Postest<--- ISTEPb	.095	.033	2.877	.004	

Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
Postest<--- Instruction	.750
Postest<--- Pretest	.221
Postest<--- SES	-.241
Postest<--- ISTEPb	.282

Means: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
ISTEPb	512.838	8.531	60.112	***	
SES	.250	.049	5.132	***	
Pretest	35.900	1.844	19.473	***	
Instruction	.588	.055	10.607	***	
Gender	.513	.056	9.113	***	
Cosmobeliefs	2.525	.122	20.710	***	
Ethnicity	2.475	.096	25.847	***	

Intercepts: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Postest	-32.450	15.403	-2.107	.035	

Covariances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
SES <--> ISTEPb	-7.039	3.049	-2.308	.021	
Instruction<--> ISTEPb	-11.111	3.574	-3.109	.002	
Pretest <--> ISTEPb	750.261	157.115	4.775	***	
Instruction<--> SES	.078	.026	3.059	.002	

Correlations: (Group number 1 - Default model)

	Estimate
SES <--> ISTEPb	-.214
Instruction<--> ISTEPb	-.298
Pretest <--> ISTEPb	.604
Instruction<--> SES	.366

Variances: (Group number 1 - Default model)



	Estimate	S.E.	C.R.	P	Label
Instruction	.242	.039	6.285	***	
Pretest	268.490	42.720	6.285	***	
SES	.187	.030	6.285	***	
ISTEPb	5749.877	880.395	6.531	***	
Gender	.250	.040	6.285	***	
Cosmobeliefs	1.174	.187	6.285	***	
Ethnicity	.724	.115	6.285	***	
e1	265.801	42.292	6.285	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Postest	.595

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	24	23.599	20	.260	1.180
Saturated model	44	.000	0		
Independence model	16	156.610	28	.000	5.593

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.849	.789	.974	.961	.972
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.714	.607	.694
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	3.599	.000	19.964
Saturated model	.000	.000	.000
Independence model	128.610	93.017	171.720

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.299	.046	.000	.253
Saturated model	.000	.000	.000	.000
Independence model	1.982	1.628	1.177	2.174

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.048	.000	.112	.478
Independence model	.241	.205	.279	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	71.599	77.771		
Saturated model	88.000	99.314		
Independence model	188.610	192.725		

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.906	.861	1.113	.984
Saturated model	1.114	1.114	1.114	1.257
Independence model	2.387	1.937	2.933	2.440

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	106	126
Independence model	21	25

## REFERENCE LIST

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- Anderson, B. (1999). *A comparison of old-earth, young-earth creationist models*. Retrieved August 29, 2009, from <http://www.rae.org/oldyoung.html>
- Arbuckle, J. L. (2006). *Amos* (Version 7.0) [Computer Program]. Chicago: SPSS.
- Archer, G. (1984). A Response to The Trustworthiness of Scripture in Areas Relating to Natural Science. In E. Radmacher & R. Preus (Eds.), *Hermeneutics, inerrancy, and the Bible*. Grand Rapids, MI: Zondervan.
- Baharudin, L., & Luster, T. (1998). Factors related to the quality of the home environment and children's achievement. *Journal of Family Issues, 19*, 375-404.
- Bankston, C. L., III, & Caldas, S. J. (1998). Family structure, schoolmates, and racial inequalities in school achievement. *Journal of Marriage & the Family, 60*, 715-723.
- Behe, M. (1996). *Darwin's black box: The biochemical challenge to evolution*. New York: New York Free Press.
- Biddle, B. (1997). Foolishness, dangerous nonsense, and real correlates of state differences in achievement. *Phi Delta Kappan, 79*(1), 8-13.
- Bransford, J. D. B., Brown, A. L., & Cocking, R. (Eds.). (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.
- Burton, L., Kijai, J., & Sargeant, M. (2005). The relationship between students' perceptions of the teaching and learning process and academic performance in science of seventh and eighth-graders enrolled in Seventh-day Adventist schools. *Journal of Research on Christian Education, 14*(2), 177-212.
- Byrne, B. M. (1998). *A primer of LISREL: Basic applications and programming for confirmatory factor analytic models*. New York: Springer-Verlag.
- Chall, J. S. (1996). American reading achievement: Should we worry? *Research in the Teaching of English, 30*, 303-310.
- Center for the Homeless. (2010). *Community programs*. Retrieved January 21, 2010, from <http://www.cfh.net/pages/programs/>

- Cole, M., & Engestrom, Y. (1993). *A cultural historical approach to distributed cognition*. Cambridge, MA: Cambridge University Press.
- Coleman, J. S. (1966). *Equality of educational opportunity study (EEOS)*. Washington, DC: U.S. Department of Health, Education, and Welfare, Office of Education.
- Darling-Hammond, L. (1999). *Teacher quality and student achievement: A review of state policy evidence*. Retrieved from <http://www.ctpweb.org>
- Dembski, W. (2002). *No free lunch: Why specified complexity cannot be purchased without intelligence*. Lanham, MD: Rowman and Littlefield.
- DeNavas-Walt, C., & Smith, J. (2007). *Income, poverty, and health insurance coverage in the United States: 2006*. Washington, DC: U.S. Census Bureau.
- Donahue, P. L., Voelkl, K. E., Campbell, J. R., & Mazzeo, J. (1999). *NAEP 1998 reading report card for the nation*. Washington, DC: National Center for Educational Statistics.
- Dummy variable. (n.d.). In V. J. Easton & J. H. McColl (Eds.), *Statistics glossary*. Retrieved October 6, 2010, from [http://www.stats.gla.ac.uk/steps/glossary/paired\\_data.html#dummyvar](http://www.stats.gla.ac.uk/steps/glossary/paired_data.html#dummyvar)
- Edwards v. Aguillard, 482 U.S. 578 (1987).
- Eldredge, N., & Gould, S. J. (1972). Punctuated equilibria: An alternative to phyletic gradualism. In T.J.M. Schopf (Ed.), *Models in paleobiology* (pp. 82-115). San Francisco: Freeman Cooper.
- Ferch, A. (1986, October 9). What creation means to me. *Adventist Review*, 11-13.
- Ferrell, V. (2001). *The evolution cruncher*. Altamont, TN: Evolution Facts.
- Findley, A., Linsey, S., & Watts, S. (2001). *The impact of religious belief on learning in the science classroom*. Annual Meeting of the Mid-South Educational Research Association, Little Rock, AR.
- Forrest, B. (2005). *The "Vise Strategy" undone: Kitzmiller et al. v. Dover Area School District*. Retrieved November 5, 2007, from <http://www.csicop.org/intelligentdesignwatch/kitzmiller.html>
- Gallup. (2008). *Gallup: Evolution, creationism, intelligent design*. Retrieved December 5, 2008, from <http://www.gallup.com/poll/21814/Evolution-Creationism-Intelligent-Design.aspx>

- General Conference of Seventh-day Adventists. (2005). *Seventh-day Adventists believe: A biblical exposition of 27 fundamental doctrines*. Hagerstown, MD: Review and Herald.
- Gentry, R. (1998). *A new redshift interpretation*. Retrieved May 4, 2008, from <http://arxiv.org/abs/astro-ph/9806280>
- Harkreader, S., & Weathersby, J. (1998). *Staff development and student achievement: Making the connection in Georgia schools*. Atlanta, GA: The Council for School Performance.
- Hecht, J. (2006). *Why doesn't America believe in evolution?* Retrieved from [http://www.newscientist.com/article.ns?id=dn9786&feedId=onlinenews\\_rss20](http://www.newscientist.com/article.ns?id=dn9786&feedId=onlinenews_rss20)
- Hoff, D. (2002). State of the states: Louisiana. *Education Week: Quality Counts*, 21(21), 120.
- Hooykas, R. (1972). *Religion and the rise of modern science*. Edinburgh, UK: Scottish Academic.
- Hoyt, W. (2008). *Cambrian explosion disproves evolution*. Retrieved July 11, 2009, from <http://www.learnthebible.org/cambrian-explosion-disproves-evolution.html>
- IBJ Staff and Associates Press. (2009). *Progress stalls on national, state math scores*. Retrieved from <http://www.ibj.com/progress-stalls-on-national-state-math-scores-/PARAMS/article/10549>
- Indiana Department of Education. (2008). *The Office of Student Assessment*. Retrieved March 28, 2008, from <http://www.doe.state.in.us/istep/welcome.html>
- Ingram, E., & Nelson, C. (2006). Relationship between achievement and student's acceptance of evolution or creation in an upper-level evolution course. *Journal of Research in Science and Teaching*, 43(1), 7-23.
- Johnson, C. (2003). *The International Flat Earth Society*. Retrieved February 24, 2008, from <http://www.holysmoke.org/hs00/flaterth.htm>
- Johnson, P. (1993). *Darwin on trial*. Downers Grove, IL: Intervarsity Press.
- Kitzmiller v. Dover Area School District. 400 F. Supp. 2d 707 (M.D. Pa. 2005).
- Lawson, A. (1983). Predicting science achievement: The role of developmental mental capacity, prior knowledge and beliefs. *Journal of Research in Science Teaching*, 20, 117-129.

- Linder, D. (2000). *An introduction to the John Scopes (Monkey) Trial*. Retrieved May 30, 2009, from <http://www.law.umkc.edu/faculty/projects/FTrials/scopes/evolut.htm>
- Margulis, L., & Sagan D. (2002). *Acquiring genomes: A theory of the origins of species*. New York: Perseus Books Group.
- Marsh, H. W., & Hau, K. T. (1996). Assessing goodness of fit: Is parsimony always desirable? *Journal of Experimental Education*, 64, 364-390.
- McKeachie, J., Lin, Y., & Strayer, J. (2002). Creation vs. evolutionary beliefs: Effects on learning biology. *American Biology Teacher*, 64(3), 189-192.
- Meyer, S. (2004). The origin of biological information and the higher taxonomic categories. *Proceedings of the Biological Society of Washington*, 117(2), 213-239.
- Michaels, S., & Schweingruber, H. (2008). *Ready, set, science!* Washington, DC: The National Academies Press.
- Miller, J. (1999). *Relationship of beliefs, epistemology, and alternate conceptions to college student understanding of evolution and common descent*. Columbus, OH: Ohio State University.
- Miller, J. (2002, January/February). Civic scientific literacy: A necessity in the 21<sup>st</sup> century. *The Journal of the Federation of American Scientists*, 55(1), 3-6.
- Morris, H. (1996). *Evolution and the Pope*. Retrieved April 15, 2008, from <http://www.bible.ca/tracks/b-pope-accepts-evolution.htm>
- National Center for Science Education. (2010). *Evolution education: Understanding and teaching the science of evolution*. Retrieved October 6, 2010, from <http://ncse.com/evolution>
- National Center for Education Statistics. (2005) *NAEP and No Child Left Behind: Important aspects of No Child Left Behind relevant to NAEP*. Retrieved October 2, 2010 from <http://nces.ed.gov/nationsreportcard/nclb.asp>
- National Research Council. (2005). *National science standards*. Retrieved October 2, 2010, from <http://www.cotf.edu/ete/teacher/changeemp.html>
- National Science Teachers Association. (2010). *The national science education standards*. Retrieved October 2, 2010, from <http://www.nsta.org/about/positions/standards.aspx>
- Nominal scale. (n.d.). In *Statistics.com*. Retrieved from <http://www.statistics.com/resources/glossary/n/nomscale.php>

- Northwest Evaluation Association. (2009). *Science concepts, processes, and general science overview*. Retrieved August 1, 2009, from <http://www.nwea.org/assessments/science.asp?state=IN#availability>
- Numbers, R. (1992). *The creationists: The evolution of scientific creationism*. Oakland, CA: University of California Press.
- Olson, S. (2000). *Inquiry and the National Science Education Standards: A guide for teaching and learning*. Washington, DC: National Academies Press.
- Ordinal scale. (n.d.). In *Statistics.com*. Retrieved August 28, 2009, from <http://www.statistics.com/resources/glossary/o/ordscale.php>
- Padilla, M., Miaoulis, L., & Cyr, M. (1999). *Prentice Hall explorer: Cells and heredity*. Upper Saddle River, NJ: Prentice Hall School Corp.
- Paley, W. (1802). *Natural theology; or, evidences of the existence and attributes of the deity*. New York, NY: American Tract Society.
- Paulson, A. (2007). New report ranks teens 29<sup>th</sup> in science worldwide. *Christian Science Monitor*. Retrieved from <http://www.csmonitor.com/2007/1205/p02s01-usgn.html>
- Piaget, J. (1928). *The child's conception of the world*. London: Routledge and Kegan Paul.
- Pigliucci, M. (2002). *Denying evolution: Creationism, scientism, and the nature of science*. Sunderland, MA: Sinuaer Associates.
- Reed, S. (2004). *Indiana's academic standards and resources*. Retrieved August 18, 2009, <http://dc.doe.in.gov/Standards/AcademicStandards/index.shtml>
- Reiss, M. (2008). Creationism, Darwinism, and id: What are biology teachers supposed to do? *Biologist*, 55(1), 28-32.
- Rennie, J. (2002). 15 answers to creationist nonsense. *Scientific American*, 287(1), 78-85.
- Santapau, T. (2007). *Highlights from TIMSS 2007: Mathematics and science achievement of U.S. fourth- and eighth-grade students in an international context*. Retrieved March 27, 2008, from <http://nces.ed.gov/timss/results07.asp>
- Sadler, W. (2010). *An outline of Old Testament history*. Retrieved September 12, 2010 from [http://urantiabook.org/urantiabook/bible\\_history/hist\\_1\\_11.htm](http://urantiabook.org/urantiabook/bible_history/hist_1_11.htm)
- School snapshot: Clay Intermediate Center 7425*. (n.d.). Retrieved March 26, 2008, from <http://mustang.doe.state.in.us/SEARCH/snapshot.cfm?schl=7425>



- Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modeling* (2<sup>nd</sup> ed.). Mahwah, NJ: Lawrence Erlbaum.
- Scott, E. (1997). Antievolution and creationism in the United States. *Annual Review of Anthropology*, 26, 263-289.
- Sharp, C. (2004). *Young earth and scientific creationism in the U.S.A.* Retrieved from <http://www.authorstream.com/Presentation/Cinderella-24304-creationism-Young-Earth-Scientific-Contents-1-2-Abstract-Christianity-Scien-as-Entertainment-ppt-powerpoint/>
- Shermer, M. (2006). *Why Darwin matters: The case against intelligent design*. New York: Henry Holt.
- Smith, C. S., & Sullivan, C. (2007). *The top ten myths about evolution*. Amherst, NY: Prometheus Books.
- Smith, D. (2005, October 21). Intelligent design not science: Experts. *Sydney Morning Herald*. Retrieved October 2, 2010 from <http://www.smh.com.au/news/national/intelligent-design-not-science-experts/2005/10/20/1129775902661.html>
- South Bend Community School Corporation. (2007). *South Bend Community School Corporation monitoring report*. Retrieved March 29, 2008, from <http://indiana.schooltree.org/district/South-Bend-Community-School-Corporation-004497.html>
- South Bend Community School Corporation. (2009, October 1). *Afterschool programming available in St. Joseph County, Indiana* [Television broadcast]. South Bend, IN: Fox 28.
- Stassen, C. (2005). *The age of the earth*. Retrieved April 18 2008 from <http://www.talkorigins.org/faqs/faq-age-of-earth.html>
- Scopes v. State, 152 Tenn. 424, 278 S.W. 57 (Tenn. 1925)
- Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioural Research*, 25, 173-180.
- Stremmel, A., & Fu, V. (1993). Teaching in the zone of proximal development: Implications for responsive teaching practice. *Child and Youth Care Forum*, 22(5), 337-350.
- Sunderland, D. (1988). *Darwin's enigma: The fossil record-- Non-life to Reptiles*. Retrieved February 8, 2008, from [http://creationism.org/books/sunderland/DarwinsEnigma/DarwinsEnigma\\_03NonLife.htm](http://creationism.org/books/sunderland/DarwinsEnigma/DarwinsEnigma_03NonLife.htm)

- Thomas, J., & Stockton, C. (2003). *Socioeconomic status, race gender & retention: Impact on student achievement*. Retrieved October 10, 2010 from <http://www.usca.edu/essays/vol72003/stockton.pdf>
- Trott, R. (2004). *Duane Gish and creationism: Richard Trott rebuts Gish' response*. Retrieved October 3, 2010 from <http://www.talkorigins.org/faqs/gish-rutgers/spin-doctor.html>
- Tuttle, T. (2004). *Family background, locality, and the influence on SAT scores for Indiana class of 2000*. Indiana Project for Academic Success 2. Retrieved May 29, 2008, from [www.indiana.edu/~ipas1/resources.html](http://www.indiana.edu/~ipas1/resources.html)
- U.S. Department of Education. (2001). *The Longitudinal Evaluation of School Change and Performance (LESCP) in Title I Schools*. Jessup, MD: Office of the Deputy Secretary.
- U.S. Department of Education. (2007a). *Highlights from TIMSS 2007: Mathematics and science achievement of U.S. fourth- and eighth-grade students in an international context*. Retrieved March 27, 2008, from <http://nces.ed.gov/timss/results07.asp>
- U.S. Department of Education. (2007b). *Summary of final regulations on modified academic achievement Standards*. Retrieved October 3, 2010, from <http://www2.ed.gov/policy/speced/guid/modachieve-summary.html>
- United States Census Bureau. (2001). *2000 decennial profiles*. Retrieved October 3, 2010, from [www.census.gov/prod/cen2000/dp1/2kh00.pdf](http://www.census.gov/prod/cen2000/dp1/2kh00.pdf)
- Verhey, S. (2005). The effect of engaging prior learning on attitudes toward creationism and evolution. *Bioscience*, 5(11), 996-1003.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Wallace, T. (2000). *A theory of biblical creation*. Retrieved May 31, 2009, from <http://www.trueorigin.org/createtheory.asp>
- Williams, P. (2006). *Science & Christianity--Theistic evolution and intelligent design*. Retrieved July 27, 2009, from <http://www.bethinking.org/science-christianity/theistic-evolution-intelligent-design-in.htm>
- Yen, H., & Sidoti, L. (2010). *US poverty on track to post record gain in 2009*. Retrieved September 12, 2010, from [http://news.yahoo.com/s/ap/20100911/ap\\_on\\_bi\\_ge/us\\_poverty\\_in\\_america](http://news.yahoo.com/s/ap/20100911/ap_on_bi_ge/us_poverty_in_america)
- Young, D. (1982). *Christianity and the age of the earth*. Grand Rapids, MI: Zondervan.

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**Objective** To acquire a faculty teaching position in Elementary or Middle School Science Education.

**Experience** **Middle School Science Teacher**  
*South Bend Community School Corporation* *South Bend, IN* Aug '99 - Present  
I have taught Geology, Chemistry, Applied Chemistry, Physics, Cells, Heredity and Evolution to seventh and eighth graders since 1999.

**Family Case Manager**  
*Elkhart County Child Protective Services* *Elkhart, IN* Aug '98 - Aug '99  
Family Case Manager for CPS: Elkhart County, Indiana.

**Family Case Manager**  
*Lane County Child Protective Services* *Eugene, OR* Apr '96 - May '98  
Family Case Manager for CPS: Lane County, Oregon.

**Family Case Manager**  
*St. Joe County Child Protective Services* *South Bend, IN* Aug '94 - Feb '96  
Family Case Manager for CPS: St. Joseph County, Indiana.

**Education** **Doctor of Education** (Educational Administration)  
*Andrews University* *Berrien Springs, MI* May '11  
Dissertation: Cosmological Beliefs and Other Factors as Predictive of Science Achievement Among Junior High-School Students in South Bend, Indiana

**Master of Science** (Elementary Education)  
*Indiana University South Bend* *South Bend, IN* May '02  
Master's Thesis: Ecosystem Education Among Middle School Students

**Bachelor of Arts** (Elementary Education)  
*Bethel College* *Mishawaka, IN* Dec '95

**Licensure / Certification** K-6 Certified Indiana Teacher (Elementary Education Master's + 30)  
7-9 Middle School Science Endorsement

**Honors** Elementary Education Graduate Student of the Year 2002  
Disney Hand Award Nominee 2002-2003  
Clay Middle School Teacher of the Year 2002-2003  
Lilly Foundation Teacher Creativity Grant Recipient 2005  
Time Magazine's "Person of the Year" 2006

**Membership** National Education Association  
Indiana State Teachers Association  
Northern Indiana Science Engineering and Mathematics Collaborative

**Points of Interest**

I have been the Clay IC Cross Country Coach every fall since 2002.  
I perform with and manage a musical group, "The Van Dyke Revue."  
I perform acoustic and electric guitar(s), blues harmonica, and lap dulcimer.  
I hold conversational-level sign-language skills.  
I have composed many songs, including learning songs for children.  
I am co-writing a book on inclusion from the perspectives of a gen ed teacher (myself) and a special ed teacher (my wife, Dawn), parents of a child with special needs (our son, Jacob).  
I serve as part of the South Bend Tribune's Political Panel.  
I have completed two marathons (2001, 2006), two half-marathons, a 25K and dozens of 5 and 10K races.

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