

EVOLUTION AND PERSONAL RELIGIOUS BELIEF:  
CHRISTIAN BIOLOGY-RELATED MAJORS'  
SEARCH FOR RECONCILIATION AT A CHRISTIAN UNIVERSITY

by

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B.S., Greenville College, 1987  
M.S., University of Kansas, 1990

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Curriculum and Instruction  
College of Education

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

2008

## **Abstract**

The goal of this study was to explore how Christian biology-related majors at a Christian university perceive the apparent conflicts between their understanding of evolution and their religious beliefs, and how their faith, as a structural-developmental system for ordering and making meaning of the world, plays a role in the mediating process. This naturalistic study utilized a case study design of 15 participants specified as undergraduate biology-related majors or recent biology-related graduates from a midwestern Christian university who had completed an upper-level course on evolution. Data were collected through semi-structured interviews that investigated participants' faith and their views on creationism and evolution. Fowler's theory of faith development and Parks' model of college students' faith was extensively used. Additional data were collected through an Evolution Attitudes Survey and a position paper on evolution as an assignment in the evolution course. Data analysis revealed patterns that were organized into themes and sub-themes that were the major outcomes of the study.

Most participants were raised to believe in creationism, but came to accept evolution through an extended process of evaluating the scientific evidence in support of evolution, negotiating the literalness of Genesis, recognizing evolution as a non-salvation issue, and observing professors as role models of Christians who accept evolution. Participants remained committed to their personal religious beliefs despite apprehension that accompanied the reconciliation process in accepting evolution. Most participants operated from the perspective that science and religion are separate and interacting domains.

Faith played an important role in how participants reconciled their understanding of evolution and their personal religious beliefs. Participants who operated in conventional faith dismissed contentious issues or collapsed dichotomies in an effort to avoid ambiguity and perceived tensions. Participants who operated in young adult and adult faith tended to confront their perceived tensions and worked towards reconciling their understanding of evolution and their personal religious beliefs. The rich description of this naturalistic study lends heuristic insight to researchers and educators seeking an understanding of the complex processes by which Christian biology-related majors approach learning about evolution and seek reconciliation between their understanding of evolution and their personal religious beliefs.

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Approved by:  Co-Major Professor Dr. Larry Scharmann	Approved by:  Co-Major Professor Dr. John Staver
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## Table of Contents

List of Tables.....	xii
Acknowledgements.....	xiii
Dedication .....	xv
CHAPTER 1 INTRODUCTION TO THE STUDY.....	1
Context of the Study.....	2
Purpose of the Research.....	8
The Central Question and Sub-questions .....	8
Definitions.....	9
Delimitations .....	11
Limitations .....	11
Significance of the Study .....	13
CHAPTER 2 REVIEW OF THE LITERATURE.....	15
Early Twentieth Century American Fundamentalism.....	15
The Rise of Creationism in the Mid-Twentieth Century .....	24
Modern Creationism.....	27
The Influence of Creationism on the Study Site Denomination .....	37
Belief, Understanding and Acceptance of Evolution.....	42
Evolution and Personal Religious Beliefs.....	48
Faith Development Theory .....	51
Young Adult Faith.....	56
Faith Development Research .....	60
Critical Analysis of Faith Development Theory .....	61
Christian University Students' Accommodation of Evolution .....	66
Summary of the Literature Review .....	73
CHAPTER 3 METHODOLOGY.....	74
Naturalistic Research .....	74
Rationale for Naturalistic Research .....	76
Case Study Design .....	77

The Role of the Researcher .....	79
Site Selection.....	83
Gaining Entry .....	85
Sample Selection.....	85
Sample Size.....	86
Data Collection Procedures.....	87
In-depth Interviews .....	88
Documents.....	92
Fieldnotes .....	94
Pilot Study.....	94
Data Analysis Procedures .....	96
Trustworthiness of the Study .....	103
Credibility.....	104
Transferability .....	108
Dependability and Confirmability.....	109
Ethical Considerations .....	110
Summary of the Methodology .....	111
CHAPTER 4 RESEARCH FINDINGS .....	112
Description of the Origins Course and the Learning Environment.....	113
The Campus and Science Building .....	114
Origins Course Environment.....	115
Origins Course Professor and Her Interactions with Students .....	116
Origins Course Assignments.....	119
Origins Course Reading Materials .....	121
Audiovisual Materials Viewed in Origins.....	126
Guest Presentations in Origins .....	128
Summary of the Origins Course and Learning Environment.....	129
Summary of Participants' Demographics .....	130
Summary of Participants' Views on Creationism and Evolution .....	133
Summary of Participants' Faith Stages .....	137

## Comparison of Two Recent Graduates'

Faith Stages and Views on Creationism and Evolution .....	141
Michael, Participant 14 – Views on Creationism and Evolution .....	142
Michael, Participant 14 – Faith Stage Analysis .....	145
David, Participant 15 – Views on Creationism and Evolution .....	147
David, Participant 15 – Faith Stage Analysis.....	153
Similarities in Backgrounds .....	156
Faith Stages and Views About Evolution and Creationism .....	159
Introduction to Categories, Themes and Sub-themes .....	165
Relationship of Categories to the Study's Central Question and Sub-Questions .....	168
Category 1 - Influences on Participants' Views of Creationism and Evolution .....	169
Category 2 – Participants' Views on the Domains of Science and Religion .....	183
Category 3 – Participants' Extant Ideas about Creationism and Evolution .....	206
Category 4 – Participants' Reconciliation	
of Their Understanding of Evolution and Personal Religious Beliefs.....	217
Category 5 – Faith and Reconciliation of Evolution and Religious Beliefs .....	242
Summary of the Research Findings .....	251
CHAPTER 5 SUMMARY, OUTCOMES, AND RELEVANCE FOR AUDIENCES .....	253
Summary of the Methodology .....	253
Summary of the Research Findings .....	255
Discussion of the Results .....	255
Reflections and Relevance .....	259
Limitations .....	261
Relevance for Evangelicals .....	263
Relevance for Christian University Professors .....	269
Relevance for Secular University Professors .....	280
Relevance for Researchers .....	282
Recommendations for Further Research.....	284
Researcher's Reflections .....	288
A Final Thought .....	289
References .....	290

Appendix A - Faith Development Coding Criteria .....	314
Stage 2 Mythic Literal Coding Criteria.....	315
Stage 3 Synthetic-Conventional Coding Criteria .....	316
Stage 4 Individuative-Reflective Coding Criteria.....	317
Appendix B - Parks' Model of Faith Development .....	318
Appendix C - Interview Protocol .....	319
Appendix D - Sample Faith Development Scoring Sheet.....	324
Appendix E - Life Tapestry Exercise.....	325
Sample Life Tapestry Exercise Worksheet.....	327
Appendix F - Evolution Attitudes Survey.....	328
Appendix G - Participant Informed Consent Form.....	329
Appendix H - Member Check Form .....	332
Appendix I - Classroom Observation Participants Informed Consent Form .....	334
Appendix J - Research Assistant/Transcriber Confidentiality Agreement Form.....	336
Appendix K - Summative Content Analysis of all Interview Transcripts and Documents .....	337
Appendix L - Peer Debrief Letter of Support .....	340
Appendix M - Peer Debrief Audit Report.....	341

## List of Tables

Table 4.1 <i>Participants' Demographics</i> .....	131
Table 4.2 <i>Participants' Childhood Beliefs and Present Views on Creationism and Evolution</i> ..	133
Table 4.3 <i>Participants' Faith Stages</i> .....	138
Table 4.4 <i>Overview of Categories and Themes</i> .....	167
Table 4.5 <i>Participants' Views and Active Expressions on the Domains of Science and Religion</i> .....	195
Table 4.6 <i>Participants' Evolution Attitude Survey Results</i> .....	207
Table 5.1 <i>Study Timeline</i> .....	254

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## **Dedication**

To Karla Beth.

## CHAPTER 1

### INTRODUCTION TO THE STUDY

The conflict of the religious and scientific debate regarding evolution remains unabated. Creationism and the recent advent of Intelligent Design continue to fuel the controversy, seeking to cast doubt on if not overturn currently accepted theories of biological, geological and cosmological evolution, and foster distrust in science within the minds of large segments of the American public, especially among Christian fundamentalists. Christian students who attend secular or Christian universities that include the topic of evolution in the science and social sciences curricula must eventually come to terms with their existing notions of creationism and evolution and the larger issues of science and personal religious belief.

Biological evolution has been characterized as one of the cornerstones of modern science learning (Jackson, Doster, Meadows, & Wood, 1995). Recognizing the inherent differences between science and religion and the tensions so evident in the creationism-evolution debate, science teachers in public classrooms must walk a fine line in contrasting these two ways of knowing (Bybee, 2004; Scharmann, 2005; M. U. Smith, 1994), while neither advocating nor impugning religious views (National Science Teachers Association, 2003). While these sentiments are warranted in public education, such limitations do not apply in Christian higher education. The goal of higher education at Christian liberal arts institutions is to help students develop a Christian worldview in which religious belief interacts with all areas of life, including science (Holmes, 1987; Poe, 2004). Students' responses to evolution are greatly influenced by their worldview and extant religious conceptions of creation (B. J. Alters & Nelson, 2002; M. U. Smith, 1994). This study explored the faith development and perceived tensions between

evolution and personal religious beliefs of undergraduate biology-related majors and recent biology-related graduates from a Christian liberal arts institution in the Midwest.

### Context of the Study

Religious views of creation and evolution, creationists' strategies to undermine evolution in the public classroom, and the impact of these issues on Christian university students were part of a broad context for this study. The faith paradigm, as a structural-developmental theory of psychology, and the importance of faith as a worldview in helping Christian university students find reconciliation between science and faith were also central aspects of the context.

“Creationism” is the Christian view that God directly created the universe (Scott, 2004). A broad spectrum of beliefs exists within creationism. At one end of the creationism spectrum, “Young Earth Creationists” with a literal interpretation of Genesis believe that the universe is 6,000-10,000 years old and that God created a multiplicity of living beings in a matter of days (Dalrymple, 2000). Another distinct group on the creationism spectrum is the Progressive Creationists (B. J. Alters, 1996; Scott, 2004). Also known as “Old Earth Creationists” (Colburn & Henriques, 2006), progressive creationists agree with currently accepted cosmological and geological theories, but reject basic tenets of biological evolution such as the dynamic view of speciation (Scott, 2004). The days of Biblical creation, instead of 24-hour periods, are long epochs of millions or billions of years and are generally compatible with the Big Bang, radiometric dating, and old-earth geological evidence. Progressive creationists believe that God, in a supernatural act, created plant and animal life at important junctures in history (B. J. Alters, 1996). All creationists categorically reject evolution as descent with modification from a single common ancestor.

Intelligent Design (ID) is a relatively recent form of creationism. Scott (2004) identifies ID as Progressive Creationism, but the ID movement has also been described as a “Big Tent” for all creationists (*Kitzmiller v. Dover Area School District*, 2005, p. 34). Intelligent Design advocates posit that certain biological structures have the appearance of being intelligently designed (Behe, 1996) and could not have come about by evolution. Leaders within the movement avoid revealing an identity, but most assume the “designer” is the Judeo-Christian God (K. R. Miller, 1999; Scott, 2004). Intelligent Design literature aims to undermine what its proponents call “Darwinism,” a term loosely associated with anything related to Darwin’s idea of natural selection (Scott, 2004).

Since the famous Scopes trial in 1925, creationists have aspired to debunk evolution and insert their ideas into the public classroom as a legitimate alternative to evolution (Staver, 2003). Their intrusions into public education have resulted in several court decisions that creationism, including Intelligent Design, is religious rather than scientific and has no place in the science classroom under the Establishment Clause of the First Amendment (Moore, 1999a, 1999b; *Kitzmiller v. Dover Area School District*, 2005). In contrast, the courts have consistently upheld the legitimate role of evolution in the science classroom (*Kitzmiller v. Dover Area School District*, 2005; Moore, 1999b; Scott, 2004). The National Academy of Sciences (1998) asserts that evolution is “the most important concept in modern biology, a concept essential to understanding key aspects of living things” (p. viii). Dobzhansky (1973), in arguing that evolution is the preeminent theory that unifies the many fields within biology, writes, “Nothing in biology makes sense except in the light of evolution” (p. 125).

Religious belief does not have to preclude acceptance of evolution. Theistic evolutionists believe that God works through the laws of nature in harmony with currently accepted theories

of science. Colburn and Henriques (2006) broadly define theistic evolution as a “marriage of theism and evolution” (p. 435). Theistic evolution should not be confused with deism, as a central tenet of Christianity maintains God is actively involved in creation (Murphy, 2002).

Scott (2004) and Skehan (2000) claim that a majority of American Christians accept evolution, although little data is provided to substantiate the claim. In contrast, a recent 2004 Gallup poll indicates that 45% of Americans believe that “God created human beings pretty much in their present form at one time within the last 10,000 years or so” (Newport, 2004, ¶ 12). Support for evolution was weakest among those who were frequent church attendees, conservatives, Protestants, Republicans and living in the middle of the country. Several of these demographics including frequent church attendance, conservatives, Protestants, and a Midwestern background characterize students who enroll at the Christian university that was the setting for this research (Hampton, 2007).

Theistic evolution introduces a variety of complex theological issues that must be addressed if one ascribes to a God who works through evolution (Peters & Hewlett, 2003). These include teleology (the purpose or ultimate goal of a random universe), divine action (how God works in the universe), theodicy (the problem of evil) and the nature of the human soul. These theological implications are pertinent for Christian university students struggling to find balance in reconciling their personal religious beliefs with science (Colburn & Henriques, 2006; Brem, Ranney, & Schindel, 2003; Nord, 1999).

The religious beliefs of college students tend to interfere with their ability to objectively evaluate scientific evidence (Sinclair, Pendarvis, & Baldwin, 1997). Meadows, Doster, and Jackson (2000) found that increased understanding does not necessarily change religious students’ personal views about evolution. Lawson and Weser (1990) discovered that students

with poorly developed reasoning skills may express a belief in a correct scientific conception but are not firmly committed to that conception. They are “merely agreeing with that belief because they have been told that it is correct by some authority figure, rather than arriving at that belief themselves through an internal hypothetico-deductive dialogue concerning the alternatives and the evidence” (p. 144). Several researchers argue that teachers should strive for their students to develop an understanding of rather than a belief in evolution (e.g., Scharmann, 2005; Staver, 2003). Colburn and Henriques (2006) write, “We should help students understand and accept it [evolution] but we should not be striving to make them believe it” (p. 439).

However, as already noted, a direct connection exists between students’ religious beliefs and their acceptance of evolution. Dagher and BouJaoude (1997) found evidence that a good understanding of evolution does not necessarily lead to an acceptance of the theory when religious beliefs interfere. Numerous educators agree that a better understanding of students’ religious conceptions, worldviews, and cultural and personal values is important for teachers to reduce religious resistance to evolution (Colburn & Henriques, 2006; Scharmann, 2005; Sinclair et al., 1997; M. U. Smith, 1994; Staver, 2003).

Meadows et al. (2000) encourage teachers to become more aware of how students make sense of evolutionary theory within the framework of their religious beliefs. Investigating the interaction of religious beliefs and views on evolution, Meadows et al. determined that teachers who are Christian approach the conflict in different ways. While some compartmentalize their beliefs, other teachers purposefully address the dissonance, enabling their two belief systems to begin to converge. Meadows et al. suggest that managing the conflict is the most effective strategy in allowing teachers to “comfortably engage in learning about evolution, while maintaining the integrity of their religious beliefs” (p. 106).

The overarching goal of this study was to examine the “crucible” within Christian university biology-related majors’ minds that mediates the disequilibrium between their understanding of evolutionary theory and their personal religious beliefs. This researcher investigated whether faith, as a system of composing and making meaning of the world, plays a key role in how Christian university biology-related majors accommodate evolutionary theory and how centers (e.g., persons, ideas, doctrines, objects) of ultimate power and value for Christian students affect the perceived dissonance between science and their personal religious beliefs.

The conceptualization of a faith system has been empirically explored and described by Fowler (1981). His research culminated in the seminal book entitled *Stages of Faith: The Psychology of Human Development and the Quest for Meaning*. Fowler described faith as a universal mode of cognitive rationale and affective response in shaping one’s world, “an orientation of the total person, giving purpose and goal to one’s hope and strivings, thoughts and actions” (Fowler, 1981, p. 14).

Faith is not synonymous with religious belief. Parks (1986) clarifies that “faith must be emancipated from its too facile equation with religion and belief and reconnected with trust, meaning, and truth” (p. 10). Fowler distinguishes the developmental *structures* of faith from the *contents* of faith, “the realities, values, powers and communities on and in which persons ‘rest their hearts’” (p. 273). Faith structures appropriate the contents of spiritual or ideological beliefs.

Relying heavily on the structural-developmental theories of Piaget and Kohlberg and psychosocial theories of Erickson, Fowler operationalized six stages (and an additional “undifferentiated” pre-stage in infancy) as a system to understand the growth process of a person’s faith. However, Fowler infused a broader understanding beyond cognitive structures in

claiming that faith involved “passionality” in addition to rationality. The faith stages integrate the “structures of affective, valuational and imaginal modes of knowing . . . that Piagetian and Kohlbergian stage theories have intended to avoid” (1981, p. 99).

Fowler’s six stages of faith are described in Chapter 2 in this report. Stages 2 through 4 are most pertinent to university students (Holcomb & Nonneman, 2004). Stage 2 is a mythic-literal faith characteristic of children who rely on intuition and lack critical thinking skills. Typical of adolescents, Stage 3 faith is tacitly held and based on uncritical conventions in conforming to peer groups and external sources of authority. Stage 4 is an “individuative,” explicit faith stemming from critical reflection of assumptive values and an internalization of the locus of authority.

Parks (1986) focused her study of faith stages specifically on college students. Because the progression from Stage 3 to Stage 4 can be an extended process, Parks proposed an intermediate “young adult” stage between a Stage 3 conventional faith and the Stage 4 adult faith. The young adult stage describes an equilibrated position through which many college students transition. Parks’ model, as compared to Fowler’s model, is more nuanced and descriptive of college students’ faith and is primarily used in this study.

Existing research regarding religious belief and evolution in the classroom focuses on the contents of faith - what it is that students believe - rather than studying the larger issue of what role faith plays in appropriating those beliefs (e.g., Dagher & BouJaoude, 1997). Much research also centers on students’ cognition and reasoning abilities (e.g., Lawson & Worsnop, 1992). Jackson et al. (1995) argue that focusing on these aspects alone misses part of the story and assert that motivational issues such as goals and values are important contributors to conceptual change, especially in the perceived conflict between evolution and personal religious beliefs.

## Purpose of the Research

The purpose of this research was to explore how Christian biology-related majors at a Christian university perceive the apparent conflicts between their understanding of evolution and their personal religious beliefs and how their faith plays a role in the mediating process. As Jackson et al. (1995) point out, “science educators must try to understand orthodox Christians’ beliefs on their own terms, as representing a different set of values and concerns, which they see as justified in their own way for valid psychological reasons” (p. 604). Parks’ (1986) model of college students’ faith, in association with Fowler’s (1981) general theory of faith development, served as a platform from which to study the intersection of evolution and personal religious beliefs.

This naturalistic research study utilized a case study design of participants specified as undergraduate biology-related majors or recent biology-related graduates from a Christian liberal arts university in the Midwest. Seven undergraduates who were seniors, and eight recent graduates who had graduated within the last two years, participated in the study. Data were collected through semi-structured interviews, an Evolution Attitudes survey, and a position paper on evolution as an assignment in an “Origins” undergraduate biology course. Analysis of the data produced themes and sub-themes, which are the major findings of this study.

## The Central Question and Sub-questions

The central question that framed this study was: How do Christian biology-related majors at a Christian university reconcile their understanding and acceptance of evolution and their personal religious beliefs? Four sub-questions relevant to the central question were investigated:

1. What factors influence participants’ perspectives on evolution and creationism?
2. What are participants’ extant views on evolution and creationism?

3. What aspects of evolutionary theory and personal religious beliefs create dissonance for participants?
4. What is the role of participants' faith in reconciling their understanding and acceptance of evolutionary theory and their personal religious beliefs?

### Definitions

The following terms used in this study require definition and clarification:

Faith – The concept of faith, as used in this study, defies a concise dictionary definition.

Parks (2000) defines faith as “meaning-making in its most comprehensive dimensions,” an activity in which “all human beings compose and dwell in some conviction of what is ultimately true, real, dependable” and thereby stake their lives on that composition of reality (p. 21). Faith is operationalized in Fowler’s (1981) and Parks’ (1986) theories of faith stage structure and development and is not conflated with the contents of religious belief in the context of this study.

Religious belief – Fowler (1981) states that belief is “the holding of certain ideas” (p. 11). Faith, as a system to order meaning, appropriates those ideas, which may include the contents of religious belief. Religious belief is a propositional affirmation of the existence of a supernatural force or entity (National Academy of Sciences, 2008) and the implications of that proposition. For example, Creationism is a religious belief since it asserts a supernatural being created humankind (*Edwards v. Aguillard*, 1987).

Christian university – For the purposes of this study, the broad scope of “Christian university” is narrowed to the Christian liberal arts institution. Poe (2004) defines Christian liberal arts institutions as colleges or universities that have strong cultural ties to their denominations and “regard the religious and academic programs as parts of the whole that should not be separated” (p. 36). Subject matter at a Christian university is ideally grounded in the

Christian worldview and studied from a religious perspective. In this study, recent graduates provided valuable data on Christian university students' faith development and perceived conflict of evolution and personal religious beliefs. Therefore, the term "Christian university student" is inclusive of undergraduates and recent graduates.

**Evolution** – The term evolution in the context of this study is narrowed to biological evolution. The participants majored in a biology-related field and their use of the term was oriented towards biological evolution. Therefore, evolution does not include geological and cosmological aspects unless specifically stated. When the term is used alone, evolution is strictly confined to the biological sciences, without appealing to the religious (theistic), metaphysical (philosophical naturalism) or social (social Darwinism) constructs. Evolution includes macroevolution, the emergence of new species through mutation, variation and natural selection (K. R. Miller, 1999). Evolution, in this study, should not be conflated with abiogenesis, the origin of life in the appearance of the first cell (Scott, 2004).

**Creationism** – The term creationism refers to the various anti-evolution theories of the Young Earth Creationists and Progressive Creationists, including Intelligent Design advocates. The terms "creation science" and "scientific creationism" are not used in this study unless in a direct quotation, because according to the overwhelming majority of scientists, creationism is not science (Clough, 1994; Moore, Jensen, & Hatch, 2003; Scott, 2004). Creationism should not be confused with the general term "creation," which for instance could be used to describe the scientific emergence of new species. Also, the phrase "God created" does not strictly imply creationism. A theistic evolutionist could employ the same phrase as such, "God created through evolution."

## Delimitations

Delimiting a study refers to describing the intellectual territory to be researched as well as the methods and procedures. Delimitations for this study included the type of naturalistic research, nature and analysis of the data, sampling method, time and location. A case study is an “intensive, holistic description and analysis of a single unit or bounded system” (Merriam, 1998, p. 12). In this study, the bounded system was a group of undergraduate biology-related majors and recent biology-related graduates at a Christian liberal arts university in the Midwest. Data collection and analysis focused on students’ expressed faith as a way of making meaning of the world, and the interaction of their personal religious beliefs and views on evolution.

The purposeful sampling method (Patton, 1990) was employed to select “information-rich” cases (participants) with significant relevance to the central question of the study. Selection criteria, described in Chapter 3, were used to select promising cases. The typical site sampling strategy was used for this study, meaning, “the site is specifically selected because it is not in any major way atypical, extreme, deviant, or intensely unusual” (Patton, 1990, p. 173). While there exists a diversity of approaches to handling evolution issues at Christian universities (B. J. Alters & S. M. Alters, 2001), no aspect of the study site suggested that it was atypical of higher education institutions committed to the teaching of evolution in non-opposition to religious belief. Data in the form of semi-structured interviews and documents for analysis were collected from December 2006 to August 2007.

## Limitations

Limitations are those issues and factors that are beyond the intellectual and methodological territory, and the boundaries of the study, yet are relevant and may influence the research. Several limitations are pertinent to this study. First, this case study was bounded to

biology-related majors from a single Christian institution. The selection of biology-related undergraduate seniors and recent graduates was a purposeful boundary designed to provide greatest insight of the general process biology-related majors undergo in wrestling to reconcile evolution and personal religious beliefs. The variety in personal values, experiences, dispositions, and backgrounds that participants naturally brought to the study facilitated a rich and holistic description of each individual and a broad, narrative picture of all participants.

Second, the researcher's relationship with the participants must be acknowledged. As the study site is a relatively small institution, each participant had taken one or two science courses from the researcher. It is possible that some aspects of the participant-researcher relationship may have influenced the data, including a sense of obligation, resentment of grade, or response to what the participant perceived the researcher wanted to hear. To mitigate these effects, the informed consent form clearly explained that participation, non-participation, or withdrawal from the study had no effect on the participants' relationship with the researcher or course grades. Eighty-three percent of the biology-related majors in the participant pool completed the study, which indicated that the existing relationship brought an element of rapport and trust between the researcher and the participants.

As with any naturalistic research, this study endeavored to represent phenomena from the participants' points of view (Merriam, 1998). The researcher is the primary instrument for data collection and analysis in "understanding the meaning people have constructed" (p. 6) of their experiences. The final product of this study is ultimately the interpretation of the data through the researcher's own perspective.

## Significance of the Study

Prior studies in high school and college general biology classrooms have used survey and pre/post-test instruments to study how religious beliefs affect an acceptance of evolution (e.g., Lawson & Worsnop, 1992; Sinclair et al., 1997). Some studies have used naturalistic designs. Interview participants have included a wide spectrum from university professors and pre-service science teachers (e.g., Jackson et al., 1995) to clergy (e.g., Colburn & Henriques, 2006).

This study's unique features make a contribution to existing knowledge of why students with religious beliefs struggle with accepting evolution. The research occurred in a Christian university context where open dialogue about religious beliefs is encouraged. The participants were biology-related majors relatively advanced in their programs compared to the students in high school and college general education biology courses who were investigated in other studies (e.g., Sinclair et al., 1997; Lawson & Worsnop, 1992). The research protocol, including a semi-structured interview, provided a flexible and adaptive method for focusing on critical affective factors. Finally, the approach was unique in utilizing faith development as a holistic construct, which in addition to cognition incorporated the emotional concerns, personal values, and perceptions of ultimate meaning for Christian university biology related majors.

This study may provide information and insights for Christian university faculty to assist biology-related majors negotiate the conflicts between their emerging scientific viewpoints and existing beliefs. The results of this study may help Christian university faculty better understand the critical role of faith in students' reconciliation of evolutionary theory and their personal religious beliefs.

Finally, this study may benefit secular university professors who consider it important to address the dichotomy that many perceive between their scientific and a religious worldview (B.

J. Alters & Nelson, 2002). As Dagher and BouJaoude (1997) report, “Efforts are not likely to affect major cognitive differences in students without actively engaging-neither ignoring nor fighting-other factors [such as religious belief] that underlie their resistance to the ideas about evolution” (p. 441). To the extent that educators can broach the interaction of science and religious belief in the public classroom (NSTA, 2003), this study’s results may have important relevance.

## CHAPTER 2

### REVIEW OF THE LITERATURE

The literature review is an overview of three factors in the cultural and educational milieu that shape Christian university students' views on evolution. These factors are the American fundamentalist movement and its influence within the Protestant Evangelical church, creationism and its impact on education in the United States over the last four decades, and evolution education, including teaching strategies. The first two factors, creationism and American fundamentalism, are presented in a historical chronology with attention to the perspectives of the denomination associated with the study site university. A discussion of understanding, acceptance, and beliefs forms a backdrop to introduce faith as an important construct that influences how Christian university students negotiate perceived tensions between evolutionary theory and their personal religious beliefs.

#### Early Twentieth Century American Fundamentalism

The tenacity of creationist groups in actively opposing evolution in public education is largely rooted in religious objections that came about with the rise of American fundamentalism in the late nineteenth century (Larson, 2003). Fundamentalism is historically a subset of the Evangelical movement within United States Protestant churches (Ingersol, 2005). Although the fundamentalist movement reached an apex in the first half of the twentieth century, its habits of mind have influenced generations of Evangelicals and continue to be the dominant intellectual mindset of many Evangelical churches (Noll, 1994). The following narrative describes Evangelicalism, the historical movement of fundamentalism, and fundamentalism's continuing influence on the conflict between evolution and religion in the United States.

Evangelicalism evades a standard definition as it historically represents a mosaic of movements, alliances between religious groups, and the influence of authoritative religious leaders (Dayton & Johnston, 1991). Noll (1994) identifies four characteristics of Evangelicalism: a “new birth” as a life-changing religious experience; a reliance on the Bible as the authoritative revelation from God; a commission to spread the gospel through evangelism; and the saving work of Jesus Christ’s death and resurrection. According to a national survey of religion conducted in 2007, 26.3% of Americans identify themselves as affiliated with an Evangelical Protestant church (Forum on Religion & Public Life, 2008). The percentage swells to nearly 51.3% when mainline churches and historically black Protestant churches are included. In a 2004 national survey of religion and politics, Evangelicals were the most religiously and politically active of any religious group identified by the survey (Green, 2004). Nearly two-thirds of Evangelical Protestants in the survey, the largest of any identified group, disagreed with the statement, “Organized religious groups should stay out of politics” (Green, 2004, p. 13).

The fundamentalist movement arose within the Evangelical Protestant church in the United States during the late 1800s (Larson, 2003). As with Evangelicalism, fundamentalism is a difficult term to define (Marsden, 1991). Marsden uses paradigmatic leaders to identify two distinguishing features of historical fundamentalism: soul winning and a militant defense of the faith. Dwight L. Moody, a key leader in the rise of fundamentalism, founded the Chicago-based Moody Bible Institute, which played an active role in the anti-evolution crusades in the 1920s (Larson, 2003). Regarded as the “Billy Graham of the nineteenth century” in his zeal for soul winning (George, 1999), Moody espoused a doctrine of biblical inerrancy that ran counter to emerging scientific findings. Moody had little regard for scientists who, as he described them, “dug up old carcasses. . . to make them testify against God” (quoted in Numbers, 1992, p. 14).

After Moody's death in 1899, a more socially active and militant form of fundamentalism began to emerge (Larson, 2003). A series of twelve booklets called *The Fundamentals: A Testimony to the Truth* (see Torrey & Dixon, 1917) was printed between 1905 and 1915, during which three million copies were distributed free of charge. Containing more than one hundred articles by leading Evangelical scholars, *The Fundamentals* reasserted scriptural inerrancy in response to criticism by modernist scholars (Baker, 2006; Larson, 2003). Early twentieth century modernism espoused a higher criticism of scripture, the interpretive technique that accommodates the cultural, historical and literary aspects of the Bible (Scott, 2004). Marsden (1980) writes that although *The Fundamentals* did not have an immediate impact on Evangelicalism, the booklets came to symbolize a broad united front in opposition to modernism.

Four articles appeared in *The Fundamentals* in response to evolution (Larson, 2003). James Orr and George Wright each authored earlier articles that, while favorable to theistic evolution of subhuman species, "argued strongly against Darwinian claims that evolution could explain the origins of life or the uniqueness of humans" (Marsden, 1980, p. 122). Two later articles written in 1912 presented more virulent "scientific-sounding arguments against Darwinism" (Larson, 2003, p. 43) and opposed the teaching of Darwinism in schools. Marsden (1980) observes that the mixed messages in *The Fundamentals*, including one by George Wright who was known to be sympathetic to theistic evolution, reveal that the "battle lines [of fundamentalism] were not yet firmly fixed against every sort of biological evolutionism" (p. 122).

In addition to countering modernism and evolution, fundamentalism was also a reaction to the transformation of American universities from the 1860s to the turn of the twentieth century

(Noll, 1994). For instance, 51 of the 54 presidents of America's universities in 1839 were Evangelical clergymen, but that number fell significantly by the end of the nineteenth century. The new university had shifted away from focusing on Christian higher education to a new emphasis on intellectual pursuit and scientific research. Fundamentalism was also a response to the early twentieth century immigration of Roman Catholics, Jews and non-religious newcomers into a nation that Evangelicals had always considered as Protestant (Noll, 1994).

Although the distinctions between Evangelicalism and fundamentalism in the early twentieth century were blurred, the renowned liberal preacher Harry Emerson Fosdick in a famous 1922 sermon stated, "We should not identify the Fundamentalists with the conservatives. All Fundamentalists are conservatives, but not all conservatives are Fundamentalists" (Fosdick, 1922, p. 716, quoted in Ingwersol, 2005, p. 125). What separates the fundamentalists from the theologically conservative is "not the content of their doctrine but the basic spirit that the fundamentalist brings to it. Fundamentalism is not simply Christian orthodoxy; it is militant orthodoxy – orthodoxy on the warpath, with a glint of blood in its eye" (Ingwersol, 2005, p. 125). However, according to Weber (1991), Evangelicalism holds to traditional orthodoxy with a "somewhat lighter touch, especially in the area of biblical inerrancy, the use of biblical criticism, and certain behavioral mores" (p. 13). Yet, Marsden (1980) suggests that some of the nuances of fundamentalism will always be part of the Evangelical psyche as a response to modernity and change.

Noll (1994) describes three theological innovations that left a profound impact on the intellectual mindset of the Evangelical church: the Holiness movement, Pentecostalism, and dispensationalism. While careful to recognize the positive aspects of these innovations in defending important Christian convictions, Noll identifies dispensationalism as the most cerebral

form of fundamentalism in generating new forms of “anti-intellectualism” that remain a persistent influence in the modern Evangelical church (see also Ingersol, 2005).

Dispensationalism posits that God’s relationship with humanity can be divided into distinct epochs that extend from Genesis to the end of time as delineated by special interpretations, or “dispensations” in the Bible (Noll, 1994). The notion that God holds transcendental control over history is also associated with dispensationalism. Ironically, at a time during the early twentieth century when fundamentalists perceived negative shifts in the American culture, dispensationalists “were casting about for some means to bring history back under their control” (Frank, 1986, p. 73). Parallels may be drawn to the modern day fundamentalists’ reaction to an apparent downward spiral of American culture (e.g., Ham, 1987).

Central to dispensationalism is the doctrine of Biblical inerrancy, meaning “the Bible not only is an infallible authority in matters of faith and practice, but also is accurate in all its historical and scientific assertions” (Marsden, 1991, p. 25). Clouser (1999) calls this the “encyclopedic assumption” in which the Bible is an encyclopedia with unquestionable information on every topic. Noll (1994) writes that although inerrancy was “an idea that had been around for a long time,” it had “never assumed such a central role for any Christian movement” (p. 133). Marsden (1991) notes that fundamentalists equate a literal interpretation of the Bible with belief in the Bible itself. In other words, people who interpret the Bible in any other way than a literal sense deny the truth of scripture by putting their own standards of interpretation above that of the Bible’s inerrancy.

Blaising (1992) observes that the problem with early dispensationalism was the “failure to recognize that all theological thought, including one’s own theological thought, is historically conditioned . . . by the tradition to which that theologian belongs as well as personal and cultural

factors such as education or experience” (p. 22). Eventually, classical dispensationalism resulted in a Baconian, inductive approach to reading the Bible (Noll, 1994). That is, dispensationalists sought an objective, disinterested, and unbiased interpretation in complete disregard to the human, historical and cultural elements of the scriptures. Unequivocal in his indictment of this approach, Noll (1994) writes,

If that [Christian] community’s habits of mind concerning those things to which the community pays most diligent attention and accords highest authority—that is, to the Bible and Christian theology—are defined by naïve and uncritical assumptions about the way to study or think about anything, so will its efforts to promote Christian thinking about the world be marked by naïveté and an absence of rigorous criticism. In these terms, the problem of fundamentalism was that the worst features of the nineteenth-century intellectual situation became the methodological keystones for mental activity in the twentieth century (p. 130).

A modern-day example of an absolutist view of the Bible as the supreme authority, even in scientific matters, is found in a quotation from an article posted at the Institute for Creation Research Web site. Lubenow (1978, ¶ 6) writes,

If creation has ceased, as Genesis 2:4 . . . would indicate, then one is in error in seeking to utilize present day insights or hypotheses of scientists to cast light on past supernatural acts of creation. Here, of all places, Scripture *must* have the highest priority and it *alone* must be the final authority [italics in original].

Noll (1994) observes that an absolutist view of the Scriptures was not the dominant paradigm in the mid-1800s. A number of theologians and scientists ascribed to God’s two “books” of revelation: the Bible and nature itself. For instance, in the 1860s, Princeton

theologian Charles Hodge advocated the use of science to help interpret scriptures, citing science's contribution to overturning the geocentrism associated with earlier interpretations of the Bible (Noll, 1994). Joseph LeConte, a geologist and liberal Christian, wrote a popular high school textbook in 1884 that advanced an evolutionary geological history of the Earth (Larson, 2003). Asa Gray, a Harvard botanist and orthodox Christian, embraced Darwin's theory of natural selection (Larson, 2003). Indeed, Gray was a close associate of Darwin and tried unsuccessfully to convince him that the theory of natural selection could be understood as part of God's providential design and ongoing involvement in the world (Noll, 1994). Gray accommodated evolution with his theology by adjusting God's role in creation. Larson (2003) summarizes Gray's view: "God still lies behind nature, but the secondary cause of evolution replaced His creative hand as the immediate instrument of speciation" (p. 10).

Whatever influences these theologians and scientists had in advocating an interactive approach to evolution and orthodox Christianity soon dissipated by the turn of the century following their deaths (Larson, 2003). Social and religious concerns became the dominant force leading up to the Scopes Trial in 1925, and engendered an anti-evolution crusade that was fueled by fundamentalist rhetoric as exemplified by William Jennings Bryan's cry to "drive Darwinism from our schools" (as quoted in Larson, 2003, p. 27). Bryan, a well-known lawyer and Democratic politician, was moderate in his acceptance of an ancient earth history (Larson, 2003). However, he was firmly opposed to the notion that man was an "improved monkey" and viewed human evolution as the immoral basis of social Darwinism and eugenics (Bryan, 1913).

The public school classroom became a battleground in the 1925 Scopes Trial, in which Tennessean schoolteacher John Scopes was tried for teaching evolution in violation of Tennessee law. Bryan served as prosecutor, and Clarence Darrow, working with the American Civil

Liberties Union (ACLU) and representing Scopes, led the defense in the highly publicized 8-day trial. Near the end of the trial, Bryan had inexplicably taken the stand to support a scriptural view of creation. However, Bryan had looked foolish instead under Darrow's crushing cross-examination for insisting on a literal interpretation of the Bible in the face of scientific evidence to the contrary. Although Scopes was convicted of teaching evolution, the victorious Christian fundamentalists and anti-evolution crusaders were largely ridiculed by the press and in public opinion (Larson, 2003).

One week after the Scopes decision, William Jennings Bryan died in his sleep on July 26, 1925. As Larson (2003) writes, "The anti-evolution movement lost its prime mover, but momentum carried it on" (p. 70). Scopes' conviction was appealed to the Tennessee Supreme Court but was overturned on a technicality in 1927 (*Scopes v. State*, 1927). Scopes had been fined \$100 by the judge, and the Tennessee Supreme Court ruled that instead the jury should have decided an appropriate fine. Evolution supporters, hoping the decision would be upheld to enable the anti-evolution law to be taken up by the U.S. Supreme Court, were disappointed in having no case to take forward (Larson, 2003). Arkansas and Mississippi soon instituted laws against the teaching of evolution in public schools.

During the early twentieth century period in which *The Fundamentals* pamphlets were printed and factions within the American Evangelical Protestant church were actively resisting the rise of modernism, a new denomination was formed. The study site denomination was established in 1908 as the merger of several Holiness and Pentecostal churches (Manual, 2005). The denomination's 2005 – 2008 manual states two distinctions regarding the church: a mission to spread the gospel; and the "primary objective . . . to advance God's kingdom by the preservation and propagation of Christian holiness as set forth in the Scriptures" (p. 7).

Ingersol (2005) writes, “Among theological conservatives, there were few corners where fundamentalism did not penetrate in the 1920s, 1930s, and 1940s” (p. 131). R.T. Williams, an early church leader, remarked at the 1928 General Assembly of the study site denomination, “Every man in this body is a fundamentalist, and so far as we know there is not a modernist in the ranks” (as quoted in Ingersol, 2005, p. 123). At the same assembly, a move was made to introduce the doctrine of Biblical inerrancy into the church’s Article of Faith on Scripture (Ingersol, 2005). H. Orton Wiley, an early denominational theologian, avoided the extremists’ position in guiding the General Assembly to adopt the following article, which still remains in the church manual:

“We believe in the plenary inspiration of the Holy Scriptures, . . . given by divine inspiration, inerrantly revealing the will of God concerning us in all things necessary to our salvation; so that whatever is not contained therein is not to be enjoined as an article of faith” (as quoted in Ingersol, 2005 p. 132).

The qualifier “revealing the will of God concerning us in all things necessary to our salvation” was an important distinction from absolute inerrancy in all matters. Indeed, Wiley and other early denominational theologians, including A.M. Hills, supported an ancient Earth geology (Giberson, 1993). Wiley wrote extensively on cosmogony, seeking to align modern scientific discoveries with the Genesis account (Wiley, 1940). “Nevertheless, in the conflict between fundamentalists and modernists,” as Ingersol (2005) notes, denominational sympathies during this period in the late 1920s “were clearly on fundamentalism’s side and against religious skepticism, the higher critics of the Bible, the Darwinists, and the liberal Protestant theologies” (p. 133). With this mindset, many within the study site denomination would embrace the rise of creationism over the next several decades.

## The Rise of Creationism in the Mid-Twentieth Century

Battles between evolution-supporters and anti-evolution activists subsided over the three decades following the Scope's trial. Evolution remained largely absent from public school textbooks until the 1960s (Scott, 2004). Restrictions on teaching evolution became a matter for the local school boards to determine rather than state legislatures (Larson, 2003).

However, the launch of Sputnik in 1957 by the Soviet Union catalyzed a major reform in K-12 science and mathematics education. One component of this reform was the development of new science curricula with funds provided by the National Science Foundation. The Biological Science Curriculum Study (BSCS) developed several high school biology curricula in the 1960s and integrated evolution as a prominent theme (DeBoer, 1991). Despite "significant state and local opposition," Larson (2003) notes the BSCS textbooks "quickly gained and held half the biology textbook market" (p. 95).

In 1965, Susan Epperson, a Little Rock high school biology teacher, challenged an Arkansas law that declared it unlawful to teach that "man has descended from a lower order of animal" (quoted in Larson, 2003, p. 54). The trial eventually reached the Arkansas Supreme Court, which ruled the law was a valid exercise of the state's power to specify the curricula in its public schools (*State v. Epperson*, 1967). However, the decision was appealed to the United States Supreme Court, which ruled in 1968 that the Arkansas law was unconstitutional in violation of religious neutrality (*Epperson v. Arkansas*, 1968). The Supreme Court decision was the first of its kind to invalidate a state statute that prohibited the teaching of evolution in public education.

Nevertheless, anti-evolution supporters were galvanized in the wake of the *Epperson v. Arkansas* (1968) ruling. The reappearance of evolution in the curriculum and the battle lines

drawn in the Supreme Court decision helped spark a creationism movement (Numbers, 1992). Creationism can be traced to the writings of Seventh-day Adventist George McCready Price, who in 1923 published *The New Geology*, which argued that a simple reading of Genesis demonstrated a six to eight thousand year-old Earth with geological features created by a great flood (Numbers, 1992). In 1961, theologian John C. Whitcomb and hydraulic engineer Henry M. Morris published *The Genesis Flood: The Biblical Record and its Scientific Implications*, which updated and strengthened the theological and scientific premise of Price's earlier book. Larson (2003) remarks that Morris soon became the “leading voice for scientific creationism” (p. 92).

Although the *Epperson v. Arkansas* (1968) decision upheld evolution education, it did not address the constitutionality of teaching creationism in the public classroom. Creationist groups such as the Institute for Creation Research (ICR), founded by Henry M. Morris, were increasingly active in defending the teaching of creationism as an alternative to evolution in public schools. Morris, citing an Associated Press and NBC News survey that found 76% of Americans favored teaching both biblical and scientific views of creation, co-wrote in an ICR book, “Creationists only request *fair* [italics in original] treatment, not favored treatment, in the schools” (H. M. Morris & Parker, 1982, p. 226).

Responding to public opinion favoring the teaching of creationism in their states, the Arkansas and Louisiana legislatures enacted “balanced treatment” laws in 1981 (Larson, 2003). However, the ACLU and several religious groups filed a lawsuit alleging the new Arkansas law, Act 590, endorsed religion in violation of the constitution. Reverend Bill McLean, a Methodist minister, represented the plaintiffs. Judge William Overton, in *McLean v. Arkansas Board of Education* (1982), ruled the law was unconstitutional and wrote, “Since creation science is not

science, the conclusion is inescapable that the *only* [italics in original] real effect of Act 590 is the advancement of religion” (p. 941). Because the defendants did not appeal the U.S. District Court’s ruling, the force of law in *McLean v. Arkansas Board of Education* (1982) applied only in Eastern Arkansas.

The ACLU also filed a lawsuit against Louisiana’s balanced treatment law in 1981. Many other educational groups such as the National Association for Biology Teachers and the National Science Teachers Association joined the lawsuit. Individual plaintiffs included Donald Aguillard, a local Louisiana teacher. Although the *McLean v. Arkansas Board of Education* (1982) ruling was decisive, Larson (2003) notes, “Many of the more damning features of the Arkansas act were absent from the Louisiana law, including . . . the Genesis-like definition for creation science” (p. 167). The lawsuit against the Louisiana balanced treatment law worked its way through the courts and reached the U.S. Supreme Court in December 1986. In a sweeping decision on June 19, 1987, the Supreme Court ruled in *Edwards v. Aguillard* (1987) that the Louisiana law requiring creationism be taught in the public classroom whenever evolution was taught was unconstitutional in advancing a particular religion.

While the *Edwards v. Aguillard* (1987) ruling dampened creationist efforts to overtly insert creationism in the public classroom, creationism as a movement continued to strengthen and diversify in the 1990s. Evangelicalism continued to be receptive to creationism because it so easily accommodated intuitive beliefs in the simple teachings of the Bible (Noll, 1994). Larson (2003) writes that after the 1987 U.S. Supreme Court decision, “biblical creationists turned inward to entrench their views within American’s vibrant conservative Christian subculture. There they flourish, unchallenged and virtually inaccessible by evolutionists” (p. 190).

Today, modern creationism falls into several camps, including Young Earth Creationism, Progressive Creationism, and Intelligent Design. Each of these positions is presented below. Additionally, creationists have modified their attempts to influence public education and these efforts are discussed in the context of recent court cases and school board conflicts.

### Modern Creationism

Since the 1960s, the creationism movement that sought to support its religiously inspired tenets with underpinnings of science (e.g., Whitcomb & H. M. Morris, 1961; Sarfati, 1999) eventually became known as Young Earth Creationism (YEC). The Institute for Creation Research (ICR), founded by Henry M. Morris, long located near San Diego, California, and recently moved to Dallas, Texas, is the flagship of the YEC movement (Scott, 2004). The ICR insists on the absolute inerrancy of the Bible and claims scientific evidence for a recent seven-day creation and the Noahic flood. In addition, much of ICR's research focuses on undermining the contemporary theories of Big Bang cosmology, biological evolution, and plate tectonics.

The ICR maintains an “accredited” graduate school offering M.S. degrees in Science Education with an emphasis Astro/Geophysics, Biology, and Geology, although the school appears to be exempt from California state accreditation approval (Institute for Creation Research Graduate School, n.d.). B. J. Alters and S. M. Alters (2001) report that ICR's periodicals have a circulation of over 300,000 per month. The Institute for Creation Research recently moved its headquarters to Dallas, Texas in the Fall of 2007 (J. D. Morris, 2007), and is seeking accreditation for its master's degree program from the Texas Higher Education Coordinating Board (Blumenthal, 2007).

Various groups similar to the ICR appeared in the 1980s, and include Answers in Genesis (AiG), Creation Science Evangelism, and the Creation Evidence Museum. AiG is especially

polemical in its attacks with book titles such as *The Lie: Evolution* (Ham, 1987). Much of AiG's Sunday School material for children denigrates evolution and advocates a strict, literalist Biblical interpretation. Jonathan Sarfati of AiG writes, "Creationists ultimately date the earth using the chronology of the Bible. This is because they believe that this is an accurate eyewitness account of world history, which can be shown to be consistent with much [scientific] data" (Sarfati, 1999, p. 115).

The Young Earth Creationism movement is well-funded and active. Both the Institute for Creation Research (ICR) and Answers in Genesis (AiG) have annual budgets of approximately five million dollars (B. J. Alters & S. M. Alters, 2001). AiG recently completed a \$25 million Creation Museum in 2007, located near Cincinnati, Ohio, and anticipates more than 250,000 visitors per year (Answers in Genesis [AiG], 2006). According to the AiG Web site, the group conducts over 400 meetings each year reaching more than 100,000 people, while its radio program is heard on about 800 U.S. stations (Ham, 2006).

While YEC proponents adapt science to conform to a strict literal reading of Genesis, Progressive Creationism (PC) accommodates modern theories of cosmology and geology to fit a mostly literal interpretation of Genesis (Scott, 2004). Contrary to YEC's insistence that all living things were created during a short period of time, progressive creationists argue that God created organisms from simple to complex in multiple acts of special creation over eons of time in agreement with the geological column. These innumerable creation miracles were followed by the laws of nature such as variation within species to account for the present diversity today (Bradley, 1984). Reasons to Believe, a leading PC group, states, "God has miraculously intervened throughout the history of the universe in various ways[.] millions, possibly even

billions, of times to create each and every new species of life on Earth” (Reasons to Believe, n.d.).

Although Young Earth and Progressive creationists differ in the nuances of their “scientific” theories, they commonly accept microevolutionary processes such as natural selection, mutation, and genetic drift at the level of species (Wright, 2003). That is, microevolution as natural selection operating at the level of pesticide resistance and bacterial antibiotic resistance is plausible within the creationist framework (Gregg, Janssen, & Bhattacharjee, 2003). Some scientists describe the relatively complex process of macroevolution as evolution above the species level that involves large-scale analysis of lineage, morphology, rates of change and extinction (Scott, 2004).

Creationists posit that major groups of living things, including phyla and classes that are the upper taxonomic levels, could not have evolved through macroevolution but are specially created (Scott, 2004). John D. Morris of the Institute for Creation Research argues that microevolution as small “horizontal changes” is observed. But large “vertical changes” known as macroevolution have never been observed (J. D. Morris, 1996). Morris concludes that the classic examples of evolution, such as changes in the beak sizes of finches, the color of peppered moths, and germ resistance in no way support the emergence of new “types.” While limited speciation “within kinds” is tenable, creationists reject evolution as descent with modification from a common ancestor (Sarfati, 1999). However, Wright (2003) correctly observes that the microevolution and macroevolution distinction is made “for religious reasons rather than scientific ones” and “if macroevolution is rejected, there is nothing within science to erect in its place as a paradigm for explaining the data that have accumulated over the years in so many subdisciplines” (p. 131).

Intelligent Design (ID) is a relatively recent form of creationism that gained widespread appeal in the United States during the early 1990s with the publication of Phillip E. Johnson's *Darwin on Trial* in 1991 (Baker, 2006). Johnson, a retired faculty member and dean of UC Berkley's Law School, characterizes modern evolution as driven by a materialistic philosophy and charges evolution education is a "campaign of indoctrination in the public schools" (P. E. Johnson, 1991, p. 144). *Darwin on Trial* set the stage on which two concepts emerged to become the intellectual arguments of intelligent design: irreducible complexity and design inference (Scott, 2004).

Michael Behe, biochemist and a leading ID scientist, argues in *Darwin's Black Box* (1996) that cellular structures such as the bacterial flagellum and mechanisms such as the vertebrate blood clotting system are irreducibly complex. That is, these structures could not have evolved by natural mechanisms in incremental stages because the component parts must be simultaneously present in order for the structure to function. Behe, in contrast to Young Earth and Progressive Creationists, does not deny evolution as descent with modification from a common ancestor. Instead, Behe insists on evidence of intelligent design in the creation of irreducibly complex systems.

William Dembski, a prominent ID mathematician and philosopher, claims that certain phenomena in nature are such low-probability events that they can only be credited to an intelligent designer (Dembski, 1998). Although creationists have long used probability arguments to discredit evolution, Dembski's theory is mathematically more sophisticated (Scott, 2004). To infer design, Dembski uses a "filter" that serves as an elimination algorithm. Causes behind common phenomena are accounted for by natural law. Phenomena that are not accounted for by natural law but are associated with an intermediate probability may be attributed to chance

events. However, low-probability specified complex information that is not due to natural law or chance must be credited to intelligent design. Scott (2004) interprets Dembski's filter to claim, "Something is explained by design when it is *not* explained by law or chance [emphasis in original]" (pp. 121-122). But as Scott points out, the design inference allows for false positives when information is missing or not yet known.

Since modern creationism has diversified into Young Earth, Progressive and Intelligent Design creationism, a relevant question is: "How united are these groups?" B. J. Alters and S. M. Alters (2001) report that leaders from the YEC and PC camps have long-running arguments in print that assail the other's positions. ID proponents generally ascribe to either the Young Earth or Progressive tradition (Scott, 2004). Yet, the YEC group Answers in Genesis faults the Intelligent Design movement for failing to provide a historical "story of the past" and for avoiding identification of a designer (Wieland, 2002; see also Ross, 2002 for a similar Progressive Creationism view). Still, Intelligent Design has represented a unifying movement for many creationists, as ID does not require one to accept a strict doctrine about biblical literalism or the age of the earth (Baker, 2006).

Creationists agree that evolution is inherently anti-religious, and uniformly allege that evolution is an atheistic religion (e.g., H. M. Morris, 2001) and anti-God philosophy that is destroying America (e.g., Ham, 1987). Creationists gain much of their ammunition from scientists and philosophers who espouse materialistic naturalism in popular literature. Identifying modern science with atheism, creationists often refer to noted astronomer Carl Sagan's famous dictum that "The Cosmos is all there is, ever was, or ever will be" (Sagan, 1985, p. 1). Philosopher Daniel Dennett asserts that Darwinism is a "universal acid; it eats through just about every traditional concept [including religion]" (Dennett, 1995, p. 63). Biologist Richard Dawkins

(2006) also uses science to oppose religion. Even science educators join the fray. Addressing the evolution debate in the classroom, Good (2003) writes, “When young children are indoctrinated into believing that for which there is no evidence (God, Heaven, Hell, etc.), a habit of mind is being developed that is inconsistent with the open, inquiring mind needed for scientific study” (p. 515). Larson (2003) observes that “gifted polemicists,” including Dennett and Dawkins, would have generated public controversy in the late twentieth century even if the biblical creationists had not done so. Not surprisingly, Intelligent Design creationists such as Philip E. Johnson speak of using a “wedge strategy” to split open the scientific materialism “log” of evolution (P. E. Johnson, 1997, p. 93).

Intelligent Design proponents present their theories as “scientific alternatives to evolution” in the same manner Young Earth Creationists and Progressive Creationists advance the terms “scientific creationism” or “creation science” (Scott, 2004). However, the lack of peer-reviewed research and the absence of a theory with predictive or explanatory power, much less a mechanism to explain the diversity of species, have led scientists and educators to denounce intelligent design as non-scientific (Berman, 2003; Scharmann, 2003; Staver, 2003). Biologists have used scientific evidence to invalidate Behe’s claims (K. R. Miller, 1999; Pallen & Matzke, 2006). Others have criticized Dembski’s work for a lack of scientific merit (Fitelson, Stephens, & Sober 1999; Shallit & Elsberry, 2005).

Regardless of pervasive scientific criticism of their ideas, in the last decade creationists have sought to influence the science curriculum in public education. Rather than impose an explicit form of creationism, creationists have utilized Intelligent Design strategies in an attempt to undermine the scientific veracity of evolution as manifested in two recent court cases. One

such strategy is “play upon common usage of the word ‘theory’ to mean ‘hunch’ or ‘educated guess’” to demote the theory of biological evolution (Baker, 2006, p. 163).

In March of 2002, the Cobb County Board of Education in Georgia approved the placement of a sticker on the front cover of the high school biology textbook, *Biology* (K. R. Miller & Levine, 2002). The 1,100-page textbook contained a major 101-page unit on evolution. The sticker read, “This textbook contains material on evolution. Evolution is a theory, not a fact, regarding the origin of living things. This material should be approached with an open mind, studied carefully, and critically considered” (*Selman v. Cobb Country School District*, 2005, p. 13). On January 13, 2005, District Judge Clarence Cooper ordered the removal of the stickers from the 34,000 textbooks, citing that the Cobb County Board of Education violated the Establishment Clause of the First Amendment. Cooper wrote that an “informed, reasonable observer would understand the School Board to be endorsing the viewpoint of Christian fundamentalists and creationists that evolution is a problematic theory lacking an adequate foundation” (*Selman v. Cobb County School District*, 2005, p. 33). Four days later, on January 17, 2005, the School Board voted to appeal the ruling to the Eleventh US District Court of Appeals. On May 25, 2006, a three-judge panel of the federal court vacated the district court’s ruling and remanded the case back to trial court for further evidential review. However, the Cobb County Board of Education signed a settlement on December 19, 2006 and agreed not to hinder the teaching of evolution in the school district. (National Center for Science Education, 2006).

In another recent case, Intelligent Design proponents directly influenced a Dover, Pennsylvania school board to alter the high school biology curriculum to teach the “controversy” of evolution and suggest Intelligent Design as an alternative scientific theory. In October of 2004, the Dover Board of Education, under advice from the ID-oriented Discovery Institute,

added a resolution to its biology curriculum that stated students should be made aware of gaps and problems in Darwin's theory. In addition, students should also be introduced to "other theories of evolution including, but not limited to, intelligent design" (*Kitzmiller v. Dover Area School District*, 2005, p. 1). The school board announced in January of 2005 that teachers would be required to read a statement to ninth grade biology classes that Intelligent Design was an alternate explanation of the origin of life and the book *Pandas and People* (Davis & Kenyon, 1993) was available on reference in the library. Tammy Kitzmiller, a parent of a ninth grade student, filed a lawsuit challenging the constitutionality of the board's 2005 decision as a violation of the Establishment Clause in the First Amendment of the U.S. Constitution.

The case was tried in court from September to November of 2005. On December 20, 2005, Judge John Jones ruled that ID is "nothing less than the progeny of creationism" (*Kitzmiller v. Dover Area School District*, 2005, p. 31). Judge Jones also found that an older edition of *Pandas and People* had been revised following *Edwards v. Aguillard* (1987) to cloak classical creationism with the newer ideas of Intelligent Design. In addition, Judge Jones wrote that ID is grounded in theology, not science, and that irreducible complexity has no scientific merit, as it "has been refuted in peer-reviewed research papers and has been rejected by the scientific community at large" (p. 79). Though only setting a local precedent, the decisive ruling in *Kitzmiller v. Dover Area School District* case may discourage other school districts from adopting ID curricula in the future (Scott & Matzke, 2007).

Intelligent Design advocates have also sought to influence educational agencies at the state level. The Kansas State Board of Education has been a recurrent locus for creationist activism in public education. In 1999, the Kansas State Board of Education stripped cosmological, geological and biological evolution from the state science standards. In 2001, a

newly elected Board restored cosmological, geological and biological evolution to the state science standards. However, in November of 2005, the Kansas State Board of Education by a vote of 6 to 4 adopted a new set of science standards that called into question the veracity of biological evolution. While the Kansas State Board of Education claimed the “Science Curriculum Standards do not include Intelligent Design” (Kansas State Board of Education [KSBE], 2005, p. ii), the Standards contained ID language such as, “Whether microevolution (change within a species) can be extrapolated to explain macroevolutionary changes (such as new complex organs or body plans and new biochemical systems which appear irreducibly complex) is controversial” (p. 76), and asked students to explain scientific criticisms of biological evolution. Krebs (2006) argued that the Standards allowed inclusion of supernatural causes by changing the previous definition of science as the “human activity for seeking natural explanations” (KSBE, 2001, p. 4) to science as a systematic method that leads to “more adequate explanations of natural phenomena” (KSBE, 2005, p. ix). The replacement of the modifier “natural” with “adequate” was a subtle but telling indication of ID proponents’ influence on the Standards.

Amid the public controversy over the standards, two creationist members were voted off the Kansas State Board of Education Board in the November election of 2006 and replaced by two pro-evolution members. On February 13, 2007 the Kansas School Board approved a set of science standards “in which evolution is treated in a scientifically appropriate and pedagogically responsible way” (National Center for Science Education, 2006, ¶ 1). The vote represented the fourth time the Board had revised the state science standards over evolution in eight years.

Larson (2003) notes that a common creationist tactic since *Edwards v. Aguillard* (1987) is to use “academic freedom” as a pretext for teaching alternatives to biological evolution. For

example, the Oklahoma House of Representatives in 2006 considered the Academic Freedom Act (2006), or House Bill 2107, that stated,

Every public school teacher in the State of Oklahoma, shall have the affirmative right and freedom to present scientific information pertaining to the full range of scientific views in any curricula or course of learning. . . .The rights and privileges contained in the Academic Freedom Act apply when topics are taught that may generate controversy, such as biological or chemical origins of life.”

And finally, as if to suppress any protest over its intent, the Bill added, “Nothing in this act shall be construed as promoting . . . discrimination for or against religion or nonreligion.”

On March 2, 2006, the Republican-controlled Oklahoma House of Representatives passed House Bill 2107 by a vote of 77 – 10. However, the approved Bill generated considerable controversy in the public. Responding to the criticism, Sally Kern, Republican state representative and author of House Bill 2107, defended it in an opinion piece in *The Daily Oklahoman*: “Today Darwin’s theory of evolution is often taught as fact and no distinction is made between macro- and micro-evolution. However, leading evolutionists see weaknesses in Darwin’s theory and have published their critiques in leading scientific journals” (Kern, 2006). House Bill 2107 never reached the floor of the Democratic-controlled Oklahoma Senate, which adjourned in May 2006. Consequently, House Bill 2107 is defunct.

In summary, the creationism movement has sought to offer a “scientific” alternative to evolution since the 1960s. Proponents from these groups espouse a scientific rationale for their arguments while simultaneously disparaging the credibility of evolution. Creationists decry the moral and social implications of evolution and denounce the materialistic naturalism that is vocalized by many scientists and philosophers. Creationism groups are well-financed and

actively promote their views in written publications and radio and television broadcasts. Their influence has extended beyond the church into state and school boards of education, resulting in numerous lawsuits that have consistently upheld the legality of evolution education and the unconstitutionality of religious creationism in the science classroom.

The previous discussion has focused primarily on highly publicized creationist attempts to influence science education in public schools. Less well known is the effect that creationism has had within the Evangelical church (Larson, 2003). The research site for this study was at a Christian university associated with a church denomination. The following section explores the influence of creationism within the study site denomination.

#### The Influence of Creationism on the Study Site Denomination

In the century since its inception in 1908, the study site denomination has grown to an international membership of 1,496,296 persons (Manual, 2005, p. 26). In 2007, the United States church membership was 642,000, as stated on the denomination's Web site. The denomination continues to be aligned with Evangelicalism (Manual, 2005).

The influence of creationism on the denomination is difficult to assess. Although the denomination has an official statement on creation, the actualization of the denomination's position within individual churches is often a local affair. In this section, a description of creationism within the study site denomination is provided through three lines of evidence: the general influence of creationism on Evangelicalism; a few published theological journal articles; and related circumstantial events that have received national attention.

As discussed in the section on early twentieth century American fundamentalism, the study site denomination was founded during a period in which many Protestant churches were struggling with the rise of modernity in American culture. The denomination's General

Assembly in 1928 avoided a strict, literalist stance on the inerrancy of the Bible and approved a statement asserting a belief in the “plenary inspiration of the Holy Scripture, . . . inerrantly revealing the will of God concerning us in all things necessary to our salvation.” This statement remains in the denomination manual (Manual, 2005, p. 31). It is difficult to assess the extent of fundamentalism in the early denomination (Ingersol, 2005). Some early church leaders described themselves as fundamentalists and insisted on a literal interpretation of the scriptures. However, other denomination theologians and church leaders were open-minded with respect to scientific theories on origins.

Noll (1994) has observed that fundamentalism and creationism are inextricably linked and states that the “mentality of fundamentalism lives on in modern creation science, even if some of the early fundamentalists themselves were by no means as radical in their scientific conclusions as Evangelicals have become in the last forty years” (pp. 188-189). Noll laments that creationism has profoundly damaged modern Evangelicals’ ability to reflectively look at the world. The fundamentalists’ simplistic Baconian approach to interpreting the Bible has carried over into science where there can be no speculation without direct empirical evidence. Noll claims that creationists “seek to convince their audience that they are merely contemplating simple conclusions from the Bible, when they are really contemplating conclusions from the Bible shaped by their preunderstandings of how the Bible should be read” (p. 189). This type of fundamentalist thinking leads to a Manichaean view of the world, an all or nothing, sectarian approach to politics, science and the Bible (Ingersol, 2005). The fundamentalist tendency for Christians is to self-impose dualism: either God-ordained creationism or God-less evolution (Wright, 2003). For the uncritical Christian, the choice is straightforward.

Ingersol (2005), writing specifically about the study site denomination, is wary of creationists' bid to ask the church to "reject the perspectives of their own denomination's first generation of theologians and accept an obscurantism that is neither native to it nor wise" (p. 141). In 2000, a randomized survey of the denomination's clergy determined that 93.1% opposed evolutionary theory and 83.4% agreed that "scientific creationism" should be taught in biology classes if the theory of evolution is taught (Beail & Crow, 2004). Clearly, many of the denomination's clergy either don't understand or dissociate themselves with the sequence of U.S. Supreme Court rulings, including *Edwards v. Aguillard* (1987).

The high percentage of denominational clergy opposing evolution is remarkable considering the denomination officially takes a more open view towards evolution. In the "Current Moral and Social Issues" chapter of the denomination's 2005-2009 manual, a statement on "Creation" reads,

The Church . . . believes in the biblical account of creation. . . . We oppose any godless interpretation of the origin of the universe and of humankind. However, the church accepts as valid all scientifically verifiable discoveries in geology and other natural phenomena, for we firmly believe that God is the Creator (p. 371).

The denomination manual is "authoritative as a guide for action" (Manual, 2005, p. 8). However, creationists within local congregations may be unaware of the Manual's statement on creation. Some creationists may interpret the Manual's statement as favoring their own particular viewpoint. As discussed earlier, creationists decry evolution as an anti-religious, "godless" scientific interpretation. Creationists are also prone to setting their own criteria for defining what constitutes "scientifically verifiable discoveries." In other words, while the denomination manual

statement appears accommodating towards evolution as a God-ordained mechanism for creation, the statement does not categorically disavow creationism (Oord, 2006).

Dr. Jim Bond, General Superintendent of the denomination in 2001, commented on the freedom allowed within the manual statement on creation:

The fact is we do not draw a line in the sand and demand adherence to any one view. . . .

As a General Superintendent, I am guided by the Manual and pledged to uphold it.

Therefore, I reject the Fundamentalist's dogmatism regarding its view of creation but within the boundaries of our Manual, I also defend . . . [the] right to view creation as having occurred within a seven day period of 24 hour days in the same way that I defend those who believe that "scientifically, verifiable discoveries . . ." compel them to believe in "gradual creation" (Bond, 2001, pp. 6 - 7).

While affirming a tolerance for "differences in non-essential matters," such as creation views, Bond however observed, "Fundamentalism has insidiously crept into the mainstream of our denomination. I fear that many of our people, even including our pastors, are more fundamentalist than they realize" (Bond, 2001, p. 7). Bond calls for more scholarly research from denomination university educators in key areas, including a better understanding of creationism and evolution issues within the denomination. This study may help in that regard.

While many of the science departments at the denomination's seven universities teach evolutionary theory, there is no mandate for or against teaching creationism. Georgia Purdom, a Ph.D. molecular geneticist, taught biology at one of the denominational university for six years until becoming a full-time researcher for Answers in Genesis in 2006 (AiG, 2007; Purdom, 2006). On the other hand, science professors at three denomination universities have written

books in support of evolution as a God-ordained mechanism for creation (Colling, 2004; Falk, 2004; Giberson, 1993; Giberson & Yerxa, 2002).

In particular, Richard Colling, a Ph.D. microbiologist at a denominational university in Illinois, self-published a book in 2004 entitled, *Random Designer: Created from Chaos to Connect with the Creator*. Colling defines random design as “a powerful method for creating higher order, particular in living beings. It functions by generating large arrays of potential building blocks from which the most suitable candidates are sequentially incorporated into an ever-advancing architectural design” (p. 1). Positing God as the designer who creates through random processes, including evolution, Colling’s intent is for “*science and faith to embrace and find common ground* [italics in original]” (p. 20).

In the Fall semester of 2007, the university president prohibited Colling from teaching the general biology class as reported in the national magazine *Newsweek* (Begley, 2007). Colling had taught general biology courses at the university since 1991. Additionally, the university president prohibited *Random Designer* from use in other university courses. A local denominational church apparently had threatened to withdraw financial support from the university and parents and pastors had complained to the university president.

In summary, the denomination’s stance on creation is to affirm God’s role as the Creator and to accept scientific theories based on verifiable evidence. Therefore, the denomination’s position implicitly allows an acceptance of “gradual creation,” the theistic interpretation of evolution. Still, the denomination’s official statement does not explicitly support or deny creationism. Denomination leaders affirm that church members have the freedom to believe in theistic evolution or creationism. However, studies show that most denomination clergy reject evolution and support the teaching of creationism in public education. Controversy has erupted at

one of the denomination's universities where a biology professor has come under fire for teaching and writing in support of theistic evolution. Church leaders have expressed the need for a better understanding of creationism and evolution issues within the denomination. This study lends insight into how biology-related majors at one of the denomination universities seek to find reconciliation between their understanding of evolution and their personal religious beliefs.

### Belief, Understanding and Acceptance of Evolution

Science education research literature contains several interventions to help students achieve an understanding of evolutionary theory. The conceptual change model uses a constructivist approach to recognize that the learning of new concepts hinges upon or may be impeded by students' existing conceptions (Wandersee, Mintzes, & Novak, 1994). Numerous conceptual change studies identify the contents and structure of students' existing conceptions and suggest methods to foster change in the students' conceptions (Bishop & Anderson, 1990; Demastes, Settlage, & Good, 1995; Hallden, 1988).

More recently, science educators have focused on teaching the nature of science to promote an acceptance of evolutionary theory (Backhus, 2002; Bybee, 2004; Dagher & BouJaoude, 1997; National Academy of Sciences [NAS], 1998). Providing students with an understanding of the nature of science allows them to demarcate the bounds and distinguish between knowledge claims made by science and religion. However, M. U. Smith and Scharmann (1999) argue that instruction should center on assisting students to use descriptors to judge the merits of knowledge claims, rather than imposing a set of rules that dichotomize science and non-science (i.e., religion).

A thorough understanding of the nature of science and conceptual change is an important component in learning evolution. A critical question follows: "What is the goal for evolution

instruction?” There is not yet consensus on the answer to this question in the literature. Three terms are found most often that articulate the goal of evolution instruction: belief, understanding, and acceptance. In the context of this study, the appropriate usage of these words is an important topic in investigating Christian university biology-related majors’ perceived conflicts between evolution and personal religious beliefs.

A number of studies focus on investigating the factors that affect students’ belief in evolution, as if belief is the goal of instruction (e.g., Bishop & Anderson, 1990; Lord & Marino, 1993). For instance, McKeachie, Lin, and Strayer (2002) asked, “How does a biology course affect student beliefs about evolution?” (p. 189). Meadows et al. (2000) studied how teachers dealt with their perceived dissonance between two beliefs systems: religious beliefs and beliefs about evolution.

Lawson and Worsnop (1992) studied high school biology students’ acquisition of scientific beliefs and the rejection of nonscientific beliefs, including special creation and related religiously-inspired beliefs. The researchers created a 17-item questionnaire to assess students’ beliefs. According to the pre- and post-test mean scores, instruction had no overall effect on the creationist students’ beliefs. In the study, 49.5% of students agreed with the statement, “All living things were created during a short period of time by an act of God” in the pre-test. That percentage dropped an insignificant amount to 47% after instruction. Students’ reasoning skills were also measured as part of the study. Reflective students were less likely to be committed to non-scientific beliefs, while intuitive students were most likely to agree with creationist statements. Lawson and Worsnop posit that the creationist students lack the hypothetico-deductive reasoning abilities needed to evaluate hypothesized alternatives that help change

beliefs towards evolution. In other words, a sophisticated level of rationality is required to believe evolution.

Cobern (1994) argues that the primary goal of teaching evolutionary concepts is the understanding of evolution rather than a belief in evolution. However, Cobern stresses that belief should be “allowed a legitimate role in the science classroom” (p. 588) as personal beliefs can impede an understanding of evolution. Meadows et al. (2000) similarly contend that persons whose religious beliefs are in apparent conflict with evolution may actively resist learning about evolution. Meadows et al. state, “These students do not fail to learn about evolution as teachers often think; instead, they actively choose not to learn about evolution” (p. 106).

Cobern (1994) associates belief with knowing, defined as the process by which one comes to accept a concept as true or valid. M. U. Smith (1994) contends that Cobern’s view of knowing is misguided in equating the acceptance of a concept with believing that is so. Smith agrees that students’ beliefs can significantly impact their learning of evolution, but writes, “The genuine scientist is bound by the rules of evidence and judges the validity of various claims on the basis of empirical evidence, not on the basis of his personal convictions, opinions, and beliefs” (p. 594). Scharmann (2005) also argues that the goal for biology education is not to make students believe in evolution. Rather, the goal is for students to “*understand* evolutionary theory to be the most powerful contemporary problem-solving tool at the disposal of the biologist [italics in original]” (p. 13). The goal for science education is neither to believe in evolution nor to reject creationism (M. U. Smith & Scharmann, 1999).

If belief in evolution is not the primary goal in education, what then is the importance of and relation between acceptance and understanding? A study of an undergraduate non-majors biology class showed that there is no relation between students’ knowledge of evolution and their

reported acceptance of it (Sinatra, Southerland, McConaughy, & Demastes, 2003). Bishop and Anderson (1990) found that an improvement in college students' understanding of evolution "did not generally change their convictions about the truthfulness of the theory" (p. 426). Dagher and BouJaoude (1997) cite evidence that a good understanding does not necessarily lead to an acceptance of evolution when religious beliefs interfere. In a study by Lord and Marino (1993), most of the three-quarters of the college students who said they thought evolution was true did not have an understanding of the mechanism behind it. Summarizing these studies, understanding does not necessarily lead to an acceptance of evolution, nor is understanding a prerequisite to accepting evolution.

In a study of university students in an upper-level evolution course, Ingram and Nelson (2006) sought to increase both an understanding and acceptance of evolutionary theory. Acceptance was equated with attitude as measured by a survey, and understanding was equated with achievement as determined by a course grade. The study found that although constructivist instruction significantly increased acceptance of evolution, the acceptance or rejection of evolution did not have a significant influence on achievement or understanding. Ingram and Nelson maintain that understanding enables but does not require an acceptance of evolution. Therefore "understanding evolution is more important than accepting evolution," and teachers should ask students to "strive for understanding prior to making decisions regarding acceptance of any theory" (Ingram & Nelson, 2006, p. 20).

A recapitulation of these studies shows mixed conclusions. Some studies find no relation between acceptance and understanding (e.g., Sinatra et al., 2003). Ingram and Nelson (2006) posit that understanding facilitates acceptance while Lawson and Worsnop (1992) claim that

advanced reasoning skills are central to a belief in evolution. Many studies recognize that beliefs impede an understanding of evolution (e.g., Meadows et al., 2000).

The National Academy of Science recently released *Science, Evolution, and Creationism*, the third edition of a publication that addresses science and religion (NAS, 2008). The book contains a section entitled, “Isn’t belief in evolution also a matter of faith?” Within that section, the NAS states, “*Acceptance* of evolution is not the same as a religious *belief* [italics in original]. . . Evolution is accepted within the scientific community because the concept has withstood extensive testing by many thousands of scientists for more than a century” (p. 49). As noted earlier, M. U. Smith and Scharmann (1999) argue that the primary goal of evolution instruction is an understanding of evolution, not a belief in evolution. Scientists do not believe in evolution – they accept it as a theory, the best explanation available in accordance with a systematic evaluation of the evidence (M. U. Smith, 1994). Ethically, instruction should enable students to understand a theory prior to an acceptance or rejection of that theory. Therefore, a secondary goal is acceptance, judging evolution to be valid and true based on a thorough understanding of evolutionary evidence and theory (Ingram & Nelson, 2006) and evolution’s usefulness as a diagnostic, problem-solving tool (Scharmann, 2005).

Nonscientific beliefs can interfere with an understanding of evolution (Dagher & BouJaoude, 1997; Meadows et al., 2000) and should be addressed in a supportive, non-threatening, constructivist manner in the classroom (Coborn, 1994; Scharmann, 2005), especially in religious education. An acceptance of evolution should not come at the expense of religious belief, but through reconciliation of perceived conflicts (Colburn & Henriques, 2006; Dutch, 2002; Meadows et al., 2002). Appropriate teaching methods include: directly addressing the cultural and religious concerns of evolution at the outset of an evolution unit (M. U. Smith,

1994); promoting peer discussion to ameliorate negative emotional reactions (Scharmann, 1990); encouraging students to examine personal beliefs and attitudes in light of evolutionary evidence (Ingram & Nelson; 2006); and providing nature of science learning opportunities to allow students to judge the relative merits of knowledge claims (M. U. Smith & Scharmann, 1999; see also Scharmann, M. U. Smith, James, & Jensen, 2005).

With the exception of a relatively few studies (e.g., Lawson & Worsnop, 1992) that minimize the importance of religious belief in relation to reasoning ability, the preponderance of studies recognize the importance of attitudes, values and beliefs in affecting students' understanding and acceptance of evolutionary theory. Sinatra et al. (2003) state that researchers are beginning to acknowledge the role of the affective in addition to the cognitive in stimulating conceptual change. Dagher and BouJaoude (1997) argue that rationality is not the only factor in students' synthesis of evolutionary theory. Prior ideas, beliefs, values and emotions form a set of interpretive categories through which new knowledge is incorporated.

Coborn (1994) highlights the importance of the worldview that appropriates meaning according to "culturally dependent presuppositions or assumptions about what the world is ultimately like and what constitutes first causes" (p. 587). The interpretive worldview "predisposes one to feel, think, and act in predictable patterns" (Coborn, 1991, p. 19). Recognition of the importance of affect and a structured worldview by which predictable patterns emerge are critical aspects of Fowler's stages of faith (Fowler, 1981) and Parks' model of young adult faith (Parks, 1986). This study utilized faith development theory as a useful means to investigate Christian university biology-related majors' perceived conflicts between their understanding of evolution and their personal religious beliefs.

## Evolution and Personal Religious Beliefs

The perceived relationship between science and personal religious beliefs has important ramifications as to whether a Christian biology-related major will accept the theory of evolution. Several science educators refer to scientific theory and religious belief as distinct tools that are not in competition (M. U. Smith & Scharmann, 1999). Staver (2003) writes that teachers should help students understand “that using the tools of science does not require the rejection of existing tools such as personal religious beliefs” (p. 35). Some scientists, philosophers, and theologians similarly argue that science and religious belief operate in exclusive realms (Edis, 2004; Singham, 2000) or “nonoverlapping magisteria” (Gould, 1997).

The National Academy of Sciences in a 1984 publication on science and religion supported a “two worlds” model, stating, “Religion and science are separate and mutually exclusive realms of human thought whose presentation in the same context leads to misunderstanding of both scientific theory and religious belief” (NAS, 1984, p. 6). Nord (1999) claims this “independence” position is the orthodox view of science education, allowing science and religion to be compartmentalized and non-conflicting. In 1999, the second edition of the NAS publication on science and creationism stated, “Science and religion occupy two separate realms of human experience. Demanding that they be combined detracts from the glory of each” (NAS, 1999, p. 10). The recent 2008 third edition states, “science and religion are separate and address aspects of human understanding in different ways. Attempts to pit science and religion against each other create controversy where none needs to exist” (p. 12). Each succeeding NAS edition takes a less confrontational approach between science and religion while affirming the distinctions between the two ways of knowing. Regardless of the independent and compatible

model of science and religion, research documents that many Christian fundamentalists perceive an inherent conflict with evolution (Good, 2003; Ingersol, 2005; Noll, 1994; Stokes, 1989).

Meadows et al. (2000) found four categories in which Christian teachers approached the conflict. In the first two categories, teachers unintentionally or intentionally compartmentalized their religious beliefs from evolution and comfortably engaged in learning evolutionary concepts. In a third category, teachers were emotionally troubled by the conflict and reflexively questioned their own religious views. Their beliefs about religion and beliefs about evolution were more convergent than the first two groups. The fourth category of teachers “managed” the conflict, moving back and forth between the two systems of beliefs. For these teachers, the gap between beliefs about religion and evolution narrowed but did not disappear.

Maintaining a “peaceful coexistence” through unintentional or intentional compartmentalization of religion and science is not the goal of Christian universities (Holmes, 1987). Poe (2004) writes that the end result of such action is “internal conflict and cognitive dissonance for the person [Christian student] who attempts to compartmentalize life” (p. 39).

Christian liberal arts institutions seek integration between religious beliefs and learning (Holmes, 1987; Poe, 2004). Poe writes that Christian liberal arts colleges consider “the religious and academic programs as parts of a whole that should not be separated. Their approach to education is grounded in a Christian worldview that examines subject matter from a [religious] faith perspective” (p. 39). Hasker (1992) posits that there is a “single reality, all of which is created by God” (p. 236). Therefore, “one is not confronted with the task of ‘integrating’ two or more or less separate and disjoint bodies of knowledge and belief; rather, there is a unitary vision of truth” (pp. 236-237). Still, Hasker acknowledges diversity in ways of knowing: science as an empirically driven discipline; and theology as a response to God’s revelation. Holmes (1987)

claims that all truth is God's truth and "in the final analysis there will be no conflict between the truth taught in Scripture and truth available from other sources [e.g., science]" (p. 18). Holmes argues for a constructive dialog, an interaction between religious beliefs and learning similar to what occurs in the narrowing-the-gap category in the religion-evolution interaction as demonstrated in the Meadows et al. (2000) study.

A poignant example of religious beliefs interacting with science is found in Ebenezer's (1996) study of Christian preservice teachers' responses to constructivism in a curriculum and instruction course. The following quotation is from a study participant:

When it comes to religious beliefs, there are things [truths] that are not negotiable. . . .

And understanding those truths and accepting them have eternal consequences and eternal value, whereas in scientific circles when you are talking about understanding the properties of matter we come to some social negotiation about it. It doesn't really matter if you negotiate it wrong. It doesn't have eternal consequences (p. 444).

Clearly, the preservice teacher's personal composition of what is of ultimate importance, that is religious truths, superseded scientific legitimacy. In contrast, Holmes (1987) stresses that the challenge for Christian higher education is to help students develop a faith responsive not only to spiritual belief but also to evidence and arguments from other ways of knowing, including science (see also Poe, 2004).

In summary, while some scientists, philosophers, and theologians argue for a mutually exclusive and non-interactive approach to science and religion, many Christian educators recognize the importance of finding ways in which science and religion positively interact to form a coherent Christian worldview. Meadows et al. (2000) show that some Christians who initially find evolution and their personal religious beliefs in conflict seek to reduce the

dissonance between the two. This study investigated the nuances of how Christian biology-related majors at a Christian university reconciled their understanding of evolution and their personal beliefs. Additionally, this study explored how faith, the personal system of discerning what is right and of ultimate importance, is integral to the reconciliation process.

### Faith Development Theory

This researcher hypothesized that faith as a system of composing and making meaning of the world plays a key role in how Christian biology-related majors accommodate evolutionary theory. Parks' model of young adult faith (1986) served as the primary tool with which to understand Christian university students' faith in this study. Since Parks' model is substantially predicated on Fowler's theory of faith development (1981), Fowler's theory is described below. Parks' model is described in the next section.

In his 1981 seminal book entitled *Stages of Faith: The Psychology of Human Development and the Quest for Meaning*, James Fowler formulated a structural-developmental theory of faith to describe the cognitive rationale and affective response in shaping one's world. In *Stages of Faith* and subsequent writings, Fowler broadly defines faith:

Faith has to do with the making, maintenance, and transformation of human meaning. It is the mode of knowing and being. In faith, we shape our lives in relation to more or less comprehensive convictions or assumptions about reality. Faith composes a felt sense of the world as having character, pattern and unity. In the midst of the many powers and demands pressing upon us, enlarging and diminishing us, it orients us toward centers of power and value which promise to sustain our lives (Fowler, 1986, p. 15).

Faith is a universal phenomenon, regardless of any religious affiliation, that all humans possess whether or not they aware of it. Parks (1986) writes, “To be human is to dwell in faith, to dwell in one’s meaning – one’s conviction of the ultimate character of truth, of self, of world . . . whether that meaning be strong or fragile, expressed in religious terms or secular” (p. xv). From this perspective, W. C. Smith (1979) argues that only a faith-less person would love no one, care for nothing, see no beauty, and have no joy or hope. Fowler (1986) acknowledges that faith is expressed in the symbols, rituals and beliefs of particular religious traditions.

Fowler was inspired by the structural-developmental theories of Piaget and Kohlberg and psychosocial theories of Erickson to operationalize six stages of faith (and an additional “undifferentiated” pre-stage in infancy). He recognized in their work the power to formally describe “predictable changes in human thought and adaptation” (Fowler, 1981, p. 89). Fowler also observed crisis and dissonance as critical experiences that accompany stage transitions. Fowler’s faith stages are therefore strongly linked to Piaget’s cognitive development stages, Kohlberg’s moral development framework, and Erickson’s eras that focus on the search for identity.

Fowler acknowledges a fundamental difference between his work and the progenitors of his structural-developmental ideas. Faith cannot be reduced to either cognitive or moral stages or a mixture of the two. Faith development theory, as distinguished from Piaget and Kohlberg, incorporates affect as an emotional dimension of knowing. Fowler (1986) writes that faith is a “knowing which involves both reason and feeling; both rationality and passionality” (p. 21).

Using the interview protocol described in *Stages of Faith* (Fowler, 1981), Fowler and a group of graduate students of theology and developmental psychology at Harvard in the 1970s interviewed 359 subjects from age 4 to subjects in their early 80s. Roughly half of the

participants in Fowler's study were female. In the same way Piaget and Kohlberg relied on cognitive problems and moral dilemmas, respectively, Fowler relied on persons' expressions of experience and interpretations of life challenges to construct his theory of faith development. The following is a brief description of the six main stages as described in *Stages of Faith*.

Stage 1, intuitive-projective, occurs from ages 3 to 7 when children's faith is fantasy-filled and impressionable, unrestrained by logic. Towards the end of this stage, children become self-aware but are egocentric to others' perspectives. Eventually, children begin to develop a personal basis for differentiating what is real from what is imagined.

Stage 2, mythic-literal, occurs with the rise of concrete operational thinking. Children begin to order their world, uncritically assimilating the beliefs and rules of the community. With an increased understanding of other's perspectives, children's notions of fairness and morality are based on reciprocity. Towards the end of this stage, the rise of formal operational reasoning enables children to reflect on the emerging contradictions of simplistic morality and literal thinking.

Stage 3, synthetic-conventional, is typical of adolescents with their "conformist" identity and heavy reliance on interpersonal relationships. As one's world enlarges to encompass new demands from school or work, the Stage 3 person's sense of identity is tuned to the expectations and judgments of significant others. Authority is external, lying in the consensus of those significant others and in the authority figures and symbols that represent the traditions by which the person has found value and meaning. To summarize, Stage 3 persons accept the conventions of group and societal norms without critical analysis. Although beliefs and life-guiding values are deeply felt, their structure is tacitly held without conscious analysis. Many adults remain fixed in the synthetic-conventional stage for life.

Stage 4, individuative-reflective, occurs as a person critically reflects on his or her personal identity and beliefs. Through a personal crisis or a clash of authority figures and symbols, the tacit assumptive values system gives way to the explicit through reflection. Authority relocates from the external to within the self in what Fowler calls the emergence of an executive ego. Stage 4 persons recognize the relativity of their perspectives and those of others. Transition to Stage 4 can occur at any time in adult life and the process may take many years.

In Stage 5, conjunctive faith can occur as persons recognize the inadequacy of their personal ideology in handling the complexities of life. Stage 5 persons demonstrate a sense of “epistemological humility,” ready to recognize the value of religious and cultural traditions unlike their own. Conjunctive faith finds truth in apparent contradictions and accepts the paradoxes of life. This stage of faith, if reached at all, generally does not occur before midlife.

Stage 6, a universalizing stage, is realized by very few. Fowler would reserve persons such as Gandhi, Martin Luther King Jr., and Mother Teresa as belonging to this most developed stage. Universalizing persons bear a vision of what life is “meant” to be and move beyond the apparent paradoxes to relinquish self-preservation for the ideals of absolute justice and love. While the previous stages were formulated from empirical data, Fowler constructed Stage 6 based on biographies and from developmental and theological perspectives (Parks, 1986).

Fowler (1981) uses seven aspects to operationalize the features of each stage. These are shown in Appendix A for Stages 2 through 4, the stages most pertinent to university students (Holcomb & Nonneman, 2004; Parks, 1986). Each aspect, as delineated by Fowler (1986) and Fowler, Streib, and Keller (2004), is described below.

- Form of Logic: This aspect is based upon Piaget’s theory of cognitive development.

- Social Perspective Taking: Fowler integrates Selman's (1976) developmental theory of role taking. As persons mature into adulthood, they are able to incorporate more information, including the perspectives of others to eventually see a situation from the view of an objective bystander. Fowler extends Selman's ideas to include persons' construction of the perspectives of their own chosen groups and eventually those of groups and ideologies other than their own.
- Form of Moral Judgment: Kohlberg (1976) proposed six sequential and invariant stages of moral reasoning. Fowler claims Kohlberg's stages parallel faith development.
- Bounds of Social Awareness: Fowler utilizes this aspect to study how persons select and construct reference groups to which they identify.
- Locus of Authority: This aspect focuses on whom and what composes an authority figure by which validation and legitimization of ultimate meaning is given.
- Form of World Coherence: This aspect describes how a person perceives patterns of coherence in constructing an understanding of “‘How do things make sense?’ or, ‘How do the various elements of my experiences fit together?’” (Fowler et al., 2004, p. 25).
- Symbolic Functions: Fowler seeks to integrate imaginal ways of knowing. Symbols are representations of images that take the form of concepts (e.g., God), events (e.g., Easter), persons (e.g., Jesus) or things (e.g., Bible). Parks

(1986) writes that symbols function to “grasp and shape into one a conviction of fitting reality” (p. 124).

The seven structural aspects become more interconnected as a person progresses through the stages of faith (Fowler, 1986). The importance of role taking is emphasized in social perspective taking, forms of moral judgment, and to some extent, bounds of social awareness. Cognition is emphasized in the forms of logic and moral development as well as social perspective taking. The remaining aspects encapsulate what Fowler terms the “logic of conviction” as an affective mode of knowing that is interrelated to the “logic of rational certainty” in forming larger epistemological structures.

### Young Adult Faith

While Fowler’s theory of faith stages serves as an important backdrop for this study, Parks’ (1986) focus on the faith development of college students is particularly relevant. As the shift from Stage 3 to Stage 4 can be an extended process, Parks proposes an intermediate “young adult” stage to span the transition from adolescence to adulthood. Parks claims this intermediate stage holds a kind of “equilibrated integrity that itself constitutes a distinct form of faith – a developmental balance worthy of attention” (Parks, 2000, p. 61). Based on their work in conducting qualitative interviews with 240 Christian university students, Holcomb and Nonneman (2004) support Park’s designation of an intermediate stage.

Parks (1986) identifies three concepts that describe college students’ transitions in faith: form of cognition; form of dependence; and form of community (see Appendix B). Building upon the work of William Perry’s (1970) investigation of university students’ cognitive growth, Parks describes four positions as a form of cognition that begins at Fowler’s Stage 3. These are authority-bound/dualistic; unqualified relativism; commitment in relativism; and convictional

commitment. Authority-bound persons uncritically assume a trust in an authority outside themselves. They tend to compose their perceptions of self and the world in dualistic terms (i.e., right and wrong, true and untrue). When persons recognize that their established patterns of thinking clash with lived experiences, they may shift to a position of unqualified relativism, realizing that all knowledge is relative in being conditioned to the knower. Perry (1970) termed this position “multiplicity,” in which without reasoned analysis, every opinion and judgment is as valid as another. When persons make a self-conscious commitment to critically reflect and make judgments based on principles rather than intuition and assumptions, they have moved from a tacit set of assumptions to an explicit system, a so-called commitment in relativism.

Parks (1986) expands the commitment in relativism position to two eras: probing commitment and tested commitment. In the probing commitment, persons operating in young adult faith test possible forms of truth and how they fit personal concepts of self and the world. Through experience, crisis, and journey, probing commitment evolves to a more mature and equilibrated tested commitment. Parks writes that persons may eventually reach a position of convictional commitment well after college during midlife, when they develop a mature wisdom that fully engages with “complexity and mystery” (p. 51). Parks aligns this transition from the explicit to the “multi-systemic” with Fowler’s Stage 5, conjunctive faith.

Nelson (1999) describes a scheme based on Perry’s (1970) research in using four modes that closely parallel Parks’ description of the cognitive dimension in college students’ faith: dualism; multiplicity; contextual relativism; and commitment (see Appendix B). Like Parks’ probing commitment, Nelson writes that contextual relativism “fails to provide frameworks for choosing among approaches in nonarbitrary ways” (p. 174). Nelson’s commitment mode is similar to Park’s convictional commitment. Nelson and Parks acknowledge that few college

students reach this mode of cognitive sophistication. While Parks recognizes that faith theory implies a linear and fixed development, Nelson states that students in intermediate stages can retreat to earlier modes and take a mosaic approach that incorporates a variety of personal notions of truth, opinions and rational criteria.

Like Fowler, Parks (1986) values the role of affect in faith development, stating, “Cognition and affect are intimately woven together in the fabric of knowing” (p. 52). Parks describes three forms of dependence: dependent/counter dependent; inner-dependent; and interdependent. Dependence is a tacitly held trust in which an assumed authority determines “feelings of assurance, rightness, hope, fear, loyalty, disdain or alarm” (p. 55). When persons begin to test truth for themselves, counter-dependence occurs in opposition to that dependence, yet the authority still remains in control. Inner-dependence appears when persons “include the self within the arena of authority” (p. 57) while still responsible to external authority figures.

In the inner-dependence form, Parks sees the shifting of the locus of authority away from the assumed authority as a two-step process. While the young adult self-consciously negotiates a new sense of inner directedness, external authorities continue to exert influence in what Parks terms a fragile inner-dependence. The adult faith, in becoming less dependent upon others for a sense of value and meaning, shifts to a confident inner-dependence. Eventually, individuals’ primary trust may lie neither in outside authority nor the inner self, but in interdependence where trust is centered “in the meeting of self and other, recognizing the strength and finitude of each and the promise of the truth that emerges in relation” (p. 59). Parks notably cites evidence from Carol Gilligan’s study (1982) on the psychological development of women as an example of the inner-dependence form. Parks writes, “People (especially women) who have previously tended

to extend care almost exclusively to others to the neglect of the self . . . can now extend care also to the self" (Parks, 1986, pp. 57 – 58).

The form of community describes the social dynamics and networks that influence how persons compose meaning (Parks, 1986). Forms of community include conventional, diffuse, self-selected class or group, and open to others. In conventional community, worldviews are greatly influenced by the social norms and interests of the group to which persons feel a sense of belonging, similar to Fowler's Stage 3, synthetic-conventional. The diffuse form of community is analogous to unqualified relativism as a form of cognition. During this time, as individuals begin to desire independence in thinking, they may look to a multiplicity of relationships with which to connect. Parks states that the young adult's form of community tends to be centered on those that are ideologically compatible. Thereafter, persons may self-select and reconstitute the class or group to which they belong, enabling a diversity of political, religious, and philosophical perspectives to emerge.

In the midst of an emerging self-awareness and determination, young adults cling fiercely to their new systems of meanings. Parks (1986) writes,

The fragile young adult must stand over-against the world to observe it, to critique it, to test it, and to save it. The tested adult has the confidence to stand within the world to engage it, to contribute to it, and . . . to transform it (p. 94).

The open-to-others form of community occurs when individuals yearn to be more inclusive in their associations, based on a sense of love and social justice.

While Fowler (1981) provides a global perspective, Parks' (1986) description of young adult faith in the transition from adolescence to adulthood presents a more nuanced view of the context and factors inherent in a university student's journey of faith development. Therefore,

Fowler's theory was used in this study to help distinguish Christian university biology-related majors' stages of faith, while Parks' model added rich insights into the forces that shape Christian university students' reconciliation of their perceived conflicts between evolution and personal religious beliefs.

### Faith Development Research

Faith development theory (Fowler, 1986) has been utilized in a variety of research contexts. The following sampling demonstrates the research breadth: faith stages of geriatric persons (Shulik, 1988); adolescent faith maturity (Martin, White, & Perlman, 2003); cross-generational faith within the same family (Gross, 1981); identity development of black students (Stewart, 2002); and bereavement (Balk, 1999; Battan & Oltjenbruns, 1999).

Several recent doctoral research projects have utilized Fowler's theory to investigate the faith development of college students. These include analyzing faith stages of incoming freshmen and graduating seniors (Holcomb, 2004) and college students' faith development due to a semester of study abroad (Reinhard, 2005). Each of these studies was conducted at a Christian college or university. Other recent doctoral research projects have purposefully employed Parks' model of young adult faith in addition to Fowler's theory. These include studying the institutional elements that affect Christian students' faith development at a Christian college (Braun, 2006; Durgan, 2004) and at a public university (Wilson, 2004); assessing the impact of short-term cross-cultural service learning projects on university students' faith (Radecke, 2007); and exploring the role of religion in shaping the educational identities of Muslim female college students (Tabbaa-Rida, 2004).

Faith development studies within the context of the evolution and creationism debate are not readily found in the research literature. Fowler (1981) writes that "conflicts between

authoritative stories” such as “Genesis on creation versus evolutionary theory” (p. 150) may initiate faith development transition. Verhey (2005) had students write evolution and creationism book critiques and incorporate nature of science discussions to facilitate progress through Perry’s (1970) modes of cognitive growth. Verhey states that the experience helped students think “effectively about evolution” (p. 997). The study was prescriptive rather than descriptive and focused only on the cognitive domain. Therefore, a fuller accounting of Parks’ (1986) faith dynamics of dependence and community in mediating Christian university biology-related majors’ perceived conflict is warranted.

### Critical Analysis of Faith Development Theory

Since the 1980s, Fowler’s (1981) structural-developmental faith model has remained the dominant paradigm for faith-development research (Jones, 2004) and has gained general acceptance among religious scholars and groups (Avery, 1992). Holcomb and Nonneman (2004) write that a more viable faith development theory has yet to emerge. Parrott and Steele (1990) contend that Fowler’s faith development theory is especially comprehensive and applicable to college students’ experiences. Still, faith development theory has its share of critics who have found fault in Fowler’s structural-developmental framework and definition of faith. In this section, criticism of Fowler’s theory is described in two regards: Fowler’s association with Kohlberg’s theory of moral development and neglect of women’s psychological development; and the structure and scope of Fowler’s theory.

Fowler (1981) models his faith stage theory on the structural-developmental work of Kohlberg, Erickson, and Piaget. Fowler uses Kohlberg’s (1976) theory of moral development to establish one of the seven aspects to assess faith stages, as seen in the fourth column of the faith development coding criteria table in Appendix A. One year after Fowler published *Stages of*

*Faith*, Carol Gilligan wrote a book in 1982 entitled *In a Different Voice: Psychological Theory and Women's Development*. In her book, Gilligan discusses the theories of Erickson and Piaget, but is particularly critical of Kohlberg for asserting universality for his six stages of moral development when his study only included the development of 84 boys over a period of 20 years. Gilligan aptly writes, "It all goes back, of course, to Adam and Eve – a story which shows, among other things, that if you make a woman out of a man, you are bound to get into trouble" (Gilligan, 1993, p. 6).

Gilligan studied both women and men and determined that according to Kohlberg's theory, women are judged deficient in moral development for remaining in stage three in which morality is "conceived in interpersonal terms and goodness is equated with helping and pleasing others" (Gilligan, 1993, p. 18). Gilligan criticizes Kohlberg for implying that only those women who follow traditional male roles of independence will recognize their moral inadequacy and progress like men toward the next stage where relationships are subordinated to rules. Gilligan questions why the "very traits that traditionally have defined the 'goodness' of women, their care for and sensitivity to the needs of others, are those that mark them as deficient in moral development" (p. 18).

Fowler (1993) has suggested that stage four, individuative-reflective faith in his theory of faith development, may need further adaptation to account for women's development. Schweitzer (1997), in discussing Fowler's theory, posits that more research is needed to ascertain whether an alternative path of "connectedness," rather than individuative understanding or meaning making, may better describe women's transitions from stage three. Parks (2000) addresses the differences between women and men in their understanding of the self. Parks writes, "For males, . . . a central task in becoming the self is separation or differentiation, going

forth and heading out. In contrast, for females the task of becoming a self requires identification with, attachment, and connection” (p. 49).

Acknowledging Gilligan’s seminal research with women, Parks (1986) recognizes the relational aspects of young adult faith. Parks notes the importance of “voice,” or persons’ expressions that seek to give

adequate expression to the reality of evolving relationships and responsibility. This “voice” (expressive of both male and female experience, but tending to be more salient in the expression of women) contrasts with the juridical voice of differentiation and rights that had been identified in Kohlberg’s earlier study of moral reasoning in males (p. 38).

Parks, in constructing a model of faith development between stage three, conventional-synthetic faith and stage four, individuative-reflective faith, seeks to incorporate relational aspects in her form of dependence. Both the young adult faith and adult faith forms of dependence are characterized by inner-dependence. Parks (1986) writes, “Inner-dependence, in contrast to common associations we make with notions of independence or autonomy, is not intended to connote a ‘standing all by oneself’” (p. 57). Instead, Parks notes that inner-dependence means including the self as a source of authority while “sources of insight outside the self” and the “claims of others for care” remain relevant (p. 58).

While Fowler’s theory of faith development is associated with Kohlberg’s theory of moral development that neglects the relational aspects of women’s development, the contribution of Kohlberg’s theory is only one of seven aspects in assessing a person’s faith stage. In this study, Fowler’s faith stages take a secondary role to Parks’ model of young adult faith. In contrast to Fowler, Parks explicitly acknowledges the pathways of women’s development in constructing an inner-dependence form of dependence as integral to young adult and adult faith.

Fowler's theory of faith development has been criticized for its scope and structure.

Fernhout (1986) argues that Fowler's view of faith is "everything and nothing" (p. 66) in being too broad and inadequately discriminating faith from general human development. Fernhout charges that Fowler's theory is an "amorphous and unwieldy" (p. 86) description of a person's overall development and is indistinguishable from general theories of development. Nelson and Aleshire (1986) offer a mixed critique of Fowler's work, noting that Fowler has chosen a difficult research strategy. Fowler "deals with a complex concept (faith); theorizes about it from some of the more complex approaches to understanding human development (Piaget and Erickson); and conducts the research with very difficult methods (coded, life-oriented interviews)" (p. 199). Fowler (1986) readily admits that faith is an "extremely complex phenomenon to try to operationalize for empirical investigation" (p. 16). Still, Nelson and Aleshire recognize that Fowler's faith development theory is based on ten thousand pages of transcribed qualitative data and that his research methods are consistent with a structuralist approach. Nelson and Aleshire note that good theories can be falsified or disconfirmed, but recognize the difficulty in ascertaining to what extent faith development theory can be disconfirmed. Similarly to Fernhout's assessment, Nelson and Aleshire write, "Caution is needed for theories with an answer for everything; and psychodynamic theories, in particular, have a tendency to do this" (p. 200).

Fowler (1981) views faith as an inherent human quality that is not equivalent to religious belief. However, Fowler relies on "God language" (Nelson & Aleshire, 1986, p. 190) in his interview protocol (Fowler et al., 2004; see also Appendix C) to translate religious conceptions such as prayer and sin into more universal constructs. Still, many religious critics argue that Fowler's formulation of faith is not a true synthesis of Christian faith (Ford-Grabowsky, 1986).

Avery (1992) contends that Fowler's attempt to construct a universal faith system removes many of the content specifics that Christians traditionally ascribe to faith, including the notion of faith as a God-given gift. E. L. Johnson (1996) contends that Fowler's theory is constructivist and relativistic, devoid of any recognition of "Truth" (p. 88). Other Christian researchers who have studied persons' faith in church congregations have developed a decidedly more Christian content-oriented construct (e.g., Benson & Eklin, 1990).

Jones (2004) asserts that Fowler's stages of faith should not be recognized as the development of Christian faith. Instead, faith development theory provides the "psychical context within which Christian faith occurs and develops . . . [in] parallel to Fowlerian faith" (p. 354). Dykstra (1986) similarly sees faith development theory as a "conversation partner" (p. 259) with religious educators, which may provide illuminating perspectives on the "'how' of faith as a dynamic but structured process" (p. 257).

In summary, Fowler's faith developmental theory has been criticized for its high degree of complexity and its inherent difficulty in assessing faith stages. Still, Fowler's generic faith development theory adds power to this study. While acknowledging the importance of God, the Bible and other religious symbols central to Christian university students' beliefs, Fowler's system enables an investigation of how students negotiate their values, locus of authority, and commitment to centers of ultimate importance in evaluating evolutionary theory against the backdrop of their religious beliefs. Dykstra (1986) writes that faith development theory provides a means to "discern the various *ways* in which such 'contents' of faith are 'structured' and 'processed' by various people in a faith community [italics in original]" (p. 257). As such, Fowler's faith development theory is useful in this study.

Additionally, Fowler's theory has been criticized for relying partially on Kohlberg's theory of moral development, which neglected women's psychological development. However, the primary tool for understanding faith stages and transitions in this study is Parks' model of young adult faith, which accounts for the unique aspects of women's faith development. Therefore, Parks' descriptive perspectives on faith are a powerful means by which to investigate Christian biology-related majors' perceived tensions between their understanding evolution and their personal religious beliefs.

#### Christian University Students' Accommodation of Evolution

Accommodation occurs when learners are confronted with evidence that conflicts with existing mental structures and subsequently adapt their schema to minimize the dissonance in a process of equilibration (Renner & Stafford, 1979). Science and religious belief integration issues, particularly regarding evolution, can represent a crisis experience for Christian college students (K. B. Miller, 2003). In order for Christian university biology-related majors to minimize the dissonance in their perceived conflicts between evolution and personal religious beliefs, this researcher postulated that a number of processes are necessary. These actions are not sequential or hierachal, but represent possible components in the reconciliation process of accommodating evolutionary concepts.

To accommodate evolution, the student must find the theory credible, or appearing to merit acceptance. This is a difficult step to take for students with creationist perspectives (Meadows et al., 2000). The creationists' *modus operandi* is to discredit evolution in its entirety (Stokes, 1989). Indeed, Judge Jones, in his ruling in *Kitzmiller v. Dover Area School District* (2005), observed that ID is "premised upon a false dichotomy, namely, that to the extent evolutionary theory is discredited, ID is confirmed" (p. 71). As discussed earlier, students may

accept evolution without fully understanding the theory. Still, the goal of evolution education is for students to understand evolution and thereby accept the theory on the basis of its validity and credibility.

A second process in Christian university students' accommodation of evolution is coming to terms with a viable interpretation of Genesis (Dutch, 2002). The Barna Group found that 64% of Christians who identified themselves as Protestant "embraced the accuracy" of the Bible (Barna, 2006). Creationist leaders (e.g., Ham, 1987) portray a literary, rather than a literal interpretation, of Genesis as a dangerous, slippery slope. MacArthur (2001) warns, "Tamper with the Book of Genesis and you undermine the very foundation of Christianity" (p. 44).

Science education literature is silent on how to deal with students' interpretation of Genesis. Skehan (2000), in writing for the National Science Teachers Association, describes Genesis 1-11 as an imaginative narrative that uses poetic language, imagery and figures of speech. However, Shekan's discussions are intended for teachers and do not provide guidance on how or whether to approach this topic in the public classroom.

A Christian university professor teaching evolution would have the freedom, if not a responsibility, to discuss Biblical interpretation within the broader scope of addressing the interaction of science and religion (Holmes, 1987; Poe, 2004). Scholarly and reasoned discussions notwithstanding, recomposing a new interpretation of Genesis 1-11 is a formidable task for Christian university students with prior creationist beliefs. Fowler's and Parks' theories of faith stages are germane. Stage 3 college students' form of knowing, trusting and believing is "authority-bound" (Parks, 1986). An authority takes shape in a particular individual or group or anything that represents a person's conventional ethos, including books such as the Bible. Parks writes that Stage 3 persons have an assumed trust in these external sources of authority.

Relinquishing a tacit trust in a literal interpretation of scripture can represent a shipwreck of faith (Parks' metaphor) for the Christian student. This study investigated the dynamics of that crisis.

A third process in Christian university students' accommodation of evolution is reconciling the personal and social implications of evolution. Young Earth Creationism and Intelligent Design groups engage in tactics that decry the moral bankruptcy of Darwinism. Evolution is construed to be the foundation by which people justify what creationists characterize as social "ills," including homosexuality, family break-up, euthanasia, racism, pornography and abortion (H. M. Morris, 1976). MacArthur (2001) writes that the "moral catastrophe that has disfigured modern Western society is directly traceable to Darwinism and the rejection of the early chapters of Genesis" (p. 16).

Brem et al. (2003) studied the perceived consequences of evolution in 135 college students with various majors at a major public university. The study utilized a Likert scale survey and open-ended written responses to questions regarding beliefs about the development of life on earth, and perceived impact of evolutionary theory on individuals and society. Questions concerning perceived impact focused on five areas of potential impact: a sense of purpose in life; perceptions of race and ethnicity; a sense of spirituality; perceptions of selfishness; and a sense of self-determination. The researchers classified the students into several groups, including strong creationists, non-theistic evolutionists, theistic evolutionists, and uncertain. Evolutionists (27%) were more likely than creationists (18%) to ascribe no personal or social impact to evolution. A significant majority of evolutionists surprisingly perceived a negative impact and the perceptions were "overwhelming negative" and "very similar across belief groups" (p. 193). The data show a significant direction towards an increase in selfishness and racial discrimination and a decrease in a sense of purpose, self-determination and spiritual beliefs, even when

controlling for belief. The atheistic evolutionists' decreased sense of spirituality was anticipated but the overall findings ran counter to the expectations of the researchers who had hoped that "knowing more about evolution would lead to a richer understanding of complicated issues," and instead, "the results suggest that the more a person knows about evolution the more negative they become" (p. 194).

Addressing the pedagogical implications of their study, Brem et al. (2003) argue that it is not important for people to find evolution as comforting or discomforting. Rather, the complexities should be "recognized and dealt with. Our participants do not seem to appreciate this balancing act, rather seeing the messages as strongly negative" (p. 199). However, the researchers do not elaborate on how to deal with the complexities. The results of the Brem et al. study are sobering for all educators, including those who teach at Christian universities. Professors espousing God-ordained evolution will find it particularly challenging to help students deal with the complexity and ambiguities inherent in theistic evolution. Parks (1986) and Nelson (1999) write that college students with relatively undeveloped faiths see the world in dualistic modes with little or no tolerance for ambiguity. Movement towards a more developed faith system is necessary to handle the tension associated with the perceived social implications of evolution.

In addition to social implications of evolution, Christian university students must grapple with the theological implications of evolution. Full resolution on the issues is not necessary, but the Christian university student must experience some sense of progress towards reconciliation to accept evolution (Meadows et al., 2000). Theological implications of evolution include teleology, divine action, theodicy and the nature of the human soul.

Teleology is the study of finding purpose in processes (Peters & Hewlett, 2003). In a theological context, teleology seeks answers to the question, “Is there purpose in the Universe?” K. R. Miller (1999) describes the processes of evolution as mutation, variation and natural selection. Miller characterizes mutations as “spontaneous changes in the genes. Mutations are a continuing and inexhaustible source of variation and they provide the raw material that is shaped by natural selection” (p. 49). Peters and Hewlett (2003) state that mutations are “random . . . contingent events, chance events” (p. 26). In response to the contingent nature of mutations, Miller asks the rhetorical teleological question, “Doesn’t the very randomness of evolution rule out any notion of divine purpose?” (p. 233). Some Christians struggle with evolutionary mechanisms that appear devoid of divine guidance (O’Leary, 2003).

Closely related to teleology is the issue of divine action, how God acts within nature. Discussions of divine action can become complex, even to the point of characterizing God’s action as taking place in the indeterminacy of quantum mechanics (e.g., K. R. Miller, 1999; Murphy, 2002; Peters & Hewlett, 2003). In this study, Christian university biology-related majors were not thinking on this level. Rather, they were more prone to ponder the question, “If God works through the laws of nature, how and when does God intervene to violate nature’s laws in doing miracles?”

Murphy (2002) writes that opposition to evolution by highly conservative Christians “can be understood as a reaction to the claims that the appearance, first of life and then of human beings, requires no special divine creative acts – no interventions in the natural order” (p. 33). Origin of life, or abiogenesis issues are differentiated from evolution as there is not yet scientific consensus on a model that describes the sequence of events leading to the earliest life forms (Scott, 2004). For Christian university biology-related majors developing a scientific paradigm,

the critical issue in this study was whether they depended on a natural explanation for abiogenesis or instead leaned towards a “god of the gaps” explanation (for the etymology of term, see Drummond, 1904, p. 156) that God specially created the first cell in an act of divine intervention. The National Academy of Sciences, in a veiled reference to Intelligent Design, writes,

Both science and religion are weakened by claims that something not yet explained scientifically must be attributed to a supernatural deity. Theologians have pointed out that as scientific knowledge about phenomena that had been previously attributed to supernatural causes increases, a “god of the gaps” approach can undermine faith. Furthermore, it confuses the roles of science and religion by attributing explanations to one that belong in the domain of the other (NAS, 2008, p. 54).

This study explored how Christian university biology-related majors approached abiogenesis.

Another theological implication of evolution is theodicy, which seeks to reconcile the goodness and justice of God with the problem of evil (Peters & Hewlett, 2003). Nature, “red in tooth and claw” as Alfred, Lord Tennyson (Tennyson, 1850/2000) described it, may appear antithetical to a good and just God (Moore, 2005). However, theodicy is less of a thorny issue for creationists. In the beginning, God created a perfect world in which there was no disease or destruction. Sin introduced evil and the whole of nature was affected (Ham, 1987; J. D. Morris, 2000).

Finally, evolution has theological implications for the concept of the human soul. Although there are a variety of interpretations on the soul, Murphy (2002) asserts that most Christians have a dualistic understanding that the soul is separate from the body and protects the dignity of humans as distinct from animals (see also Pope John Paul II, 1996). Yet, if *Homo*

*sapiens* evolved from other common primate ancestors, several important questions ensue. At what point did God endow humankind with a soul? What about *Homo neanderthalensis*, *Homo erectus*, *Homo habilis*, and others that might be associated with the lineage of *Homo sapiens*? In response to these types of questions, Murphy states, “The very oddity of these questions may lead to a suspicion that evolution and dualism are odd bedfellows” (p. 17). Human evolution, more than any other facet, is the sticking point that hinders students from accepting evolutionary theory (Holden, 2006).

Hume (2007) captures the essence of what Darwin’s theory may mean for some who accept its scientific premise but struggle to fit its ramifications within a theological framework:

[The] implications were . . . fairly horrifying when it came to man’s place in this Darwinian world. Higher purpose was gone. Made in God’s image – gone. And what of the soul? Only men had souls, it was said, but if humans shared a legacy with apes and sharks and garden slugs, did that even leave room for a soul? For an afterlife? For something greater than the flesh? The logic of Darwin . . . suggested that man’s ascendance was nothing more than a happy accident. . . . Life, intelligence, consciousness, and love were not gifts from God; it was all just a lucky break, a roll of the dice (pp. 4-5).

Hume’s characterization of the ramifications of evolution is the negative view that many creationists perceive in their rejection of evolution (e.g., Ham, 1987; MacArthur, 2001). This study explored how Christian university biology-related majors dealt with their perceived theological ramifications of evolution.

To summarize, in order for Christian university biology-related majors to accommodate evolution, they must come to terms with the credibility of evolution, a non-literalist

interpretation of Genesis, a rejection of creationists' conflation of social Darwinism, and at least some reconciliation of the theological implications of evolution. It cannot be overstated that each of these issues, with the exception of evolution's credibility, is *not* scientific. Still, each is fundamentally important in the "crucible" within the Christian university biology-related major's mind that mediates the perceived dissonance between their understanding and acceptance of evolutionary theory and their personal religious beliefs, and therefore was explored in this study.

### Summary of the Literature Review

Creationism in its various forms and the American fundamentalist movement within the Protestant Evangelical church have influenced today's generation of Christian university students. Studies have demonstrated that religious beliefs can interfere with students' understanding and acceptance of evolution. Garber (1996) writes that during the college years, students need to "develop ways of thinking and living that are coherent, that make sense of the whole of life. It is the difference between a worldview which brings integration to the whole of one's existence and one which brings disintegration" (p. 112). Faith, as a system of composing meaning and convictions about the ultimate nature of reality, plays a major role in the search for reconciliation. This study investigated Christian university biology-related majors' perceived tensions between their understanding of evolutionary theory and their personal religious beliefs, and the role of faith in the reconciliation process. Naturalistic inquiry and case study design were the most suitable methodologies to explore these issues and are discussed in the next chapter.

## CHAPTER 3

### METHODOLOGY

This chapter provides a description of naturalistic research, a rationale for and an explanation of the case study design, a discussion of the researcher's role, the data collection and analysis procedures, and the methods used to establish trustworthiness in this study.

#### Naturalistic Research

Creswell (2003) identifies three elements to consider in designing a study: knowledge claims; strategies of inquiry; and methods of data collection and analysis. Knowledge claims are the philosophical assumptions that underpin a study. Denzin and Lincoln (2000) write that all research is interpretive and guided by a set of beliefs that shapes how the researcher sees the world. A researcher's knowledge claim will therefore guide the questions, frame the design, affect data collection and analysis strategies, and influence the interpretation of the study's findings (Merriam, 1998). Creswell delineates four schools of thought about knowledge claims: postpositive; advocacy/participatory; pragmatic; and socially constructed.

A socially constructed knowledge claim maintains that individuals develop subjective interpretations of their experiences (Creswell, 2003). Human beings' knowledge construction of the world they experience arises from their social interactions and their individual thinking. Therefore, researchers using a socially constructed knowledge frame strive for a holistic, in-depth understanding of participants' meaning making and the context in which their knowledge is constructed. Merriam (1998) identifies this orientation to research as "interpretive," which assumes that "multiple realities are constructed socially by individuals" (p. 4). Denzin and Lincoln (2000) distinguish this paradigm as constructivist-interpretive.

According to Creswell (2003), qualitative research is the most suitable approach for a socially constructed knowledge claim. While some researchers use the term “qualitative,” “naturalistic” is used frequently in education when the researcher collects data in the location in which the phenomena are naturally occurring (Bogdan & Biklen, 2003). In this study, “naturalistic” was used to describe the methodology and “qualitative” was used to describe the nature of the data. Naturalistic research is described by Denzin and Lincoln (2000) as a multi-method field of inquiry that endeavors to “make sense of, or to interpret, phenomena in terms of the meanings people bring to them” (p. 3). Denzin and Lincoln characterize the naturalistic researcher as one who transforms the informant’s world into a set of interpretative representations that include interviews, conversations and fieldnotes.

Merriam (2003) describes five essential characteristics of naturalistic inquiry. First, the researcher focuses on understanding the meanings people have constructed and how they make sense of the world. The key concern is to understand the phenomenon from the participants’ perspective. Second, the researcher is the primary instrument for data collection and analysis. To some degree, the researcher’s biases and personal experiences inextricably affect the investigation. Third, naturalistic research involves fieldwork, during which the researcher observes people, events, and institutions in the natural setting. Fourth, naturalistic research is inductive. That is, naturalistic inquiry builds concepts and explanations from observations and insights gained in the field rather than by testing existing theory. Finally, naturalistic research results in holistic, expansive and richly descriptive findings. Words and pictures, rather than numbers, present a comprehensive understanding of the participants’ perspectives.

## Rationale for Naturalistic Research

Naturalistic research was chosen as the primary approach for this study for several reasons. First, this researcher's constructivist perspective was most closely aligned with Creswell's (2003) socially constructed knowledge claim. Within this orientation, ontological assumptions presume that multiple realities exist, including those of the participants and researcher (Creswell, 1998). As Strauss and Corbin (1998) state, "only God can tell infallible humans the 'real' nature of reality" (p. 4). The socially constructed knowledge claim supports the epistemological notion that knowledge is a co-creation between the researcher and the participants (Denzin & Lincoln, 2000), and the researcher must attempt to minimize the "distance between himself or herself and that being researched" (Creswell, 1998, p. 75). The socially constructed knowledge claim was well suited to this study because of the research focus on participants' constructions of meaning making and ultimate value, and how those constructions influenced reconciliation of perceived conflicts between their understanding and acceptance of evolution and their personal religious beliefs.

Second, the nature of the research question demanded naturalistic inquiry. This investigation explored how participants perceive conflicts between evolution and their religious beliefs and what role faith plays in mediating the conflict. These "how" and "what" questions were more appropriate for naturalistic rather than scientific study (Creswell, 1998). This study's research focus was exploratory in nature. That is, the goal was to discover the process by which faith mediates dissonance between evolution and personal religious beliefs, rather than to test a hypothesis. Although numerous studies (e.g., Brem et al., 2003; Meadows et al., 2000) have demonstrated that religious beliefs interfere with learning evolution as described in Chapter 2, there remained much to learn of the cognitive and affective processes of mediating the perceived

conflict. When processes rather than products are the primary concern of a study, naturalistic research is appropriate (Bogdan & Biklen, 2003).

Third, the nature of the research question required an inductive study. Naturalistic researchers primarily utilize an inductive research strategy (Bogdan & Biklen, 2003; Merriam, 1998). Christian university students' perceived conflicts between evolution and their religious beliefs have not been investigated in the context of faith development. As noted earlier, the affective and evaluative process of a Christian student negotiating these tensions is not well understood. When "there is a lack of theory, or existing theory fails to adequately explain a phenomenon" (Merriam, 1998, p. 7), naturalistic research as an inductive approach is warranted.

### Case Study Design

Following the identification of knowledge claim, strategies of inquiry are the second of Creswell's (2003) three elements to consider when designing a study. Naturalistic inquiry, the broad approach used in this study, has specific variations that are described as "theoretical orientations" (Patton, 1990), "traditions" (Creswell, 1998) and "strategies of inquiry" (Denzin & Lincoln, 2000). Common among these variations is the case study design.

A case study is a rigorous, holistic description and analysis of a bounded system (Merriam, 1998). The system is bounded by time and place and represented by a program, an event, an activity, or individuals (Creswell, 1998). Case study design is chosen to capture an "in-depth understanding of the situation and meaning for those involved" (Merriam, 1998, p. 19). In this research, the case study design was employed to explore and gain a thorough understanding of Christian university biology-related majors' perceptions of conflict between their understanding of evolution and their personal religious beliefs, and the process by which those students seek conflict resolution.

Three features that characterize case study are particularistic, descriptive and heuristic (Merriam, 1998). A case study is particularistic in focusing on a particular situation, event, program, or phenomenon. The bounded system is important for its potential to reveal the phenomenon it represents. The end product of a case study is descriptive, a rich and “thick” portrayal of the investigated phenomenon. Finally, a case study is heuristic, as the researcher discovers new meaning and patterns in relationships that lead to rethinking and greater understanding of the phenomenon under study.

Stake (2000) identifies three types of case studies. An intrinsic case study is conducted because of an inherent interest in a particular case. In instrumental case study research, a particular case is examined in depth to provide insight into an issue. The case itself plays a secondary role to advance understanding of an external interest. When a researcher studies a number of cases to investigate a phenomenon, a collective case study design is used.

The instrumental case study design was used in this research. The single case was a bounded system of biology-related majors at a Christian university in the Midwest. Data collection, analysis and interpretation centered on participants’ perceptions. The study’s findings revealed patterns of internal conflict and disequilibrium experienced by the participants. Redundancy and variety existed in the data collected in this bounded system, which allowed the researcher to provide a panoramic description of common and distinctive perspectives across all of the case study participants.

Stake (2000) notes that an instrumental case study acknowledges the concerns of the researchers and theorists and writes, “Because the critical issues are more likely to be known in advance and following disciplinary expectations, such a design can take greater advantage of already developed instruments and preconceived coding schemes” (p. 439). The interview

protocol and analysis procedures of Fowler et al. (2004), outlined in Appendixes A, C and D, and of Parks' model (1986), found in Appendix B, were valuable resources used in this instrumental case study.

### The Role of the Researcher

Naturalistic inquiry is interpretive research in which the researcher is the primary instrument for data collection and analysis (Merriam, 1998). The biases, values, and personal experiences of the researcher may influence the research process and warrant identification at the beginning of a study (Creswell, 2003).

My perspectives on faith and religious belief are rooted in my experience of growing up in a Christian missionary home in Taiwan. My parents were evangelical but not overtly fundamentalist. Still, in the amalgam of missionary school and Sunday School experiences, I gravitated towards a literal interpretation of Genesis and a view of the Bible as infallible. I attended a Christian college in the Midwest, similar in nature to the study site institution, and graduated with a Bachelors in Physics in 1987. After completing a Masters in Physics in 1990, I taught physics overseas at an international high school for four years.

Returning to the Midwest in 1994 to teach physics at a community college, my faith system was still relatively naïve and untested. I had strong religious convictions, but my faith was primarily authority-bound and dualistic, not only with respect to the Bible, but also to religion, morality and ethics. At that time, my views on evolution were best described as Progressive Creationism. In teaching Big Bang cosmology to college students, I pleaded ignorance when addressing biological evolution and found it easy to distance myself from the dissonance, which I have informally found is an aptitude at which many Christians excel.

The last six years have been a period of faith development for me in significant ways.

The core of my religious beliefs has not changed, but a matured and tested faith has enabled me to negotiate a heightened cognizance of inherent ambiguity in the world and to mediate cognitive and affective dissonance. A doctoral course on constructivism in 2001 stimulated a transition in my faith. For the first time, I was confronted with ontological and epistemological issues of relativism. Through a period of critical reflection, I began to enlarge my awareness of and respect for others' ideology. Using Parks' (1986) powerful imagery of faith development, I was beginning to "push away from the dock" (p. 92).

A second growth area is in reconciling my understanding and acceptance of evolution and my personal religious beliefs. Changing faculty positions in 2004 to teach at the study site university, a Christian institution, I could no longer ignore my dilemma with biological evolution. I already acknowledged the veracity of astronomy and geology. I likewise desired a similar inherent trust in biological science. Over the last four years, I have read much about intelligent design and theistic evolution. Reading cell biologist Kenneth R. Miller's (1999) book *Finding Darwin's God* was an "aha" moment for me. For the first time, I realized that a scientist could have an authentic relationship with God and fully embrace biological evolution with passion and conviction. My deepening appreciation of theistic evolution has released me from much of the dissonance I had experienced for so long. Theological implications of evolution continue as a source of tension, but a matured faith enables me to deal with the paradoxes while searching for resolution.

In discussing the researcher's role, Creswell (2003) advises commenting on connections among the researcher, participants, and research site. My teaching load at the study site university is presently composed of teaching entry level physics courses, science education

courses, and various general education courses, including astronomy and earth science. All participants who completed this study had previously taken a physics or science education course from me. No participant was enrolled in any of my courses during the period that this research was conducted. Two participants completed their science education student teaching under my supervision, but only after their interviews for this research were completed.

The researcher's existing relationship with the participants appeared to be a benefit. Of the 18 biology-related majors who were contacted for this research, 83% elected to participate in and complete the study. Despite the busy schedules of participants, several of whom were in professional studies, participants appeared eager to help the researcher. The high participant rate indicated that the research topic was relevant to participants and the existing rapport between the researcher and participants was a positive aspect of the study.

I chair a “learning society” on campus that seeks to foster a positive dialog between science and religion. The society is funded by a three-year grant sponsored by the study site university and the Metanexus Institute, an organization committed to “promote the constructive engagement of science, religion and the humanities in the communal pursuit of wisdom in order to address humanity’s most profound questions and challenges” (Metanexus Institute, n.d.). Through my efforts and other fellow faculty, the society has organized public lectures on campus from several Christian scientists who affirm theistic evolution, including Dr. Denis Lamoureux (Lamoureux, n.d.), Dr. Darrel Falk (Falk, 2004), and Dr. Keith Miller (K.B. Miller, 2003).

The study site administration is supportive of the society’s efforts and this researcher’s endeavors to promote a positive dialogue between science and religion. In her gatekeeper letter of approval for this research, the Dean of Arts and Science at the study site wrote,

On a personal note, I will be quite interested in your work. This is an area of special research interest for me, given the nature of our mission here . . . , and [I] am hopeful that your results can help us more fully understand the faith development process our students experience, especially as that interfaces with their learning of complex scientific concepts and ideas" (M. L. Banz, personal communication, December 19, 2006).

Science faculty at the study site are given academic freedom to promote a theistic view of evolution or creationism. None of the eight full-time science faculty is overtly creationist. Two biology faculty, one of whom is the Origins course professor, and two physics faculty, including me, actively promote a positive view of a 13.6 billion year old universe and theistic evolution within the classroom. In my classes, I find most students conflate science and religion and do not understand the limitations of scientific knowledge and religious beliefs. Recently, I have been more proactive in my courses to broach these issues and discuss the nature of science and religion.

Reflecting on my own faith development over the last several years, I mention several personal insights. Faith development is a process. Crisis and dissonance drive change. Community is important. Parks (1986) observes, "when faith itself is being reordered, when meaning at the level of ultimacy is disordered and under review, a community of rapport is especially crucial" (p. 120). The connections with Scharmann's (2005) emphasis on supportive peer groups in the classroom are striking. Without the sustaining community of my academic colleagues, the process of finding equilibrium would have been far more tenuous.

Based on a heightened sensitivity due to my own journey, I am more aware that many Christian university biology-related majors experience disequilibrium in their study of evolution. Auditing an Origins course in the spring of 2006 prior to conducting this research, I witnessed

students expressing their conflicts in reconciling evolutionary science and firmly-held religious beliefs. These experiences motivated me to develop a deeper understanding of students' perceived conflicts, and to discover the role of faith in mediating the conflict. In doing so, I hope to further engage in the community of rapport that is so crucial in helping students develop an enabling faith that affirms religious beliefs and an acceptance of evolution.

### Site Selection

Site selection is closely linked with sampling methodology (Patton, 1990). Purposeful sampling enables researchers to select samples "from which one can learn a great deal about issues of central importance to the purpose of the research" (Patton, 1990, p. 169). Purposeful sampling techniques include typical, unique, maximum variation, convenience, snowball, chain and network sampling (Merriam, 1998). The typical sampling technique is used to illustrate the typical, average, normal representation of the phenomenon under study. When using typical sampling, Patton writes, "the site is specifically selected because it is not in any major way atypical, extreme, deviant, or intensely unusual" (p. 173).

Merriam (1998) describes convenience sampling as selecting the sample based primarily on time, money, location, and availability of sites or respondents. Some of these characteristics corresponded with this study's sampling in the researcher's own "backyard." Patton (1990) warns that the danger of convenience sampling is information-poor samples. However, the site selected for this study was typical and provided information-rich cases to yield a "thick" description of the phenomena under investigation.

The site for this study was a Midwestern Christian university with an undergraduate enrollment of 1,200 students. The institution offers the usual variety of small university science

programs including biology, chemistry and physics degrees. Other than a high regard for its preparatory programs for graduate study and medical school, the science department is typical.

The institution's Web site describes the university as a "faith-filled community, educating students for responsible Christian living" (non-referenced for anonymity). The university belongs to the Coalition for Christian Colleges and Universities (CCCU). According to a CCCU report (Andringa, 2005), there are about 4,200 accredited, degree-granting institutions of higher education in the United States, of which 900 are described as "religiously affiliated." However, only 102 institutions characterized as "unapologetically Christ-centered" have membership in the CCCU (Andringa, 2005).

The mission of the study site university is to "educate students for responsible Christian living." The school's motto, "Character-Culture-Christ," is emblazoned on the large, arched gateway that fronts the campus. Students are required to attend chapel twice a week. Graduation requirements include the completion of four courses in Bible, theology, and church ministry. The university catalog states, "Deep commitment to the Christian faith, high standards of excellence in learning, and great devotion to integrity in living are dynamically brought together on the [study site] campus" (p. 15, 2005-2007 Undergraduate Catalog).

The Department of Biology at the study site has four full-time biology professors. More than 30 biology-related, on-campus courses are listed in the university catalog. Biology majors complete about 30 credit hours of biology courses. Biology-chemistry majors, most of whom are preparing for medical school, complete about 25 credit hours of biology courses. Biological science education majors complete a minimum of 21 credit hours of biology courses. The Origins course is an integral requirement of the core curriculum in each of the above-mentioned programs of study. A thorough description of the Origins course is given in Chapter 4.

Two of the biology department's five general objectives listed in the university catalog are: "To help students develop an appreciation for beauty and complexity in the biological domain of the cosmos – brought into being by the Creator and upheld by His hand;" and "To help students develop a satisfying integration of mainstream biological science with Wesleyan theology and plenary inspiration of the Scriptures as articulated by the [study site denomination]" (p. 91, 2005-2007 Undergraduate Catalog). The confluence of biological science and religious belief at the study site in which biology-related majors must come to grips with their understanding of evolution in the context of personal religious beliefs represents the fertile ground in which this research took place.

### Gaining Entry

Bogdan and Biklen (2003) describe two approaches to conducting a study in the field. Some researchers use a covert approach to avoid retrieving permission from a site's gatekeepers. An overt approach seeks official approval from the relevant gatekeepers. This researcher submitted the research proposal to and obtained written permission from the institution's Dean of the Arts and Sciences prior to solicitation of participants. Additionally, the researcher received approval from the study site's Institutional Review Board to conduct the proposed research on campus.

### Sample Selection

Naturalistic inquiry typically focuses on a relatively small number of samples (Patton, 1990). According to Stake (2000), case study requires the researcher to select participants based on purposeful sampling that builds on variety and opportunities for intensive study. Stake notes that even in larger collective case studies, sample sizes are usually too low to warrant random

selection. While balance and variety are important in selection, opportunity to learn is of greatest importance.

The purposeful sampling used in this study is analogous to a funnel (Bogdan & Biklen, 2003). In order to select information-rich cases, the following criteria narrowed the list of possible participants. Participants were senior Christian university students and recent graduates within the last two years who majored in biology, biology-chemistry, or biological science education, and had completed the biology course Origins. These criteria optimally filtered for participants with relatively advanced biology knowledge and reasoning skills. Completing the Origins course guaranteed exposure to contemporary debates on evolution and religious beliefs and availed the “scholarly paper” for document analysis. Enlarging the participant pool to recent graduates allowed for compelling reflection on college experiences in shaping beliefs systems and how those belief systems play out in the post-graduate world.

#### Sample Size

According to Patton (1990), “*There are no rules for sample size in qualitative inquiry* [emphasis in original]” (p. 184). Bogdan and Biklen (2003) suggest sampling widely to ensure diversity. Further, Lincoln and Guba (1985) argue that sampling is a process that continues in data collection and analysis. That is, sampling persists until redundancy and saturation of analyzed information occurs.

Sampling until redundancy, although ideal, is not pragmatic for limited timelines and constrained resources (Patton, 1990). Patton suggests specifying a minimum sample size that reasonably provides coverage of the phenomenon and addresses the goals of the study. A preliminary investigation of the potential number of pool participants revealed that eight undergraduates and thirteen recent graduates fit the given criteria. Seventy-five percent of the

potential pool were female. About two-thirds were associated with the university denomination with the remaining from a variety of denominations.

Due to the limited number of the potential participants, the entire population was selected rather than sampling from within the pool. The researcher used contact information from the study site university records to telephone or email the participants between December 2006 and August 2007. Two recent female graduates could not be located and a third male recent graduate was inaccessible for interviews in a distant location. This reduced the 21 potential participants in the original pool to 18.

Of the remaining ten recent graduates in the pool, two declined due to personal time constraints. Eight recent graduates thus participated in the study. Seven of eight undergraduates at the study site participated. An eighth male undergraduate completed the first interview but inexplicably did not return for a second interview despite the researcher's repeated email queries and was removed from the study.

In summary, the study included fifteen participants, 83% of the 18 persons in the participant pool who were accessible to and contacted by the researcher. The participants included six female undergraduates, one male undergraduate, six female graduates and two male recent graduates. Eighty percent of the study participants were female, similar to the potential pool percentage. Greater detail about the study participants is provided in Chapter 4.

#### Data Collection Procedures

Case study design draws upon three broad sources of data: interviews; documents; and observations (Merriam, 1998). According to Merriam, interviewing is the most common form of data collection in naturalistic research in education. Interviews provide "direct quotations from people about their experiences, opinions, feelings, and knowledge" while document analysis

yields “excerpts, quotations, or entire passages” from relevant documents (Patton, 1990, p. 10).

Observation is used when an activity or event can be observed firsthand. Hence, due to the nature of the research questions, the phenomenon under investigation, and the socially constructed knowledge claim that underlies this study, data took the form of interview responses, documents and fieldnotes.

### *In-depth Interviews*

Naturalistic researchers use in-depth interviews to provide an understanding of people’s interpretations of their personal experiences (Seidman, 2006). Interviewing is necessary, as Merriam (1998) notes, when intentions, behavior, thoughts, and feelings cannot be directly observed. Therefore, the purpose of interviewing is to “allow us to enter into the other person’s perspective” (Patton, 1990, p. 278).

Merriam (1998) describes a continuum of interview types in relation to the structure desired. In highly structured interviews, the wording and order of questions are predetermined. At the other end of the spectrum, unstructured interviews consist of flexible, exploratory, open-ended, and conversational questions. In the middle of the continuum, semi-structured interviews are a mixture of more- and less-structured questions. The more-structured questions elicit specific responses from the participants while less-structured questions explore for expanded answers. According to Merriam, most interviews in naturalistic research are semi-structured. The semi-structured approach increases the comprehensiveness of data, provides for systematic data collection with multiple participants and is flexible to respond to the emerging participants’ worldviews (Patton, 1990) and was therefore used in this research.

The interview protocol, shown in Appendix C, consisted of two sets of questions, or “interview guides” (Merriam, 1998; Patton, 1990). Although the dual interview design was

primarily chosen for the practical reason of avoiding a single, three hour-long session, the dual format had a positive benefit. Seidman (2006) advocates a three-interview series: the first to establish the context of the participants' experience; the second to reconstruct the details of their experience; and the third to allow participants to reflect on the meaning of their experiences. Many of the same ideas were utilized in the dual interview format used in this study. The first interview investigated the participants' faith development, allowing them to reconstruct experiences, expound on important relationships, and define critical values in their lives. The second interview allowed participants to reflect on their religious beliefs and views towards evolution arising out of a faith system very contingent on their values and lived experiences.

Questions for the first interview protocol were derived from the *Manual for Faith Development Research* (Fowler et al., 2004). Although Fowler et al. describe the protocol as "open-ended," the framework provides flexibility for exploration and is most similar to Merriam's (1998) description of a semi-structured format.

Prior to the first interview, participants completed the Life Tapestry Exercise. Appendix E shows the exercise description and includes an example worksheet from a study participant. The exercise gave participants a preview of the faith development interview and served to "prime" participants' reflection of key relationships, events and authority figures in their lives. Eight of the fifteen participants remarked that the exercise was a positive and enjoyable experience. The researcher obtained a completed copy of participants' Life Tapestry Exercises as complementary data for analysis.

At the beginning of the second interview, participants completed the Evolution Attitudes Survey (Ingram & Nelson, 2006). The survey, shown in Appendix F, is a measure of acceptance of evolution that avoids the potential confounding factor of evolutionary understanding (see also

Rutledge & Warden, 1999). The survey is composed of 12 Likert-scale items, with positive responses leaning towards a creationist view, and was used with a large group ( $n = 255$ ) of biology majors in an upper-level evolution course at a large Midwestern public university. Ingram and Nelson report a high reliability of 0.878, above the general minimal accepted Cronbach's alpha of 0.7. The survey strongly correlates ( $r = 0.879$ ,  $p < 0.001$ ,  $n = 63$ ) to the Measure of Acceptance of the Theory of Evolution assessment, a valid and reliable instrument (Rutledge & Warden, 1999). Ingram and Nelson also report that the Evolution Attitudes Survey has high face validity as judged by several science educators and biologists.

The researcher's use of the Evolution Attitudes Survey in the second interview served three purposes. First, the survey helped participants to transition from the first interview of faith issues to the second interview's exploration of views about evolution and creationism. Second, at the end of the evolution-creationism interview after the questioning was completed, the researcher quickly scanned the completed survey to ascertain areas for further exploration and clarification. Third, the survey results were another source of evidence to round out a comprehensive understanding of participants' perspectives and were an important component of the triangulation of data in this study.

The interview guide in the second creationism-evolution interview explored participants' perceived conflicts between evolutionary theory and personal religious beliefs. The questions were designed using Merriam's (1998) semi-structured approach with flexibility to adapt questions for further explanation. A number of questions discretely integrated elements of faith development into the evolution-religion context without explicit replication from the previous interview. At the end of the second interview, participants received a copy of their signed Participant Informed Consent Form (Appendix G).

The interviews were conducted from December 2006 to August 2007. Every effort was made to conduct interviews in a public setting such as a library. Eight participants were interviewed in a private conference room at the study site university library or a public library. One set of interviews was conducted in a participant's home because of her busy school schedule and remote location. Three participants were only available for interviews during inopportune times when the libraries were closed. On these occasions, interviews were conducted in a study site science building lab room in which participants were familiar and comfortable with the surroundings.

Three undergraduate seniors were enrolled in a semester experience at a biology field station in Costa Rica. To ensure high standards of data collection, interviews for these participants were completed on location in a private room at the field station in January 2007. Delaying the interviews until the participants returned for graduation in May 2007 was not feasible for the participants.

The mean length of the faith development interviews was 96 minutes with a maximum duration of 126 minutes and minimum duration of 77 minutes. The mean length of the creationism-evolution interviews was 78 minutes with a maximum duration of 96 minutes and minimum duration of 48 minutes.

The researcher transcribed four sets of interviews and three university student research assistants transcribed the remainder of the interviews. Student research assistant names were identified to participants at the outset of their first interview. Two participants chose a specific student research assistant for personal reasons while the other participants were not selective. The Participant Informed Consent Form, shown in Appendix G, assured participants that only the researcher and student research assistants knew their identity. References to names,

geographical locations, etc. were masked to guard the identity of the subjects and the site institution.

Pseudonyms were randomly assigned by the researcher to protect participants' identity with the exception of one participant who requested a specific pseudonym. The pseudonyms assigned by the researcher originated from a list of the most popular given names in 1986, the modal birth year of the participants (Social Security Administration, n.d.). Additionally, each participant was assigned a number (e.g., Participant 1) to facilitate referencing in the study.

Participants were given an opportunity to review their interview transcripts to check for accuracy and provide clarification. In addition, participants were provided portraits that described the formative events in their lives and their extant views of creationism and evolution. The portraits are described in greater detail in the "Trustworthiness of the Study" section below. Participants returned a signed Member Check Form, shown in Appendix H, after an opportunity to provide feedback. The purpose of the member checks was to ensure accuracy in description and fidelity to participants' perspectives, and thus increase trustworthiness in this study.

#### *Documents*

Documents are ready-made sources of data easily accessible to the resourceful investigator (Merriam, 1998). Personal documents refer to "any first-person narrative that describes an individual's action, experiences, and beliefs" (Bogdan & Biklen, 2003, p. 124). In the context of naturalistic research, Merriam values the use of personal documents to reflect the participants' subjective perspectives.

Participants in this study had completed the biology course Origins. The upper division course, as described in the 2005-2007 university catalog, is:

A multi-disciplinary search for the origins of the universe, galaxies, our solar system, earth, life, diversity of living organisms, and the human body. The fields of nuclear physics, astronomy, geology, embryology, comparative anatomy, genetics, cell and molecular biology, and biochemistry inform the search for physical origins. Metaphysical questions about origins are informed by scholars in Biblical analysis, theology, philosophy, and literature. Each student will develop an annotated bibliography and a scholarly paper integrating course content with his/her own worldview (p. 162).

In assessing the research value of a document, Merriam (1998) specifies a dual requirement; the document must contain insights relevant to the research question, and must be reasonably acquirable. The scholarly paper in this study met both requirements. As data in this study, the scholarly paper was a rich source of information that represented the participants' views on evolution from a religious perspective and contained important clues that revealed features of the participants' faith system.

Thirteen of the 15 participants provided the researcher with their scholarly papers at the first interview. One participant could not locate her paper. Another participant, who was a non-traditional student, took the Origins course ten years earlier and did not write a paper at that time.

The carefully prepared contents of the scholarly paper were an effective complement to the informal, spontaneous interview responses. Prior to the second interview, the researcher read the participants' scholarly papers to identify aspects of their belief systems and views on evolution for further exploration. Greater description about the Origins scholarly paper is provided in Chapter 4.

### *Fieldnotes*

According to Bogdan and Biklen (2003), fieldnotes are a written account of what the researcher “hears, sees, experiences, and thinks in the course of collecting and reflecting on the data” (p. 111). In this study, reflective fieldnotes included post-interview impressions and reflexive journaling to help the researcher remain aware of how the data influenced the development of ideas. Descriptive fieldnotes included observations of the Origins course and other ancillary information that availed a thorough description of the study context. Although the participants had completed the Origins course in a previous semester, formal classroom observation of the Origins course during data collection offered valuable insights into the processes at work in Christian university students’ mediation of evolution and personal religious beliefs.

The researcher observed the Origins course in the spring of 2007. Each of the 12 class members signed an Classroom Observation Participant Informed Consent Form, shown in Appendix I, and received a signed copy of their consent. The class met in non-testing situations 24 times, of which the researcher observed 20. The class periods were one hour and fifteen minutes long. The researcher observed from the back of the classroom and took notes of the professor’s presentation and professor-student interactions, including questions and responses. Greater description of the Origins course environment is provided in Chapter 4.

### Pilot Study

According to Yin (1994), a pilot study is an important component of preparing for a case study. The formative purpose of a pilot study is to further develop relevant lines of questions and provide conceptual clarification. The pilot study for this research occurred in December 2006 and January 2007. As the pilot study was a practice run of the procedures and interview protocol,

two undergraduates, a male and female, were convenience sampled by the researcher. Both were juniors in a biology-related major but neither had yet taken the Origins course. Pilot data consisted of the Life Tapestry Exercise, the Evolution Attitudes Survey, and the interviews, which were transcribed.

Yin (1994) recommends a pilot report that clarifies lessons learned and includes revisions to the data collection procedures. In this study, the pilot revealed several important points. The faith development interviews lasted about one and a half hours, similar in length to the results of other faith development researchers (e.g., Fowler et al., 2004; Holcomb, 2004). The evolution-creationism interviews were about one hour and fifteen minutes long. The interviews were appropriate in length and kept the full attention of the pilot participants. No modification of the original interview protocol was necessary. The pilot interviews honed the researcher's interviewing skills and discernment of issues relevant to the study.

It became evident relatively quickly in the second interviews that the pilot participants possessed a limited knowledge of evolution. Their only academic exposure to the theory was confined to a few class sessions in freshman Zoology. As such, the two pilot participants had reflected little about the religious implications of evolution, which comprised a third of the questions in the second interview. The pilot participants' relative lack of exposure to and reflection about evolution validated the selection criteria of the main study to discriminate for participants with a more extensive background in biology and familiarity with evolution.

During the pilot interviews, the researcher noticed that participants reacted to certain questions in a student to professor manner, especially in the faith development interview when the topic turned to formative, life-changing events. The researcher perceived nonverbal cues from the participants that they were anticipating an empathetic response from the researcher,

much like a student would expect from sharing something personally important in a professor's office. Seidman (2006) writes, "As in teaching, the interviewing relationship can be friendly but not a friendship" (p. 97). As a result of the pilot, the researcher articulated an informal disclaimer at the beginning of the main study interviews, which stated that the researcher was wearing a "researcher-hat" instead of the accustomed "professor-hat" and the researcher's responses would be neutral. In the main study, the participants invariably recognized the researcher's intention and graciously affirmed the researcher's clarification.

Pilot data, including the Life Tapestry Exercises and the interview transcripts, were utilized for coding practice. Fowler et al. (2004) recommend practice with interviewing and scoring two trial samples. Faith stage scoring was practiced on the pilot faith development interview transcripts before the main study.

In summary, the pilot study served an important purpose in this study. The pilot study reinforced the importance of the Origins course criterion in the main study. The pilot study also allowed the researcher to practice interviewing techniques, coding procedures and data analysis. Additionally, the pilot study provided insight into clearly articulating the role of the researcher to participants in the main study interviews.

#### Data Analysis Procedures

Data analysis, as Merriam (1998) broadly defines it, is the process of making sense out of data. Bogdan and Biklen (2003) describe data analysis as the process of systematically searching and organizing data, breaking data into manageable units, coding, and synthesizing data to find patterns that enable the researcher to produce findings. Some researchers acknowledge analysis of qualitative data as a highly intuitive process without wide consensus on methodology

(Creswell, 1998; Merriam, 1998). However, within a specific approach such as a case study, Merriam suggests that general strategies and levels of analysis are identifiable.

Merriam (1998) describes three levels of analysis of qualitative data as descriptive accounts, category construction, and theory building. Description is the most basic presentation of the study's findings and includes a detailed narrative of the case (Creswell, 1998). In the next level of analysis, the researcher constructs categories and themes that represent recurring patterns in the data. Category formation is what Creswell calls "the heart of qualitative data analysis" (p. 144). Scrutinizing data allows for regularities and patterns of words, phrases, behaviors, events, and subjects' ways of thinking to emerge, which enabled the formation of coding categories (Bogdan & Biklen, 2003). The categories are interpretive abstractions derived from the data that facilitate interpretation (Merriam, 1998).

While theory building is the central focus of grounded theory research (Strauss & Corbin, 1998), case study research focuses on holistic descriptions, in-depth analyses, and understanding of the investigated phenomenon (Creswell, 1998; Merriam, 1998). However, as Patton (1990) writes, "When careful study of the data gives rise to ideas about causal linkages, there is no reason to deny . . . the benefit of those insights simply because they cannot be proven" (p. 422). Patton advocates interpretation, going beyond descriptive data to attach "significance to what was found, offering explanations, drawing conclusions . . . making inferences, building linkages, attaching meanings . . . as part of testing the viability of an interpretation" (p. 423). Interpretations are appropriate, as long as the researcher clearly qualifies them as hypothesizing rather than theorizing (Patton, 1990).

Data analysis for this instrumental case study was a multi-step process that included multiple readings of the interview transcripts and documents, reflection notes, coding and

category formation. After the interviews were transcribed, the researcher listened to each interview audio recording while reading the transcript to check for accuracy and to correct typographical errors. Simultaneously, memos were added to transcript margins, and reflection notes regarding key concepts were organized in a document file.

During the first reading of the transcripts, a preliminary list of codes was developed. Morse & Richards (2002) define codes as descriptive labels that link pieces of data to ideas. The process of coding takes the researcher “away from the data – ‘up’ from the data to more abstract ideas or categories. . . . [and] ‘down’ from the idea to all the material” (Morse & Richards, 2002, p. 115) to which the codes are linked. Erlandson, Harris, Skipper, & Allen (1993) refer to pieces of data as “units,” which may consist of one or several words, a complete sentence, several sentences or an entire paragraph. A unit of data is the smallest bit of information that stands alone in contributing to an idea within the context of the study.

The development of codes in the first reading of both the faith development and evolution-creationism transcripts centered on participants’ views of creationism and evolution as well as the influences and events that fostered those perspectives. Bogdan and Biklen (2003) recommended limiting the development of a code list to a range of 30 to 50 entries. The preliminary list for this study after the first reading contained 46 codes. The codes were checked with the central research question and sub-questions to ensure the questions were adequately addressed. Faith stage analysis was not integral to the initial development of codes since Fowler’s coding criteria (Fowler et al., 2004) was already specified and faith stage scoring was completed near the end of the data analysis. Some codes, such as “parental influence,” naturally emerged from the data and happened to relate both to participants’ faith development and views on creationism and evolution.

The initial list of 46 codes was then used in a second reading to code line-by-line the interview transcripts, scholarly papers, Life Tapestry Exercises, and participants' member check forms. Any new codes that developed during the course of the second reading were rechecked by another search through the data using key words and phrases. For example, the researcher read through participants' key statements multiple times in developing their portraits after the second reading, and noticed that many participants referred to the scientific evidence of evolution. Although these references were subtle in the first and second major reading of the entire data, subsequent reading revealed that many participants placed an importance on evidence in coming to an acceptance of evolution, and that participants in disparate faith stages looked at the evidence in unique ways. Consequently, the researcher searched through the data, carefully read the poignant sections, and coded for "evidence."

At the end of the second reading, some codes were subsumed by other codes or adapted to fit the emergent categories and themes. The list of codes was streamlined to 41 codes. Codes were grouped under four major headings based on their similarities as shown in Appendix K. Some codes in Appendix K are followed by a sample quotation to clarify the code's meaning. The number of units and the number of participants associated with each code are also provided. The number of units associated with each code is not a measure of each code's relative importance. Instead, the number of units provides evidence of the presence of the coded information within the data.

Based on their commonality, the codes were aggregated into four groups: influences; expressed emotions and attitudes; conceptions of science and evolution; and religious ideas and implications of evolution. The codes within each of the four groups are not exclusive. For instance, the code "Bible" is listed under the "Influences" heading, but is also related to the

“Religious ideas and the theological implications of evolution” group. The four code groups facilitated organization of the data and offered explanatory clarity to the codes.

As an illustration of the coding procedure, whenever participants talked about the Bible or discussed the Bible as important in their lives, their statements were coded “Bible.” Some participants, for example, quoted scripture and others mentioned, “The Bible says . . .” Appendix K shows that all fifteen participants mentioned the Bible as an influence in their lives. Although participants used the specific word “Bible” a total of 270 times in the data, it was coded as 162 unique occurrences.

Each unit of coded material contained a reference to the participant, the data source, and a line number in that source. For instance, a coded unit with the reference 2EC – 1034 indicated the material began on line 1034 in Participant 2’s evolution-creationism interview transcript. The reference system maintained the individuality of a participant’s comments and ensured accurate links to the original source whenever context and clarification was needed in data analysis.

Coded material was copied out of the participants’ interview transcripts and documents and gathered into separate files that corresponded to the codes in Appendix K. This allowed individual codes to be studied in an aggregate form of all participants’ statements associated with that code. Sifting the coded material into separate files also winnowed over 2000 pages of interview transcripts, scholarly papers, and field notes into a manageable 500 pages of coded data.

After all data were coded, the faith development interview transcripts and Life Tapestry Exercise were read a third time while using Fowler et al.’s *Manual for Faith Development Research* (2004) for faith stage analysis. Each of the 25 questions in the faith development interview was assigned a specific key aspect as shown in the table columns of Appendix A. The

seven key aspects are: form of logic; social perspective taking; form of moral judgment; bounds of social awareness; locus of authority; form of world coherence; and symbolic function. Each aspect corresponded to either three or four interview questions.

The researcher analyzed each participant's faith development data one aspect at a time. The participant's response to a specific question generated an integer score that was entered into a scoring sheet as shown in Appendix D. The scoring sheet spreadsheet was provided by Dr. Barbara Keller, one of Fowler's co-editors in writing the *Manual for Faith Development Research* (Fowler et al., 2004) and a researcher at the Research Center for Biographical Studies in Contemporary Religion in Bielefeld, Germany. The spreadsheet calculated a mean score for each key aspect. The mean of the seven key aspects was calculated for a final score, thus giving equal importance to each aspect, regardless of the number of corresponding questions under the aspects.

Fowler et al. (2004) outlined specific procedures that were followed by the researcher in determining participants' faith stage scores. In contrast, Parks' model was applied in a holistic, qualitative approach. Parks' extensive descriptions in *The Critical Years: Young Adults and the Search for Meaning, Faith and Commitment* (1986) enabled the researcher to align participants' faith structures to specific cells in the table shown in Appendix B. The Fowlerian analysis allowed the researcher to get close to the data details much like an astronomer uses a telescope to focus on a particular celestial object. Stepping aside from the eyepiece for a more comprehensive and contextual view of the celestial landscape, the researcher analyzed participants' responses with Parks' model as described in Chapter 2.

Bogdan and Biklen (2003) write that theories can guide data collection and analysis in scientific research. By performing stage assessment relatively late in the analysis, Fowler's and

Parks' faith development models augmented rather than drove the initial analysis. This further enhanced the inductive nature of the study.

Analysis of the data was a continuous process from the first set of data in the pilot study until the final product, as advocated by Merriam (1998). The researcher reflected on the data as it was gathered and wrote notes during the transcription and coding process. As the researcher became increasingly familiar with the data, themes began to emerge from the patterns evident within the data. Merriam writes that the devising of themes "is largely an intuitive process, but it is also systematic and informed by the study's purpose, the investigator's orientation and knowledge, and the meanings made explicit by the participants themselves" (p. 179).

Since the researcher is the primary instrument and interpretive tool in naturalistic research (Denzin & Lincoln, 2000; Merriam, 1998), the themes were the researcher's inferences, the constructs which the researcher envisioned the data as communicating. Because the interview protocol was constructed in consideration of the central research question and sub-questions, the interview data naturally reflected the issues addressed in the research questions. The patterns that emerged from the data thus tended to mirror the research questions. Other patterns became apparent as well and are discussed in Chapter 4.

The patterns were written into themes and sub-themes and organized into five categories based on their similarities. Refinement of the themes and sub-themes was an iterative process. Themes were constructed based on the researcher's comprehensive understanding of the data after the second reading of the entire data when the coding process was complete and the coded units were disaggregated into separate files. Themes were then rechecked with the coded materials by constructing spreadsheets to further winnow the data. For example, in analyzing participants' views on abiogenesis, the spreadsheet rows listed participant names while the

spreadsheet columns contained notes about participants' perspectives including pithy quotations, whether participants broached abiogenesis prior to the interview question, survey results, and what participants thought about randomness and chance. Spreadsheet text and cell backgrounds were colored based on similarities and differences for a visual representation of emergent patterns and further refinement of the themes.

The themes and sub-themes were vetted with the peer debriefer who made suggestions for further clarity. Throughout the entire process of theme formation, the themes and sub-themes were continuously scrutinized, refined, and revised for consistency and accuracy by reference to the original data. The themes and sub-themes are the results of this study and are discussed in detail in Chapter 4.

#### Trustworthiness of the Study

Creswell (1998) writes that the terminology used for establishing quality and verification in naturalistic inquiry is distinct from experimental research terms. Validity, generalizability, and reliability are generally associated with experimental research, but some naturalistic researchers adapt these terms to naturalistic research (e.g., Merriam, 1998). Janesick (2000) writes that experimental terms such as validity have "technical microdefinitions" (p. 393) that are easily confused in naturalistic inquiry. Lincoln and Guba (1985) argue that experimental terminology is not consonant with the philosophical framework that underlies naturalistic inquiry in which the researcher must represent multiple constructions of reality. Although terms such as validity and reliability may be problematic in naturalistic inquiry, the intent of those constructs is still useful (Morse & Richards, 2002). Instead of using internal validity, external validity, reliability and objectivity, Lincoln and Guba offer the corollaries of credibility, transferability, dependability and confirmability to increase the trustworthiness of a study in answering the question, "How

can an inquirer persuade his or her audiences . . . that the findings of an inquiry are worth paying attention to, worth taking account of?" (p. 290).

### *Credibility*

Credibility refers to how believable the results of a study are to the participants, the constructors of the multiple realities (Lincoln & Guba, 1985). Prolonged engagement, persistent observation and triangulation are three activities that increase the likelihood of producing credible findings and interpretations.

Prolonged engagement is investing sufficient time in the study setting to develop first-hand knowledge of the culture and to build trust with the participants. The researcher taught at the site institution for more than two years prior to the study initiation and was familiar with the students' social milieu, including the Origins course of which completion was a major criterion for the study. All of the participants knew the researcher through direct coursework, and the researcher retained a professional rapport with each participant. Consequently, participants appeared to provide honest and authentic interview responses due to an implicit trust and confidence in the researcher's sincerity and promise of anonymity.

According to Lincoln and Guba (1985), persistent observation serves to identify characteristics in a situation that are most relevant to the issue under investigation. Contrasting prolonged engagement and persistent observation, Lincoln and Guba write, "If prolonged engagement provides scope, persistent observation provides depth" (p. 304). These two facets of establishing trustworthiness were present in terms of the extensive data collection and the significant number of participants in this study. The mean length of each participants' combined interviews was nearly three hours. Additionally, participants' scholarly papers, Life Tapestry Exercises, and Evolution Attitude Surveys provided a substantial amount of data. Although the

researcher audited the Origins course in the spring of 2006, the researcher observed and gathered extensive fieldnotes in the spring 2007 course as part of this research.

The data collection procedures in this study represent persistent observation, a search for the salient factors that addressed the study's central question and sub-questions. However, interviewing only a few participants would have not sufficiently provided the scope necessary for understanding the complex issues that were integral to this study. Prolonged engagement was achieved through exhausting the number of available participants in the participant pool rather than pre-maturely closing the research. As data were collected and analyzed, patterns began to form. After the first seven participants had completed the study, initial interpretations were reinforced and held up over time with additional participants. However, some of the most unique data originated from two of the last three participants. While the potential always exists for a previously unknown and unique perspective, prolonged engagement allowed a wide variety of participants' perspectives to emerge, and persistent observation allowed the complex perspectives to be fully explored.

Triangulation as the use of multiple sources of evidence is a major strength of case study design (Yin, 1994). Lincoln and Guba (1985) advocate triangulation as securing "*multiple* copies of one *type* of source [emphasis in original]" and "*different* sources of the *same* information [emphasis in original]" (p. 305). In this study, multiple copies took the form of 15 participants to increase the likelihood of credible findings. Interviews, documents, and fieldnotes constituted the different sources of the same information for this study. The in-depth interview protocol allowed a detailed and thorough description of participants' perceived evolution-religion conflict and faith's mediating role. Document analysis of participants' scholarly papers as a second data source augmented the interview data and increased the reliability of the participants' data.

Through the fieldnotes and the researcher's intimate knowledge of the study site environment, contextual information describing the phenomenon contributed to a thick description of the case.

Lincoln and Guba (1985) warn that sources of misinformation, both from researchers' perceptions and participants' misconstructions, can jeopardize the credibility of a study. Reflexivity allows researchers to be open and honest, acknowledging that all inquiry is attended with values (Creswell, 2003). This researcher maintained a reflexive journal (Erlandson et al., 1993), which included commentary on past experiences, motivations, initial expectations, biases, and orientations that may have affected the data collection, analysis and interpretation in this study. The journal also included reflections on the coding process, and notes on the formation of categories and themes in the data analysis.

Peer debriefing as an external check is advocated by Lincoln and Guba (1985), who describe it as the "process of exposing one's self to a disinterested peer in a manner paralleling an analytic session for the purpose of exploring aspects of the inquiry that may otherwise remain only implicit within the inquirer's mind" (p. 308). Peer debriefing helps expose researcher biases, allows for constructive feedback, improves rigor, and provides a sounding board for exploration and clarification of emergent ideas. Debriefing is most needed during the data collection and analysis stage to mitigate threats to credibility (Spillett, 2003).

A faculty colleague of the researcher acted as a peer debriefer for this study (see letter in Appendix L). The researcher met monthly with the peer debriefer during the data collection and analysis, until the final report was produced. The researcher's reflexive journal was a useful resource in this process. The peer debriefer provided valuable insight into the coding procedures and the construction of categories and themes. The peer debriefer also helped the researcher

better understand the unique patterns that define the moral development of females, which was an important consideration in the faith development analysis of this study.

Member checks are the most crucial method for establishing credibility (Lincoln & Guba, 1985). Member checks involve taking data and tentative interpretations back to participants to check for accuracy and plausibility (Merriam, 1998). In this study, participants received and verified the accuracy of their interview transcripts to ensure a reliable account of the data and to volunteer additional information.

Participants also received written portraits of their perceived conflicts in evolution and religious belief. The purpose of the portraits was to capture the participants' voice in conveying, "These are the events that have made me who I am and my perceptions of creationism and evolution." The portraits were based on data from the two interviews, the Life Tapestry Exercise, the Origins "scholarly paper," and the Evolution Attitude survey. The power of a portrait lies in the actual words of the participant (Seidman, 2006) and the portraits made extensive use of participant quotations.

Participants were invited to meet personally with the researcher, as suggested by Lincoln and Guba (1985), to review their portraits and transcripts, voice disagreements, clarify analysis and submit additional responses. Due to their busy schedules and remote locations, nine participants elected to receive their portraits and transcripts in the mail. The nine participants returned their signed member checks. The researcher met with six participants to review their portraits and transcripts, then audiotaped the participants' responses and collected their signed member checks. Member check data were integrated into the main study data for analysis.

Participants' responses to their portraits were consistently positive. Four participants requested minor modification to single paragraphs in their portraits to more accurately reflect

their perspectives. One participant, Brittany, Participant 10, clarified in the member check that she had undergone positive changes in her religious perspectives since the interviews and this is was noted in the research findings. Another participant, Ashley, Participant 5, wrote in response to her portrait, “I just read the paper.....perfect! Sorry, but there were no comments that needed to be made. You worked through the progression of my inner struggles precisely and represented my views exactly. Thank you for this work.”

Because inclusion of the portraits and accompanying faith stage descriptions for each of the 15 candidates would add over 100 pages to this document, summary descriptions of the participants are instead provided in Chapter 4. However, construction of the portraits was an important step in helping the researcher to focus on the essential elements of the participants' formative events and perspectives on evolution and creationism. Additionally, including portraits as part of the member checks allowed participants to see themselves as collaborators in the research process, rather than mere sources of information.

### *Transferability*

Transferability is the degree to which the study results can be transferred to other settings or contexts (Lincoln & Guba, 1985). Merriam (1998) argues that “a single case . . . is selected precisely *because* the researcher wishes to understand the particular in depth, not to find out what is generally true of the many” (p. 208). Therefore, it is not the responsibility of the researcher to provide an “*index of transferability* [italics in original]” (Lincoln & Guba, 1985, p. 316). Walker (1980) writes, “It is the reader who has to ask, what is there in this study that I can apply to my own situation, and what clearly does not apply?” (p. 34). Hence, it is the researcher’s responsibility to provide detailed and rich descriptions of the study’s context to enable readers to make transferability judgments (Lincoln & Guba, 1985). The intent of this study was to provide

a detailed and thorough account to enable readers to determine how closely their situations correspond to this study's circumstances. It is then incumbent upon the reader to decide the extent to which the findings can be transferred.

#### *Dependability and Confirmability*

To increase the dependability of a study, researchers strive to enable outsiders to concur "given the data collected, the results makes sense—they are consistent and dependable" (Merriam, 1998, p. 206). Merriam suggests three techniques to establish the dependability of a study. Two of these, researcher bias and triangulation, have been discussed within the context of credibility. A third technique to increase dependability is to establish an audit trail as evidence of how data was collected, coded and categorized, and the decision making process used throughout the study. Lincoln and Guba (1985) see the audit trail as a way to authenticate findings by providing a path that retraces the researcher's steps. In assessing whether the findings and interpretations are internally coherent and consistent with the data, an audit can enhance the confirmability of a study.

Although an outside audit was beyond the financial resources of this study, the researcher built an audit trail by organizing into binders the dissertation proposal, all related letters and forms, researcher fieldnotes and memos, reflexive journals, pilot and main study data, including audiotapes of the interviews, coded transcripts and documents, member checks, lists of codes and categories, scoring sheets, participant portraits, identified themes and sub-themes, and a recent report of the study findings. The peer debriefer acted as an internal auditor for this study. The peer debriefer's audit report is provided in Appendix M and attests to the trustworthiness of this study.

## Ethical Considerations

Bogdan and Biklen (2003) identify two guidelines that are central to ethical research when dealing with human subjects: informed consent and protection from harm. Informed consent ensures that subjects participate voluntarily and are given a full explanation of the nature of a study, including the associated dangers and obligations. The Participant Informed Consent Form (Appendix G) and the Classroom Observation Participant Informed Consent Form (Appendix I) used in this study state the purpose, methods of data collection, risks and benefits, assurance of confidentiality, and freedom to withdraw. Permission was retrieved from participants before audiotaping interviews and observing the Origins course. All participants received a signed copy of their consent form.

To protect human subjects from harm, potential risks to subjects must be less than the benefits they might gain from participating in a study (Bogdan & Biklen, 2003). In-depth interviews may carry unanticipated rewards and risks to participants. Holcomb (2004) reported instances of favorable responses to faith development interviews as a constructive experience. Many participants indicated similar responses to the faith development interviews in this study. Additionally, many participants positively reported that the questions in the creationism-evolution interview caused them to reflect on issues they had not thought about before.

A few interview questions, such as “Have you experienced times of crisis or suffering in your life?” triggered traumatic memories of past experiences for some participants. In such instances, participants were reminded that they did not have to answer the question. However, no participant elected to avoid answering any of the interview questions. In a few cases when participants showed distress in answering a question, the researcher waited patiently for participants to regain their composure and continued the interview without any problems.

Stake (2000) writes that naturalistic researchers are guests in the private spaces of the respondents' worlds and therefore every effort should be made to guard respondents' privacy. The researcher maintained participants' anonymity by using pseudonyms and masked references in this study. Three research assistant transcribers helped transcribe the interview data. All participants were provided the research assistants' names prior to the first interview and could opt out of having a particular assistant transcribe their data. The research assistants signed the Research Assistant/Transcriber Confidentiality Agreement Form, shown in Appendix J, which specified responsibilities to maintain strict privacy. Other than the assistants' help in transcribing the interviews, the researcher performed all data collection and analysis to help maximize confidentiality.

#### Summary of the Methodology

This naturalistic research study utilized a case study design of participants specified as undergraduate biology-related majors or recent biology-related graduates from a Christian liberal arts university in the Midwest. Seven undergraduates, who were seniors, and eight recent graduates, who had graduated within the last year, participated in the study. Data were collected through semi-structured interviews, an Evolution Attitudes survey, and a position paper on evolution as an assignment in the undergraduate biology course Origins. Judicious procedures were implemented to establish credibility, transferability, dependability and confirmability in this study. Additionally, high ethical standards were followed to maintain participants' dignity and anonymity. Analysis of the data produced categories, themes and sub-themes, which are the major findings of this study and are presented in the next chapter.

## CHAPTER 4

### RESEARCH FINDINGS

This chapter, which is a presentation of the research findings, provides a description of the Origins course and learning environment in which the participants studied evolutionary theory. The chapter also presents a summary description of the participants' demographics, views on creationism and evolution, and faith stages. A comparison of creationism-evolution views of two participants in disparate faith stages is given. The final section provides commentary and relevant data that support the categories and themes and address the study's central question and sub-questions.

As stated in Chapter 1, the overarching goal of this study was to examine the “crucible” within Christian university biology-related majors’ minds that mediates the disequilibrium between their understanding of evolutionary theory and their personal religious beliefs. This chapter extensively uses participant quotations to provide insight into the nuances of participants’ perspectives and give witness to emotions and experiences that form the crucible within participants’ minds. Quotations stem from participants’ interview transcripts, Origins scholarly papers, and member check forms.

Affectations, visual and audio clues are important components of interview data (Seidman, 2006) and are marked by using brackets within the quotations. The repetitious idiosyncrasies of oral speech, including “you know” and “um” are deleted from participant quotations unless their inclusion conveys context or meaning to a statement. As Seidman observes, “the claims for the realism of the oral speech are balanced by the researcher’s obligation to maintain the dignity of the participant in presenting his or her oral speech in writing” (p. 122). Because preserving participants’ dignity was an important consideration,

participants were given opportunity to read, make suggestions on, and approve their portraits and interview transcripts with a member check form.

As the goal of this study was to explore the interaction of personal religious beliefs and views about evolution, participant quotations contain a significant number of religious references. For all of the participants, religious beliefs were integral to their lives and affected their worldview. Most participants referenced God in their scholarly papers with a capitalized “He” as a sign of reverence. Others used “he.” Respecting the individual preferences of each participant, the researcher used the same convention in the transcripts and quotations within this document in accordance with participants’ personal use in their scholarly papers.

#### Description of the Origins Course and the Learning Environment

The Origins course may be unfamiliar to readers of this study. As a matter of transferability in establishing trustworthiness, Lincoln and Guba (1985) advocate providing sufficient descriptive data so that readers may judge how well the study relates to their own contexts. An essential characteristic of any naturalistic study includes understanding phenomena from the participant’s perspective (Merriam, 2003). To enable the reader to adequately understand the participants’ experiences, this chapter includes a description of the campus environment, the Origins course, and the professor.

As part of this study, the researcher observed the Origins course in the spring semester of 2007. All fifteen participants in this study had completed Origins in the previous two years; therefore, none of this study’s participants were formally observed in Origins. The researcher had informally observed Origins in the spring of 2006 before initiation of this research. Eight of this study’s participants were in the spring 2006 course. Comparing the two spring semesters, there were minor differences in required reading, class videos and guests speakers. Aside from

the classroom dynamics associated with a particular set of students, the environment was relatively similar in both spring semesters. In the description that follows, the spring 2007 course is described and any significant differences from the previous year's course are noted.

### *The Campus and Science Building*

The study site university is located in a small town located on the outskirts of a large Midwestern metropolis. The campus, four city blocks wide by three city blocks deep, adjoins a major six-lane thoroughfare and has a city feel with former municipal streets converted to pedestrian walkways. Adjoining the cement parking lots are lush green spaces and ubiquitous Bradford pear trees that mitigate the sense of being enclosed by the city.

The history of the study site university dates back to 1899 and includes the merging of five different colleges and institutions from four states. The present campus was formed in 1909 when the current administrative building was constructed. Most of the campus buildings have a 1960s era appearance with block architecture and brick veneer.

One of the largest structures on campus is the four-story monolithic science building that abuts a busy city street at the edge of campus. The three traditional sciences of physics, biology and chemistry reside on different floors. History, psychology, sociology, computer science, mathematics, and nursing fill out the rest of the space, including the basement. The science building contains the most classroom space on campus, and there is a constant flow of student traffic through the east and west entrances throughout the day.

Biology students attend the majority of their classes on the third floor. Students in the Origins course have the option of walking up non-descript stairwells on either end of the building or taking the interminably long elevator ride to the third floor. Classrooms and labs adjoin the third floor main hallway that is filled with display cases of stuffed animals. In

particular, a moose head hangs high on a wall and glowers down at students as they shuffle by. Its antlers extend up into holes cut into the false ceiling. A fish aquarium and a few snakes and lizards in cages add a modicum of life to the hallway.

#### *Origins Course Environment*

The Origins classroom is at the east end of the hallway. One can enter through two doors at the front of the classroom, thereby making tardiness an embarrassing distraction. The classroom has four rows of extended lab tables with a central aisle. With four students at each table, the classroom comfortably holds 32 students. Wood cabinets with countertops skirt three sides of the classroom. A smattering of science posters lends color to the institutional cream-colored walls. At the back of the classroom are two narrow windows that add a welcome trace of natural lighting to the standard fluorescent environment. At the front of the classroom is an instructor's station, chalkboard, and projection screen.

The 3000-level Origins course, usually taken by juniors and seniors, is offered each spring on Tuesdays and Thursdays from 11:45 AM to 1:00 PM. On Tuesdays, students arrive at 11:45 AM having just come from chapel, a short walk across campus. Occasionally, class will begin late if chapel runs long.

The Origins class had 12 students in the spring semester of 2007. Ten students were biology-related majors while the other two were an elementary education and English major. The non-science majors take the course to fulfill a science requirement for an advanced academic track program, similar to an honors program. In general, non-science majors' understanding of science is significantly limited compared to the knowledge of biology majors who are mostly upperclassmen. The professor appeared painfully aware of this disparity but patiently accommodated the non-science majors by pausing to explain fundamental biology concepts. The

biology-related majors, while genial to the occasional slackening in the learning pace, sometimes appeared bored.

#### *Origins Course Professor and Her Interactions with Students*

The professor, a biology graduate from the study site university, earned her Ph.D. in entomology at a major in-state university. She is nearing retirement after teaching in the biology department since 1968. The first impression one has of the professor is her gentle and kind spirit. She speaks in soft tones and wears a warm smile. Her hair is salt-and-pepper gray and short-cropped but dense and full. In the Origins course, students knew that she was genuinely interested in them in the way she intently looked at them from behind her glasses, and in the manner she cocked and turned her head to better hear their comments and questions.

The professor usually wore casual attire consisting of slacks and a blouse. One notable exception was when she taught half of a class session garnished with a three-foot long python around her neck. The professor acted as if nothing was out of the ordinary, only occasionally redirecting the snake when it would extend itself in search of firmer ground. The professor eventually handed the snake to two biology majors who let the python slither in and out of the rings of their binder notebooks.

The professor's teaching style was Socratic. She spoke in a calm voice but occasionally exuded excitement when a good question was asked. Invariably, she then moved to the chalkboard to write down an important point or definition to appear on the next test. Generally, she did not lecture for more than 20 minutes at any time but preferred instead to dialog with students about their required reading.

The professor also used a number of videos to stimulate class discussion. She occasionally paused the video for a short discussion but often ran out of class time before the

video ended, thereby cutting short any related discussion. Following one video presentation on comparative genetics, the professor pressed students for their reactions. When the professor asked the students if they had any problems with the 96% similarity in genetic make-up between humans and chimps, she was met with silence. The professor was visibly agitated at the students' reticence. Finally, one student asked how humans then could be so different from apes. The professor answered that the majority of genes in cells run standard functions, but the small differences in a few genes can account for vast differences in anatomy. The professor explained that God could have had an entirely new blueprint for *homo sapiens* which apparently is not the case as humans are chimp-like in many ways. As an example to support her case, the professor stated that humans struggle with hemorrhoids, or swollen veins, because our primate ancestors were not upright. She claimed, "The more you study – the more you see the physical part of us, except for brain changes, we're about the same." She asked, "Are you unhappy to hear about these similarities?" The students shifted in their seats and appeared awkward in their silence.

The professor continuously endeavored to create a supportive and non-threatening environment in the Origins course. At the beginning of class, she often prayed that students would be open-minded to what they learned, especially in their encounters with novel and challenging ideas. During the first several weeks of class, the professor appeared especially sensitive to those who were beginning to question their long-held assumptions about the Bible and creationism. "You may feel like you have the rug pulled out," she observed and then encouraged them to search for the truth. One student asked, "Do you want us to read stuff we might disagree with?" The professor enthusiastically answered, "Yes!"

Throughout the course, the professor consistently affirmed scripture and the Bible. On the first day of class, she provided a 12-page handout entitled "Creation verses" that contained

scripture selections from Genesis 5 to Revelation. In the next class meeting, the professor presented the “Framework Theory,” a literary structure that explains the Hebrew conception of God’s creative acts in Genesis 1 (see also Wright, 2003). The Hebrew word “tohu” denotes the transformation of chaos into order: the separation of light and darkness, the atmosphere and ocean, the land and ocean. The Hebrew word “bohu” suggests the filling of the void: the Sun, moon and stars to fill the light and darkness; birds and aquatic life to fill the atmosphere and oceans, respectively. The professor also discussed the differences in the creation stories between Genesis 1 and 2. Frequently throughout the semester, the professor would mention “tohu-bohu” as if to remind the students that Genesis 1 was more literary than literal. Eight participants in the main study referred to the Framework Theory and the differences between the two creation accounts as pivotal to their negotiated understanding of the Genesis creation narratives.

During the course, the professor invoked the denomination’s stand on evolution. “We reject Godless evolution,” she quoted from the denominational manual and explained that evolution as a theory is not specifically rejected but only a Godless interpretation of evolution. In an effort to help students see the debate over evolution as a contemporary issue within the denomination, the professor provided articles and editorial letters from a denominational magazine dating back to 1988 that called for tolerance and open-mindedness towards modern scientific theories on cosmology and evolution.

Two biology professors and a physics professor at other universities associated with the same denomination as the study site have each written popular science books that endorse evolution as God’s mechanism for biological creation (Colling, 2004; Falk, 2004; Giberson, 1993). The Origins course professor used Giberson’s book as required reading in the spring of 2006 and Falk’s book in the spring of 2007. In her reading accountability quizzes, the professor

would check students' knowledge of the authors' background and personal testimony as revealed in their writing.

The professor was not hesitant to discuss theology in the classroom and often appealed to what is known within the denomination as the Wesleyan quadrilateral, that is the use of scripture, tradition, reason, and experience in ascertaining truth. In particular, she highlighted the role that reason and experience play in both religion and science, that both the spiritual world and the natural world must be interpreted through reason and experience.

In summary, the professor's interaction with students is best captured through the personal note that concludes her course syllabus:

I have loved and learned about God, the Bible and living things all of my life. Questions about origins have consumed my interest academically for over 40 years. . . . I hope the course will be collegial, informal, and not intimidating. . . . Most importantly each person will be respected and his/her ideas will be respected if they are based on information and thorough study. Having the privilege of a college education and the additional blessing of intelligent peers who are believers is a blessing few people have! Take time to acknowledge that blessing! I am looking forward to studying along with you.

#### *Origins Course Assignments*

The professor gave "reading quizzes" once a week to keep the students accountable in their reading. While assessing for broad thematic understanding, quizzes also tended to focus on minutiae. For example, students were asked to provide the name of the person who wrote the forward to one of the course books. In reviewing the answers, the professor clarified that she wanted students to recognize that this person was a respected theologian at a sister university. Regardless, students murmured discontent under their breath.

In addition to the reading quizzes, the course also had three exams and a comprehensive final exam. Before the final, each student was required to generate 50 true-false, multiple choice, and fill-in-the-blank questions. The test bank eventually contained 350 questions and was copied for every student and reviewed in class prior to the final. The professor also asked essay questions on the exams.

The scholarly paper due at the end of the course was equivalent in value to two exams. The assignment description in the course syllabus stated, “Start jotting down your musings every day. . . . Begin to organize your thoughts. . . . Progressively polish it into a piece of work that you are proud to share with others.” The Origins students were encouraged to write their scholarly paper for a specific audience. As stated in the syllabus, this could be “church friends, science colleagues, young, old.” One of the participants (Jennifer, Participant 7) described how she approached the assignment:

Whenever [the Origins course professor] wanted us to write this paper, she told us to write them to people who would be reading them—like if someone came up to you and said, “What is your view on origins?” . . . So [the paper can be written to] someone who’s questioning their beliefs or questioning origins and how it can be complimented with Christianity.

The professor repeatedly encouraged students to develop their papers through the semester and had them post their work on Blackboard, a networked course Web site. Students could read each others’ papers, post comments and integrate elements from other papers within their own. The “penultimate version” was due three weeks before the end of the semester.

Thirteen of the 15 participants in this study submitted their scholarly papers for data analysis. One participant did not write a paper in taking the Origins course from a different

professor ten years earlier. Another participant could not find her paper. Of the 13 scholarly papers submitted for this study, the mean length was 18 pages. The shortest was 11 pages, and the longest was 31 pages.

The papers varied considerably in style and substance. Most were written in a colloquial format from a first person perspective. One participant wrote the paper to her father as a defense of her views on evolution and titled it, “Dear Dad …” Other titles were similarly revealing and included, “Evolution: A Beautiful Way to Understand God,” “Dynamic Belief in Both Evolution and Creation,” and “God Made the Whole World.” Perhaps, the least inspired title was, “Term Paper.”

#### *Origins Course Reading Materials*

The reading material in the spring 2007 Origins course stems from three sources: *An Introduction to Biological Evolution* (Kardong, 2005); *Origins: A Brief Journey into the Beginnings of Things* (Judd, 1997); and *Coming to Peace with Science: Bridging the Worlds between Faith and Biology* (Falk, 2004). The professor and students simply refer to these books as the “Kardong book,” “Judd book,” and “Falk book” and these colloquialisms are employed below in describing the books’ contents.

*An Introduction to Biological Evolution* (Kardong, 2005) is a commercially available textbook and is intended for a general college audience. Kardong writes in the preface, For many students, the process of evolution is still mysterious, even threatening. Most students who enter college have heard at least of evolution’s offence to religious beliefs, but not its service in unifying all of the modern life sciences. This book is intended for just such an audience (p. xi).

In the first chapter on the history of evolutionary theory, Kardong claims “fundamentalist preachers” and “anyone with a dogma to peddle—are likely to take offence at the Darwinian revolution” (p. 5). After Kardong’s initial religious reference and a general discussion of nineteenth century science’s new dependence on naturalistic explanations in the first chapter, he spends the rest of the book focused on the science of biological evolution except for a few notable exceptions.

Kardong, in Chapter 6 on the evidence for evolution, argues that Darwin provided a natural explanation for the appearance of all life on earth. Kardong then writes, “And if that were true, then humans too came out of a long history shaped by natural selection, and bear the character of that evolution rather than the stamped image of the divine Creator” (p. 83). Later in the chapter when he discusses vestigial structures still present in living organisms, Kardong states, “If we were intelligent designers, we would not leave such scraps and debris lying about in the new species we create” (p. 95). The Origins professor expected students to pick up on statements like this in their reading. In a reading quiz, the professor asked, “Kardong reveals his worldview bias about the designer by making a derogative statement. What does he say about God if he separately created the animals we see today?” In her class discussions, the professor was keen to remind students to be aware that scientists operate with biases.

*Origins: A Brief Journey into the Beginnings of Things* (Judd, 1997) is an unpublished document available only at the university bookstore. The Judd book is discussed in detail below for three reasons. First, the ideas contained in the book are a first order approximation to the Origins professor’s presentation in class. Second, nine of the thirteen participants who provided scholarly papers for this study referenced and used Judd’s ideas to support their work. Third, the

Judd book is not commercially available and the participants' use of its contents warrant an adequate description for the benefit of this study's readers.

Judd, a former biology professor and Origins course instructor, retired from the study site university in 1998 after thirty years of service. The Judd book is broader in scope than the Kardong book and includes eight chapters that cover topics as diverse as the Big Bang, origins of galaxies and the solar system, plate tectonics, biological evolution, the fossil record, human evolution and the origin of religion. As the book was last revised in 1997, some of its contents are dated. For instance, Judd leaves unanswered the question about the age and eventual fate of the universe: "Will the expansion eventually slow down and reverse itself, or will expansion continue forever?" (Judd, 1997, p. 10). Measurements made by the Wilkinson Microwave Anisotropy Probe in 2003 definitively show that the universe is  $13.7 \pm 0.2$  billion years old and is expanding at an increasing rate (Spergel et al., 2003).

In the first 70 pages of Judd's 80-page book, his presentation is primarily scientific except in a few cases where he interjects questions about religious implications that stem from the scientific evidence. For example, Judd details the cosmological timeline back to  $10^{-43}$  seconds and then states, "perhaps it's not overly optimistic to think that even the last frontier of our knowledge may be pushed back to time zero. What will we find? Probably God!" (p. 9). In his chapter on the origins of life on earth, Judd lays out the various hypotheses, each with their associated problems. Judd ends the chapter with an "AFTERTHOUGHT....." and writes:

A fascinating question arises after considering the many and varied hypotheses dealing with the origin of life on earth. Was the complex joining together of organic molecules to form life an *inevitable* result, or just a *lucky accident?* . . . Or was life a product of *chance*, a fundamentally lucky event that happened only because so much time was

available? Or perhaps, as seems most logical to some, it was a *guided process*, overseen by a divine *Creator* of the entire universe [italics in original] (p. 38).

Judd takes no definitive stand on these statements and data analysis showed the study participants had a wide variety of perspectives on abiogenesis, as described later in this chapter.

One other notable exception to Judd's scientific presentation is found in Chapter 7 on the "origin of mankind." Judd lists five features in which *homo sapiens* are distinct from other species, including skeletal features for bipedalism and upright locomotion; fully opposable thumbs; eyes with color vision and three-dimensional depth perception; and a large brain relative to body size. Judd then adds a fifth distinguishing trait, "5. Our immortal soul, a non-evolved, gift of God [underline in original]" (p. 61). Judd details evidence for human evolution. At the end of the chapter, Judd discusses religion and the search for meaning in life. Here, Judd writes that Alfred Russel Wallace, the concomitant discoverer of natural selection with Charles Darwin, came to a conclusion that "a superior intelligence has guided the development of man in a definite direction, and for a special purpose" (p. 73). Concluding Chapter 7, Judd writes,

And so it must be for the Christian. We may accept the fact that evolution is indeed the *modus operandi* of God, a belief which is usually known as **theistic evolution**, and it was used to create the immense diversity of life on earth today. But man *is* unique, and as Christians we must account for this uniqueness by using God's power. . . . Evolution as a scientific paradigm can't speak about the development of a soul or spirit, or the *image of God*, because it is only a scientific explanation for the development of the physical aspects of man. At the point when God created mankind, no matter how [*sic*] much we might physically resemble other hominids, we became separate from all the rest of God's

creation, and remain so. It seems to me that only within this context, is the evolution of mankind acceptable to the Christian [bold and italics in original] (p. 73).

Judd addresses the origin of religion in Chapter 8, the final chapter of his book. This particular chapter is neutral about religions and lacks a specific Christian viewpoint. Judd discusses various aspects of prehistoric religion, pantheism, monotheism and polytheism.

To summarize, Judd's book emphasizes scientific evidence and is similar to the Origins professor's emphasis on letting science "speak for itself." Except for the selected examples shown above, the Judd book contains very little overt Christian perspective. An obvious difference between the positions presented by Judd's book and the Origins professor was her persistent attention to helping students find a viable Christian viewpoint to co-exist with a scientific perspective.

The Origins professor utilized *Coming to Peace with Science: Bridging the Worlds between Faith and Biology* (Falk, 2004) as the third required book in the spring 2007 course. The Falk book, written as popular science, is colloquial in style compared to the Kardong book and the Judd book. Falk's first chapter is a personal testimony of being raised in the church, drifting from his beliefs as a graduate student in genetics, and eventually returning to the church a few years later. The remainder of the Falk book is suited towards helping a layperson understand radioactivity, fossil and DNA evidence in support of evolution. Throughout the book, Falk repeats the proposition that evolution operates as the "fulfillment of God's command in the Presence of God's spirit" (e.g., p. 133).

As a professor at a university in the same denomination as the site study, Falk writes that he has sought to help his students recognize the validity of evolution and to render science as complementary to faith (Falk, 2004). The Origins professor discussed these facets of Falk's life.

Remarking that she knew Falk personally, she elaborated on the controversy he faced at his university from institutional supporters and church constituents. The Origins professor appeared especially interested in making students aware of continuing conflicts over evolution and creationism within the church, and that an acceptance of evolution is often accompanied by conflicts with other Christians.

The Origins professor utilized *Worlds Apart: The Unholy War between Religion and Science* (Giberson, 1993) as the third required book in the previous Origins course in spring 2006. Giberson, a physicist at another denominational sister university, presents a broad range of topics including a historic account of the battle between science and religion dating to Galileo's struggles against the church, a contrast of philosophical naturalism and the Christian perspective, scientific arguments against creationism, and criticism of creationists' attempts to debunk evolution. In similar fashion to Falk, Giberson provides a personal testimony and chronicles his journey from a teenage, anti-science fundamentalist to a Ph.D. level, atomic physicist with religious beliefs. The Origins professor highlighted these types of sentiments in her discussions and reading quizzes.

#### *Audiovisual Materials Viewed in Origins*

Approximately one-third of the time in the Origins course was spent watching science videos and web-based presentations. The most significant set of videos watched in the course was the Public Broadcasting Service (PBS) series entitled *Evolution* (Hutton, 2001). This eight-hour documentary presents Charles Darwin's discovery of natural selection, speciation, extinction, and the development of the human mind. The series concludes with a one-hour finale entitled, "What about God?" The description for this particular episode, as offered on the PBS Web site, is:

Of all species, we alone attempt to explain who we are and how we came to be. This final episode explores the struggle between science and religion. Through the personal stories of students and teachers, it offers the view that they are compatible (Public Broadcasting Service, 2001).

The video finale focuses on several students from Wheaton College, a Christian college in Wheaton, IL. In particular, the video chronicles a geology student's change in beliefs away from creationism and the ensuing disagreements at home with family members.

Notably, the anti-evolutionist organization Discovery Institute panned the series in a 154-page response, dismissing it for misinformation and failing to present the scientific problems with Darwinian evolution (Discovery Institute, 2001). Answers in Genesis, a fundamentalist and Young Earth Creationism organization, similarly denounced the series as indoctrination and likened the geology student's acceptance of evolution to apostasy (Answers in Genesis, n.d.).

Another video presented in the Origins course was the *Origins* episode from the PBS production *A Science Odyssey*, narrated by Charles Osgood (Espar & Hendrix, 1998). The *Origins* video presents plate tectonics, the origins of life, an overview of paleontology and human evolution, and Charles Darwin's legacy.

The Origins professor also had students watch *Beyond the 'Evolution vs. Creation' Debate* (Lamoureux, n.d.), an online presentation with audio. Lamoureux criticizes atheists and creationists alike for dichotomizing science and religion into mutually antagonistic realms. The presentation provides a detailed list of categories by which a person can approach evolution, including Young Earth Creationism; Progressive Creationism; evolutionary creationism or theistic evolution; deistic evolution; and dysteleological or atheistic evolution. Lamoureux holds three doctoral degrees in dentistry, theology, and biology. His expertise in biology is in the study

of fossil jawbones. In his online presentation, Lamoureux tells his story of transformation from being an atheist to a Young Earth Creationist to believing in theistic evolution.

#### *Guest Presentations in Origins*

The professor enlisted the help of guest lecturers in Origins. A physics professor from the study site gave a one and half hour, detailed presentation of Big Bang theory. The physics professor announced he was there to discuss the science and not the theological aspects of the Big Bang. His fast-paced lecture can be likened to drinking from a fire hose, and some of the presentation was clearly beyond the scope of the biology-related majors' and non-science majors' comprehension. Still, the professor convincingly displayed the evidence for the Big Bang, including red shift measurements of the universe's expansion, the expected ratio of hydrogen to helium, and the temperature of the universe's background radiation.

The Origins professor utilized other professors to occasionally lecture in Origins. In a spring 2006 class session before this research began, Judd, the author of one of the course textbooks, brought in a number of skulls to discuss human evolution. Ashley, Participant 5, specifically mentioned this incident as particularly distressing. When Judd made a direct connection between humans and primates, Ashley stated her immediate, visceral reaction was "No!" She said it was a matter of instinct: "I don't know where it [my reaction] comes from or maybe it's my sense of security I have within myself that I don't leave certain things open for question or everything would fall apart." Greater detail about Ashley's and other participants' responses to human evolution is provided later in this chapter.

A religion professor gave a half-hour presentation to the Origins class in the spring of 2006 about the ancient Hebrew view of the universe. John, Participant 12, referred to this religion professor as a "well-respected Biblical scholar." John had already taken Origins ten

years earlier, but just happened in sit in on this presentation. He recalled the visiting professor describing the Hebrew notion of the universe to include a literal firmament that spanned the sky and contained windows that opened for rain. John remarked that this professor's explanation of the "cultural context of science in the day and age that Genesis was written" was a concept he'd never heard before. John added, "That [new understanding] made a pretty big impact on me."

The Origins professor also organized a panel discussion for the spring 2006 course. The professor invited a biology professor, a philosophy professor, and a religion professor to form the panel. The discussion was lively and many students asked about human evolution and how the story of Adam and Eve could be reconciled with evolution. The professors were aware of this difficult issue and sought to provide answers that were neither trite nor bombastic. The general sense was that there are few definitive answers to questions about Adam and Eve and the soul when evolution is taken into account. The Origins professor stated that the story of Adam and Eve is possibly an allegory for an individual's relationship with God rather than the history of a literal couple. As the students predominantly asked questions rather than made statements, conjecturing about their conclusions is unwarranted. However, it was apparent that students who spoke were struggling to make sense of their traditional understanding of human creation in the context of human evolution. These issues are further explored later in this chapter.

#### *Summary of the Origins Course and Learning Environment*

The Origins course was discussion-oriented and focused on extensive reading and multimedia presentations. Students were held accountable in their reading of the course books through numerous quizzes. Christian authors wrote two of the three course books. Three tests and a final exam were given. Students submitted a scholarly paper at the end of the semester.

The professor endeavored to maintain a supportive and caring environment in which students could freely express their ideas about creationism and evolution. Although the professor regularly encouraged students to question their assumptions, she consistently supported denominational theology and the authority of scripture. Using a variety of Christian scientists as exemplars in harmonizing religion and science, the professor advocated the model of theistic evolution. For many of this study's participants, this professor had a tremendous impact on the reconciliation of their understanding of evolution and their personal religious beliefs. The evidence of this professor's impact and other factors in the participants' lives that influenced their intellectual journey in learning about evolution are described later in this chapter.

The next three sections summarize the main study participants' demographics, views on creationism and evolution, and faith stages. The purpose of these summaries is to provide a panoramic view of participants' backgrounds and perspectives. Information is organized into tables. When anomalies in the summary data are evident, some detail is provided to explain their distinctiveness. However, the majority of the details that form the trends in the data are provided in the categories and themes section later in the chapter.

### Summary of Participants' Demographics

The undergraduate participants in this study included six female seniors and one male senior. The remaining participants included six females and two males who had graduated in May 2006, no less than fifteen months prior to their participation in this study. Eighty percent of the study participants were female.

As noted in Chapter 3, participants were given pseudonyms, and were denoted by a particular number to facilitate referencing. Participants' numbers were randomly assigned, except for Michael and David, Participants 14 and 15 respectively, whose perspectives are

juxtaposed later this chapter. Table 4.1 provides specific information about the participants' gender, status as undergraduate or recent graduate, field of study while at the university, and current work or future plans at the time of the study.

Table 4.1  
*Participants' Demographics*

Participant	Gender	Status	Field of Study	Current Work or Future Plans
1 - Gail	F	Senior	Science Education	Plans to teach middle school science
2 - Stephanie	F	Graduate	Biology-Chemistry	Veterinarian assistant, will attend veterinarian school the next fall
3 - Megan	F	Senior	Biology-Chemistry	Plans to attend medical school
4 - Diana	F	Senior	Biology and Science Education	Plans to teach middle school or high school science
5 - Ashley	F	Graduate	Biology-Chemistry	Lab technician, will attend medical school the next fall
6 - Tiffany	F	Graduate	Environmental Studies	Studying science education at another university to become a middle school science teacher
7 - Jennifer	F	Senior	Biology-Chemistry	Plans to get a graduate degree in genetic counseling
8 - Rachel	F	Senior	Biology-Chemistry	Plans to attend medical school
9 - Heather	F	Senior	Biology-Chemistry	Plans to attend medical school
10 - Brittany	F	Graduate	Biology	Veterinarian school student

Participant	Gender	Status	Field of Study	Current Work or Future Plans
11 - Nicole	F	Graduate	Biology	Graduate student in nutrition
12 - John	M	Senior	Science Education	Plans to teach high school science
13 - Elizabeth	F	Graduate	Biology-Chemistry	Medical school student
14 - Michael	M	Graduate	Biology-Chemistry	Medical school student
15 - David	M	Graduate	Biology	Enrolled in business courses at another university, plans to attend dental school

Four participants were married: Brittany, Participant 10; Nicole, Participant 11; John, Participant 12; and Michael, Participant 14. At the time of the study, all participants were in their early twenties with the exception of John, Participant 12, who was 38 years old. Fourteen of the 15 participants were Caucasian, and Ashley, Participant 5, also identified herself as partly Native American. Megan, Participant 3, was of an Eastern ethnic origin.

Eleven of the 15 participants were from the same midwestern state in which the study site university is located. The participants who came from out-of-state were: Gail, Participant 1, from a southern state; Rachel, Participant 8, from a southwestern state; Nicole, Participant 11, from a midwestern state; and Michael, Participant 14, from a west coast state.

Eleven participants identified their religious denomination as the same as the study site university. The participants who came from other denominations included Stephanie, Participant 2, from a non-denominational church; Megan, Participant 3, a Pentecostal; Diana, Participant 4, a Catholic; and David, Participant 15, a Baptist. The father of Megan, Participant 3, is a Pentecostal pastor. The father of Rachel, Participant 8, is a pastor in the study site denomination.

Additionally, the father of Nicole, Participant 11, is a district superintendent in the study site denomination.

#### Summary of Participants' Views on Creationism and Evolution

The following summary provides the variety and scope of participants' views of creationism and evolution in this study. Scott (2004) writes that a continuum of religious views exists "with creationism at one end and evolution at the other" (p. 57). The dominant Christian perspectives on this continuum, described in Chapter 2, are Young Earth Creationism, Progressive Creationism, and theistic evolution. In this study, participants' views fell into these three same categories. However, there were unique aspects of participants' perspectives within these categories, especially regarding Intelligent Design. Since this section is an overview of participants' views of creationism and evolution, the nuances of their individual perspectives are discussed later in the categories and themes section of this chapter. Table 4.2 summarizes participants' childhood beliefs, including the sources for those beliefs, and their present views on creationism and evolution.

Table 4.2

*Participants' Childhood Beliefs and Present Views on Creationism and Evolution*

Participant	Childhood Beliefs	Influenced by	Present Views
1 - Gail	Young Earth Creationism	Parents	Theistic evolution
2 - Stephanie	Young Earth Creationism	Church	Theistic evolution
3 - Megan	Young Earth Creationism	Father, who is a pastor	Theistic evolution
4 - Diana	Theistic evolution	Father, who is a geologist	Theistic evolution

Participant	Childhood Beliefs	Influenced by	Present Views
5 - Ashley	Young Earth Creationism	Mother	Progressive creationism with elements of theistic evolution
6 - Tiffany	Young Earth Creationism, accepted non-human evolution in high school	Church	Theistic evolution
7 - Jennifer	Young Earth Creationism	Parents	Theistic evolution
8 - Rachel	Young Earth Creationism	Father, who is a pastor	Theistic evolution
9 - Heather	Young Earth Creationism	Parents	Theistic evolution
10 - Brittany	Young Earth Creationism	Church, grandparents	Theistic evolution
11 - Nicole	Young Earth Creationism	Parents	Theistic evolution
12 - John	Young Earth Creationism	Parents	Theistic evolution
13 - Elizabeth	Young Earth Creationism	Church	Theistic evolution
14 - Michael	Young Earth Creationism	Mother	Theistic evolution
15 - David	Young Earth Creationism	Mother	Young Earth Creationism

Table 4.2 shows that most participants during childhood believed in Young Earth Creationism. Many participants reported that their strong creationist and anti-evolution beliefs were due to their parents' influence. Other participants remarked that they simply assimilated creationist beliefs from what they heard in church.

A noticeable exception in the childhood beliefs column in Table 2 is Diana, Participant 4. Diana, who referred to her geologist father as a "scientific dad," said, "I grew up with a dad who

pushed evolution books on us all the time. . . . He would teach us about evolution and who Charles Darwin was.” Diana was surprised in her biology courses at the study site university to discover that some of her classmates struggled with evolution. She recounted, “Somebody said, ‘Well, religious people believe this and science people believe this,’ and I was like, [sounding incredulous] ‘Some people don’t . . . believe in evolution?’”

Tiffany, Participant 6, was also unique in that she accepted non-human evolution while in high school. When Tiffany first studied evolution in ninth grade biology, she said, “It struck me during class when we were talking about evolution that evolution didn’t necessarily mean that God didn’t create everything. It just maybe meant that things evolved and that was kind of how stuff happened.” However, Tiffany faced uncertainty about human evolution because of her misunderstanding that “evolution says that humans evolved from apes.” Tiffany eventually figured out in a World Civilization course at the study site university that, as she wrote in her scholarly paper, “Evolution does not claim that man descended from monkeys, but instead, that monkeys and humans share a common ancestor.” Like Diana, Tiffany was surprised at how many of her fellow classmates struggled with evolution and said, “I didn’t even realize that until I actually took that Origins course and there were kids in there who, . . . the light bulbs were just coming on and I was like [? - quizzical expression].”

Diana and Tiffany’s relative ease with evolution contrasts with most other participants who struggled to overcome their distrust of evolution. Many participants did not realize that a Christian could accept evolution until he or she arrived at the study site university. Most participants from a creationism background who eventually accepted theistic evolution did not reach that position until late in their university tenure, and only through a process of conflict resolution and apprehension.

In contrast to their childhood beliefs in creationism, most participants, as shown in the second column of Table 4.2, now hold a theistic evolution view. Thirteen participants affirmed that God created through evolution and that all living organisms on earth shared a common ancestor. Two noticeable exceptions in the second column in Table 2 are Ashley, Participant 5, and David, Participant 15. David espoused the traditional, Young Earth Creationist view described in Chapter 2. His specific perspectives are more closely examined in the next section. Ashley's position deserves further explanation since her views are a unique mix of Progressive Creationism and theistic evolution perspectives.

Ashley came from a strong creationist background and reported that throughout her childhood, she always believed that the first chapter of Genesis was literal because, as she articulated, "That's just how I was raised." As a senior in the Origins course, Ashley struggled to make her theology and science fit. She sought to find a common ground between science and her personal religious beliefs in order to reach a sense of integrity in both. Ashley commented in her interview, "Sometimes, it's not possible."

Ashley stated that "the whole Adam and Eve passage" can be seen as "poetry to explain the ten thousand different species He put on earth to evolve later." In other words, Ashley asserted that God specially created the first line of organisms, and evolution took over from there. Ashley's views were based on a personal perspective that "creatures are so intricate and detailed, . . . I just don't see them coming out of one thing." She reiterated, "For me realistically, it seems more reasonable to have this pretty good broad set of things to start with and then to get your individual things from that."

As a result of her theological perspectives and ideas regarding the intricacies of nature, Ashley's views can best be described as a personal model of Progressive Creationism. Her view

integrates evolution to a point at which God specially intervened to create an initial line of ten thousand species. She affirmed that speciation has occurred in the past, such as “amphibian to reptile.” But she confessed, “It’s just hard for me to grasp seeing how many different things we have on this planet from a roach to a gorilla, of how all these billions of things could come from one thing.”

To summarize, most of the participants in this study were raised during childhood to believe in Young Earth Creationism. Many participants had no concept of theistic evolution and instead held anti-evolution perspectives when they entered the study site university as freshmen. However, most participants, after a process of conflict resolution, came to accept evolution as God’s mechanism for creation. These trends are further explored later in this chapter.

#### Summary of Participants’ Faith Stages

One of the goals of this study was to explore the role of participants’ faith in reconciling their understanding and acceptance of evolutionary theory and their personal religious beliefs. Faith stage analysis stemmed from two complimentary sources: Fowler’s theory of faith stage development (Fowler, 1981); and Parks’ model of college students’ faith (Parks, 1986). Table 4.3 presents a Fowler faith stage and Parks’ faith description for each participant.

The *Manual for Faith Development Research* (Fowler et al., 2004) was initially used to render a specific faith stage score as seen in the last column of Table 4.3. The researcher then used Parks’ (1986) descriptions of college students’ faith, described in Chapter 2, to align participants’ faith structures to specific cells in the table shown in Appendix B. Each participant’s forms of cognition, dependence, and community are listed in Table 4.3 as well as an overall faith stage description.

Table 4.3

*Participants' Faith Stages*

Participant	Form of Cognition	Form of Dependence	Form of Community	Parks' Faith Stage Description	Fowler's Faith Stage Score
1 - Gail	Transitioning to tested commitment	Confident inner-dependence	Ideologically-compatible	Transitioning to adult faith	3.7
2 - Stephanie	Authority-bound	Fragile inner-dependence	Conventional	Transitioning to young adult faith	3.3
3 - Megan	Tested commitment, some authority-bound	Confident inner-dependence	Ideologically-compatible	Young adult faith	3.5
4 - Diana	Authority-bound	Dependent/counter-dependent	Conventional	Conventional faith	3.2
5 - Ashley	Transitioning to tested commitment	Confident inner-dependence	Self-selected class	Transitioning to adult faith	3.8
6 - Tiffany	Authority-bound, some probing commitment	Transitioning to confident inner-dependence	Conventional	Transitioning to young adult faith	3.3
7 - Jennifer	Tested commitment	Confident inner-dependence	Self-selected class	Adult faith	4.0
8 - Rachel	Tested commitment	Confident inner-dependence	Self-selected class	Adult faith	3.9

Participant	Form of Cognition	Form of Dependence	Form of Community	Parks' Faith Stage Description	Fowler's Faith Stage Score
9 - Heather	Unqualified relativism	Fragile inner-dependence	Conventional	Transitioning to young adult faith	3.2
10 - Brittany	Unqualified relativism	Fragile inner-dependence	Diffuse	Transitioning to young adult faith	3.4
11 - Nicole	Probing commitment	Transitioning to confident inner-dependence	Ideologically-compatible	Young adult faith	3.7
12 - John	Transitioning to tested commitment	Fragile inner-dependence	Ideologically-compatible	Young adult faith	3.5
13 - Elizabeth	Probing commitment	Confident inner-dependence	Transitioning to self-selected group	Young adult faith	3.5
14 - Michael	Tested commitment	Confident inner-dependence	Self-selected class	Adult faith	4.0
15 - David	Authority-bound	Dependent/counter-dependent	Conventional	Conventional	3.0

The Fowlerian faith stage scores of the participants fell along a continuum from 3.0 to 4.0. These scores are consistent with the literature that analyzes the faith stages of Christian university students (Holcomb, 2004). Participants' faith stages, as described by Parks' model, ranged from conventional faith to adult faith, in accordance with Parks' analysis of college students' faith.

Appendix B shows the alignment of Parks' faith stage descriptions and Fowler's faith stage scores. For example, Parks' conventional faith corresponds to Fowler's Stage 3. In Table 4.3, Parks' qualitative faith description and Fowler's quantitative faith stage score are juxtaposed and demonstrate complementary, parallel outcomes from the analysis.

As discussed in Chapter 2, Parks' model is the most useful descriptor of college students' faith in this study. A striking feature of the Parks' Faith Stage Description column in Table 4.3 is the dynamic nature of college students' faith. Table 4.3 shows that at the time of the study, two participants operated in conventional faith; four participants were transitioning to young adult faith; four participants operated in young adult faith; two participants were transitioning to adult faith; and three participants operated fully in an adult faith. The transitory nature of many participants' faith does not fall into the tidy, theoretical bins of conventional faith, young adult faith or adult faith. Additionally, Table 4.3 shows that participants' don't move through their forms of cognition, dependence, and community in lockstep. For example, Stephanie, Participant 2, operated with a young-adult form of dependence. But she also operated in a conventional form of cognition and community. Parks appropriately quotes William Perry (1970), who also studied college students' intellectual and ethical development: "The person is always larger than the theory" (quoted in Parks, 1986, p. 41).

The relationship between participants' faith and their views of creationism and evolution is explored in two sections in this chapter. In the next section, two participants are closely examined to investigate the relationship between their faith and their capacity to resolve perceived conflicts between their understanding of evolution and personal religious beliefs. While a direct comparison of two participants' disparate faith stages and views of creationism and evolution clarifies specific distinctions in participants' approach to evolution, general patterns emerged in the analysis of the aggregated data. These trends are further explored in the categories and themes section later in this chapter.

#### Comparison of Two Recent Graduates' Faith Stages

#### and Views on Creationism and Evolution

This section is a closer examination of the faith stages and perspectives of two male participants, Michael, Participant 14, and David, Participant 15. Although 12 of the 15 participants in this study were female, Michael and David present an informative comparison of two participants who shared the greatest similarity in their backgrounds and yet demonstrated profound differences in the ways they made meaning of the world. They also held disparate views of creationism and evolution. The following narrative is a simplified version of their portraits, reduced to profile their views on evolution and creationism. Faith stage descriptions accompany each of their portraits. The similarities in Michael's and David's backgrounds are then considered. In the concluding section, Michael's and David's faith stages are directly contrasted and the relationship of their faith stages to their views of creationism and evolution is explored.

*Michael, Participant 14 – Views on Creationism and Evolution*

At the time of his interview, Michael was in his first year of medical school after graduating from the study site university with a biology degree. Michael grew up in a west coast state and was raised in the same denomination as the study site university. During his faith development interview, Michael was rather low-key and placid until he was asked if there was any particular cause he felt strongly about. Michael paused to think and then offered, “Kind of the whole church verses science thing.” Clarifying with an uncharacteristic show of emotion, Michael admitted that “it’s angering” when Christians act in ignorance. “Look at how many problems ignorance has caused,” Michael said and then noted, “It makes us sound stupid when we defend creationism till the last against people who can see that at least there’s evidence for evolution.” Michael leveled much of the blame on the church:

I don’t know why the church is so scared of this stuff. . . . I think they’re getting better definitely, but there’s still people out there that just make up stuff because they’re scared that it’s going to change something, that the truth will change something. . . . That really frustrates me when . . . like me growing up, . . . you pretty much get the idea of evolution is wrong and . . . the evidence they make up is false and they’re just making stuff up.

Earlier in his life when things were more “black and white,” Michael remembered that his mother “bashed evolution just by things that she was taught.” He noted, “She taught it to me because she didn’t know any better.” Michael also assimilated anti-science notions in church where “you just hear things . . . as fact because somebody in the church has told you.” Michael offered an example of what he heard as a kid: “The whole Lucy skeleton, . . . you’re told, ‘Oh, just random bones that they just found from different animals and they put them together so that they could trick us,’ which is . . . possible but [now] I don’t think that’s true.”

Michael also recalled his mother's response to other scientific theories like the Big Bang. "My mom would just be like, 'That's ridiculous. There's no way that makes sense,' or 'There's no evidence for it.'" Michael recognized that when he was young, he didn't "have any scientific education" and had "no reason to disregard what she said." When the issue came up in middle school, he "held that evolution did not make sense" because that was "what he had been told."

Eventually, Michael could not "continue ignoring the subject" in his high school junior and senior biology classes where evolution was taught. He "slowly became more open-minded . . . that God could have created the universe and the planets any way He wanted." Although not "denying evolution" at this time, Michael was "still leaning towards creationism."

Until that point in his life, Michael noted that "one of the major problems" he faced was not knowing "any Christians with an educated perspective on this matter." That changed when he came to the study site university and was exposed to "educated Christians believing wholeheartedly in evolution." For the first time, Michael saw that "these two entities [science and religion] do not have to remain separate, they are entirely compatible. I slowly moved to the position that God probably used evolution for the creation."

In his scholarly paper, Michael wrote that several university courses during his junior and senior years shaped his new understanding of evolution. He described the homologous bone structures of vertebrates that he studied in Comparative Anatomy as "uncanny." In Science, Technology and Society, Michael learned the "true meaning of a theory" as a "grouping of well-documented ideas with evidence to back it up." He discovered in Introduction to Christian Thought that Genesis was "written in poetic form" and that the "two different stories [Genesis 1 and 2] show that these passages are not intended for a scientific description of creation, but to tell us more about God, who He is, and how we relate to Him."

While Michael fully embraced evolution, he still retained some vestiges of Intelligent Design from a book that he read in high school about the “classic watchmaker thing.” He became animated when asked in the second interview if all life present on earth evolved through natural selection from one common ancestor: “Okay, here’s the deal, okay. That could’ve happened, but I believe it’s not as simple as just evolution took place.” He added that the “argument” of “Intelligent Design is sort of valid” when you “look at the number of amino acids in a protein.” Michael’s concern is that if proteins are randomly assembled, “there would not have been enough time for all the evolution of all those proteins” to occur.

When pressed on whether God specially created the first life on earth, Michael was open to two possibilities. Either God stepped in and specially created or God “set up a system” and there’s a “part of the system that we don’t know about yet that guides” evolution. Michael appeared to favor the latter option. He wrote in his scholarly paper, “There are clearly many holes that still need to be filled in the theory of evolution,” but “looking at the evidence that our world provides, . . . evolution is the best theory to describe the development and diversity of our planet.”

In response to theodicy, Michael admitted that he has “never thought about that [issue]” before, but his answers, after some initial reflection, are pragmatic:

There’s definitely an order and a balance and it’s not just carnage. . . . There’s a whole food chain and a kind of a beauty and simplicity in the way it all functions together as one. . . . If you don’t have the survival of the fittest, who’s surviving and how are you making it better?

For Michael, the apparent randomness of evolution does not diminish the purpose of life, if one posits God is the instigator of creation. He stated,

Evolution on its own, the whole concept of it is randomness of chance. That has no purpose there. That's why evolution on its own is not enough, it's kind of empty, I think. People try to hold on to just the science of it but I don't think it's enough.

Michael noted that evolution "is not necessarily totally random . . . if God had a hand in it even just starting it. He still set up the system, the framework within which it has worked."

Michael reiterated, "There's more than just evolution. Like evolution may be true, but there's also a God who . . . at least started it or created it," so therefore, "there's a purpose."

Similarly, God had a "goal in creation." It was "not necessarily humans, but a being that He could commune with and either His goal was humans or . . . humans were the first to make it to that level kinda and so He said, 'I chose them.'" Michael clarified that humans are different from animals mostly because of "higher cognitive functions," and added, "We're at another level where we can think in certain ways and communicate with a God." Later, with respect to the soul, he said, "There is something deep within us," and added that humans are destined for "more than just this life."

Overall, Michael believed that science and religion are "totally compatible" and "there's nothing in evolution that . . . discounts God at all." Summarizing his thoughts in his scholarly paper, Michael wrote, "Understanding these scientific theories give us a special way to see God. Learning scientifically about these areas only allows for better understanding of God and His vast power in the amazing way He has created this universe."

*Michael, Participant 14 – Faith Stage Analysis*

Michael's Fowlerian faith stage score was 4.0. He functioned in the tested commitment form of cognition. He has moved beyond unqualified relativism where all truth appears equally valid to a position where he critically evaluates his assumptions about the world. Asked if actions

can be right or wrong, Michael stated, “Oh there’s definitely right or wrong. I mean you can’t just go all relativism or nothing’s right and nothing’s wrong. Everything falls apart.” Michael’s answers are nuanced and have a tested quality about them. For example, in addressing moral standards, he stated, “Some people say . . . it’s wrong if it hurts someone but . . . I think that’s too simple.”

Operating in a tested commitment form of cognition, Michael displayed an epistemological humility and was circumspect when discussing differences with others. His initial answer to the question of who gets into heaven was, “Christians, some maybe, maybe not others.” Asked to clarify, he responded,

I don’t think it’s just limited to them, I’m not going to go and say, “Oh if somebody hasn’t heard about Jesus, that it’s too bad for them.” . . . I don’t know for sure, it could be, it could not. But, I wouldn’t ever try to say which way because I mean, God is graceful.

Michael joked that the solution to resolving religious differences is, “splitting the church like we’ve done.” When asked to clarify, he suggested, “There’s a right way to do it, but too often people are too stubborn to . . . sit down and talk about it” and added, “Too many times, Christians feel so threatened by something different than what they think that for some reason they hold on to it so strongly when . . . they don’t allow change.” In his tested commitment form of cognition, Michael displayed an awareness of others’ ways of thinking and he demonstrated an openness to change through dialog.

Parks (1986) writes that inner-dependence occurs when a person brings external authorities into an equilibrated position with the self. Michael appeared to be in this phase of confident inner-dependence. For example, Michael offered that free will and the ability to choose

good or bad allows the possibility of evil in the world. When asked if the freedom to make bad choices therefore was the source of evil, Michael paused to carefully consider his answer and replied, “I don’t know *what I think* [italics added] about that ‘cause I mean there’s always Satan and *everyone says* [italics added] that but I don’t know. . . Good question.” Michael recognized a source of authority in the self in “what I think,” but also affirmed external authorities in “everyone says,” which could be the Bible, pastors, professors and friends.

Michael stated that many of his closest friends were theology majors with whom he has had religious disagreements. Michael appeared to have moved beyond the diffuse community where any friendship is as good as another to a self-selected group form of community that confirmed his “new world of meaning that is composed on the other side of critical awareness” (Parks, 1986, p. 66). This was evidenced by the respect he expressed for his theology friends. Michael sought to understand their perspective even to the point of agreeing with “quite a bit of what they say.”

In summary, Michael appeared to operate in an adult faith stage. His worldview allowed him an open-mindedness to consider the evidence for evolution. Although Michael showed some concerns about the synthesis of proteins in the origins of life, he was fully supportive of the scientific aspects of evolution. A closer examination of the relationship between Michael’s faith stage and his views on evolution is presented in the section following the narrative on David, Participant 15.

#### *David, Participant 15 – Views on Creationism and Evolution*

David is a recent biology graduate with an easy smile that hints at a bit of mischief behind the eyes. He has aspired to be a dentist since middle school. Determined to fulfill his dream, David attended night school in the past year since graduation to earn an additional

business degree while working on his father's ranch. At the time of his interview, he was still waiting to receive word about his acceptance into dental school.

Conversations with David rarely go very long before the subject changes to politics. He confessed to being "kinda a political nerd." His affiliation is easily found in the "Events . . . in the World" column of the Life Tapestry Exercise, in which David wrote, "1992 remember slick Willie getting elected," and "Bill Clinton and Lewinsky." On the other hand, David was quick to defend former Republican House Speaker Tom Delay after reading Delay's book *No Retreat, No Surrender: One American's Fight* (Delay, 2007). "[It] was a really good book," he added.

David claimed there is more corruption "on the Democrat side than on the Republicans." He clarified, "I believe a lot of Republicans are more Christian-based and more – less likely to do it, where as Democrats are secular." Asked where he derived his ideas, David listed radio talk-show hosts and conservative pundits. Recently, he found some good friends that share his political views. "Whenever we get together, we always end up talkin' politics and how the Democrats are messing up our country."

David's first exposure to evolution was in a high school freshman biology course. His teacher, who David noted was a Christian, "always talked about evolution" but "he even told us one time that he didn't believe we came from apes. . . . But that was about the extent of his input on separating from the evolution hypothesis." Asked if learning about evolution bothered him, David replied that he was the "typical, lazy high schooler who just went with it and didn't question it." David clarified that his "main conflict with evolution really didn't start until probably the middle" of his freshman year at the state university, which he described as "pretty liberal." In his state university Zoology class, David said, "they were teaching evolution" and getting "hardcore into it." He added,

I was just like, “Whoa!” I don’t know if I believe this, especially with everything going on right now, the conflict between everybody about evolution. So I started kinda of looking into it some then and . . . as the years went by, I got more and more heavy into it and started reading and reading more about it and after . . . I read quite a few books about it, I was just like, “There is no evidence supporting this.”

During that period at the state university, David’s Christian values were tested. “I really did find myself challenged with a lot of things,” David said, so he read C.S. Lewis and “anything like that to help strengthen” his beliefs. When he transferred to the study site university as a junior, David felt supported in his beliefs. “Being on a Christian campus . . . really strengthened my faith a bunch,” he says, “A lot of the professors up here, they really . . . helped shape my ideas about Christianity and . . . what we should think about . . . certain topics in the Bible.”

By the time David took Origins as a senior, he already had his mind made up against evolution. “Especially as much as I had already read,” David noted, “I already knew all the points [of] evolution they were going to bring up and . . . the supposed facts they were trying to bring up to support it. It didn’t hold up.” The researcher, who audited Origins in the spring of 2006, noticed that David spent a good deal of time on his laptop during class. David grinned, “Yeah. Got in trouble a few times because I was being like, ‘Well, I’m tired of this’ and scanning the Internet or something.”

David recognized that his views about evolution in the Origins course were unique from his classmates’ views. He described Origins as a course that “was just straight about evolution and God, how they can mix and need to be. And that one was real hard for me.” Asked why it was such a difficult situation, David explained that the professor would not grade his scholarly paper, which contained arguments against evolution. He added, “She told me she couldn’t

understand how I could come to this conclusion and she gave it” to another professor to grade. David’s reaction was, “Golly! They gripe, scientists gripe about Christians being close-minded but I mean . . . she can’t even like read my paper and give me a grade for it.” He explained, “I’d always want to say something [in class], but I was just like, ‘I don’t really want to start up anything right now.’” His classmates would “all be backing evolution,” he noted, “and I was just like, ‘So I’m the loner here.’”

Throughout the second interview, David continually referred to evolution as a religion and philosophy: “I see evolution as a religion anymore. To me, it takes more faith to believe in evolution because I mean it’s a philosophy. It’s still hasn’t been proven to me.” His views were made clear on the Evolution Attitudes Survey taken prior to the second interview. Six of the twelve items were marked either “strongly agree” or “strongly disagree,” with a far greater degree of certainty than any other participant in this study. Throughout the interview, David provided a litany of reasons where evolution falls short: lack of fossil intermediates; the “biochemical challenge” to the origins of life; irreducible complexity; and the sudden, unexplained emergence of species in the “Cambrian explosion.”

David’s information originated from reading a wide range of creationist and Intelligent Design books, including *Darwin’s Black Box* (Behe, 1996). David wrote in his scholarly paper, “The major conflict with evolution is the biochemical challenge,” and he described the “hundred plus chain amino acid enzyme” formation as a “very large stretch.” David likened it to “a man claiming to be able to jump the Grand Canyon. You would immediately know it to be a lie.”

David saw himself as a “Young Earther,” stating with confidence, “I’ve looked at the facts and that’s what I believe.” As for the emergence of life, he offered, “God said, it was.” “There’s even evidence to support that just like the Cambrian explosion, we see a burst of life,”

he added. David claimed Noah's flood was a "great catastrophic event that would add time to the Earth," and give the Earth the appearance of old age. Radiometric dating was not necessarily reliable either, David noted, "[because] there might have been more of an abundance back then of Carbon-14 so it may make it look older than it is."

David doesn't condemn Christians who accept evolution. He noted that "if you're a Christian and you believe in evolution and you're fine with that, I'll tell you you're wrong and I'll point it out, but as long as we don't disagree on salvation, then that's fine." When the second interview turned to discussion of the theological implications of evolution, David considered it a moot exercise. He seemed unfazed by the theodicy issue and responded, "[The] killing of another species for this one to come about, the whole natural selection thing, . . . it doesn't bother me, but you know, like I've said, I'm not an evolutionist until they prove to me that it's true."

David saw religion and science as "100% compatible." When pressed to clarify, David said his conception of science does not include evolution. Anything that "stops questioning itself," David said, "is not science anymore." Asked for an example, David immediately replied, "Yeah, evolution, in one word." He pointed out that "those evolutionists out there . . . are just in this box and they can't see out of it and they're just, 'No you're wrong. Evolution's right.' and they don't question any facts that have been brought up to them." He added, "one of my big things now" is to "get on Facebook," an online college student social network and "get on all these groups and start debating with people and then there's those people that just get hot" and "start cussing me out about it."

Asked if he had learned anything from those people that disagree with him, David responded, "Yeah I really believe I have because . . . I find out that they're definitely closed-minded," because they are the ones who won't consider the evidence given them. David

continued, “Scientists claim they’re some of the most open-minded people but I don’t guess they understand the whole definition of being open-minded.” David didn’t see himself as close-minded: “Whenever they automatically just throw that back at you, . . . that’s a big key right there that’s showing that they’re close-minded.”

A recurrent theme throughout David’s answers was his concern over atheism. He expressed some form of the word “atheism” 18 times in the second interview. In David’s mind, atheism was inseparable from evolution. He explained,

That’s the big thing atheism is founded on, you know, is Darwinism. They have to have that for atheism to be true. Without evolution, atheism has nothing to stand on because . . . they’re at a dead end.

David connected evolution and atheism to a host of social problems. Asked whether Intelligent Design should be taught in schools, David embarked on a long diatribe about how evolution should not be taught in the science classroom, and how he was “angry that they cut off Christianity,” and that freshmen were being forced to read the Koran in state-funded colleges. David then turned to capitalism and stated,

Our country . . . was founded on Christian beliefs. . . . There is no separation of church and state. Those were two ideas that coincided together and that’s how capitalism works. I mean without those religious beliefs we have no morals. Without any morals, capitalism does not work.

David used Enron as an example and stated, “that’s where the whole atheism communism point comes into view because government’s God then.” David continued about how “secular progressives have really pushed morals out of the school by taking Christianity out of the school.” Then after discussing the welfare system and unwed pregnancies in the “black”

community, David came full circle to conclude, “I really believe that push to take Christianity out has definitely pushed us, our country down the toilet. I mean it’s getting worse everyday.”

This four-minute long monologue revealed David’s typical line of thought that linked evolution to societal issues. One further example reinforces this important point. To clarify David’s perspective, the researcher asked,

If I understand you right then, they’ve got this thing called evolution and you’ve looked carefully at the facts and that’s why you don’t believe things like macroevolution are true. But alongside of that, there are also other concerns that you have as well, about its effects . . .

David immediately stepped in and finished the sentence:

Effects on society. Yeah, it’s a – I believe it would be very harmful and thank goodness we have people like Reagan, that really took an effort to take that out of society. I mean the only big communist nations left are Red China and North Korea.

David saw one positive aspect to evolution – he can use it to proselytize non-Christians. He wrote in his scholarly paper, “My whole thing is if I can lead someone to Christ, then I will talk to them about this [evolution].” Asked if learning about evolution had changed any of his views about God, David was dismissive. “If anything, it’s brought me closer [to God],” he said and added as a reminder, “Because like I’ve said, I’m not an evolutionist.”

*David, Participant 15 – Faith Stage Analysis*

David’s Fowlerian faith stage score was 3.0. He appeared to function in an authority-bound and dualistic mindset placing an unexamined trust in external authorities, such as creationist authors and political pundits, to determine the right course of action and construct his

ideas about truth. David tended to operate in an “us” versus “them” mentality where outsiders not like “us” must be wrong.

David operated in the dependent/counter-dependent phase as a form of dependence. Parks (1986) describes this phase as when a “person’s sense of reality and what is fitting and true is dependent upon a sense of felt relationship to an ethos of assumed Authority” (p. 55). David’s construction of reality and truth was highly dependent on the conventional ethos that is advanced by conservative, social commentators. He felt a particular kinship to Republicans and anti-evolutionists and appealed to those groups’ conceptions of the way things should be.

Persons operating in faith stage 3 tend to select their authorities based on appearances and personal charisma (Fowler, 1981). David listed high-profile Republican senators and congressmen as persons he respected because of “what they stand up for.” He specified, ‘Cause like Tom Delay—he was a man of action. He really got things done and he stood up against what he believed was right and he didn’t back down. You know he was like the pit bull that’s got an animal around the neck. He don’t let go.

Noticeably absent from David’s statement of admiration was any reference to the substance or quality of what Delay stood up for. David appeared to be comfortable in this dependence with little readiness to explore its superficiality in a counter-dependent manner.

Limited perspective taking was evident in many of David’s answers. One example was his response to the question about how people should resolve their religious differences. Working from an inward perspective, David answered, “If you bring facts into the conversation, then it will snuff out any disagreements that you have,” and continued, “Even if they still don’t understand, . . . just say, ‘I’ll talk to you about it later.’” David’s answer revealed no hint that there was something to learn from someone who disagreed with him.

Parks (1986) notes that persons who operate in a conventional faith stage will draw boundary lines to include only “those like us.” David identified his closest friends as those with similar political biases against the Democrats. Asked if he or any of his friends think differently from each other, David responded, “We’re all conservative traditionalists so we’re . . . all about keeping our country the way it was founded.”

Another important aspect of David’s conventional form of community is his mother. He is still very close to her. David is asked if there was ever a time in his life when he thought what he were doing was right, but his mom thought differently. Did he ever have to go against what she said? David replied, “No, my mom was always right. Every time she’d tell me something, she’s been right.”

In summary, David operated in the conventional stage of faith marked by an authority-bound form of cognition, dependent form of dependence, and conventional form of community. Parks (1986) writes that transition to the young adult stage “typically occurs in the discomfort” of finding that established patterns of cognition, affect, and community-forming “do not accommodate lived experience” (p. 47). David experienced disequilibrium in his freshman year at the state university in his confrontations with evolution. Instead of evaluating his worldview and system to decipher what is true, David appears to have become entrenched in his conventional faith, even to the point of avoiding further change when he was immersed in a more Christian-supportive environment at the study site university. The greatest opportunity to reevaluate his worldview may have occurred in the context of studying evolution in the Origins course. Yet, David remained relatively unchanged in his perspectives by the end of Origins. The relationship between David’s faith stage and his views on evolution are further examined in the next section.

### *Similarities in Backgrounds*

Michael and David shared the greatest degree of similarity in backgrounds of all the participants in this study who had dissimilar faith stages and views on creationism and evolution. In comparing the faith stages of Michael and David, their similarities are first examined to provide a contextual backdrop with which to investigate differences in form of cognition, dependence, and community. Relevant views of creationism and evolution are also considered.

David and Michael have much in common. Both were the only boys in their families and each has an older sister. David also has a younger sister. David and Michael acknowledged their mothers as the primary spiritual influence in their formative years. Each had perceived some threat to their Christian values in the past – David in his first two years at a “liberal” state university and Michael while attending high school in an “anti-Christian” west coast state.

Both experienced significant personal, spiritual events. Even though David was “saved real early” in his life, it wasn’t until he felt challenged at a state university that he “matured” and “started understanding a lot more” about the dynamics of his Christian beliefs. Michael remembered becoming a Christian at age three but became “more serious about church” and his “faith” in the eighth grade.

One important point of departure between the two is their articulation of changes in personal beliefs. Michael observed, “Especially through college, some of my ideologies sort of freed up and . . . there can be different things besides just what . . . you grew up learning [in] the Bible stories.” Asked how his religious views may differ in the future, Michael replied, “I don’t really think of it as differently,” but instead, “as adjusting or adapting . . . because you don’t just get new information and then throw everything else out. . . . You incorporate it into the rest and then it becomes a new belief but not on its own, just with everything else.” In contrast, David

spoke very little of changes in his own religious perspectives. David instead focused on the deepening of his beliefs. He spoke of having his faith “strengthened” and explains, “I feel like I know more about Him [God] so he’s a lot more personal now.”

Both Michael and David had a close set of friends with whom they enjoyed spending time. Michael was married and David was single. Still, Michael didn’t refer to his spouse as an influential change agent in his life. He simply stated, “I’ve enjoyed married life a lot.” The differences in the ways Michael and David are influenced by their friends are discussed below.

David’s church background was Baptist while Michael’s was the same denomination as the study site. David credited his study site professors as helping shape his “ideas about Christianity” so it’s not surprising that similarities in theology emerged in their interview responses. For instance, both referred to free will when accounting for evil in the world. In many ways, the contents of their beliefs were similar, although Michael’s ideas tended to be more nuanced.

The context in which their views of evolution developed is an important consideration. Both had their first significant exposure to evolution in high school. David reacted negatively to evolution while taking Zoology as a freshman at a state university. During this time, he “read quite a few” Intelligent Design books that solidified his stance against evolution. Michael also read anti-evolution literature, including “the classic watchmaker” argument while in high school. Even though he was “leaning towards” creationism in high school biology class, Michael was becoming more open to the possibility that “God could’ve created by evolution.” Michael didn’t mention freshman Zoology as a pivotal course in developing his ideas about evolution in contrast to many of this study’s other participants. Rather, he gradually formed an acceptance of evolution during his junior and senior year in courses such as Comparative Anatomy and

Origins. Michael arrived at a point where he could say with assurance, “I can see some of this evidence. This makes sense to me. There’s a lot out there. I think this is definitely valid.”

David and Michael were in the same Origins class and exposed to the same presentations about evolution and the constructive ways in which an acceptance of evolution can coexist with personal religious beliefs. David apparently had already formed a rigid position against evolution by this time and was not swayed.

Both David and Michael were familiar with Intelligent Design arguments. Each gave unsolicited probability arguments quoting numbers that questioned the scientific basis for the origins of life. However, Michael singularly qualified Intelligent Design as a philosophy and stated that aside from “the argument about probability [of the origins of life], . . . there’s no evidence they [ID proponents] use for it.”

David and Michael both expressed anger when discussing people’s perceptions of evolution. David railed against “those evolutionists out there” who are “close-minded” and ignore the evidence against evolution. In contrast, Michael was frustrated at Christians who eschewed evolution and ignored the evidence for evolution.

In summary, David and Michael shared many common experiences. The relevant question that follows is, “Why were their views towards evolution so disparate?” One possible explanation was the different university milieus in which they learned about evolution. David’s exposure to evolution occurred in freshman Zoology at a secular university. He did not mention any Christian scientists or professors who served as role models in supporting evolution during his time at the secular university. Instead, creationism books served as his guide.

Michael also received limited exposure to evolution as a freshman in Zoology but his experience was at a Christian university, the study site. His professor acted as a Christian role

model in support of evolution. But Michael was quick to point out that while his Zoology professor was “a big proponent for pro-evolution, . . . I still didn’t want to just be like, ‘Well, because she thinks it, I’ll just believe in evolution without believing in any facts.’” Michael ultimately decided for himself to accept evolution during his junior and senior year in the very same environment in which David also participated.

The above analysis suggests that something other than the differences in their backgrounds, freshman Zoology courses, and access to Christian professors account for David’s and Michael’s contrasting perspectives. Their faith, the way in which they ascertained truth and made meaning in the world, had profound implications for the manner in which David and Michael approached evolution.

#### *Faith Stages and Views About Evolution and Creationism*

The last two rows in Table 4.3 contrast Michael’s and David’s stages in faith development. David operates fully in a conventional faith stage while Michael operates fully in the adult faith stage. An important follow-up to analysis of David’s and Michael’s faith stages is to explore the connections between how they make meaning of the world and how they view evolution and creationism. Three concepts are explored in David’s rejection of evolution: avoidance of ambiguity; lack of other’s perspective taking; and fear. Each of these is contrasted to the way Michael approached evolution.

#### *Ambiguity*

Parks (1986) writes that for a person in the authority-bound/dualistic cognitive mode, “there is little or no tolerance for ambiguity” (p. 45). This is evidenced in David’s reaction to evolution. His statements lacked even a partial acknowledgment of evolution’s validity or any hint of evolution’s usefulness as a theory to understand changes within nature. There was such an

absence of multi-faceted perspective that it became nearly impossible for him to objectively consider evidence that might support evolution. David stated early in the second interview,

Even if it [evolution] does turn out to be true, we find those missing links between every individual type of animal, then I mean it's still really gonna bother me in my – you know, the Genesis story could be true or it could be an exact way of how the earth was formed, but then also it could be an analogy so I mean either way, God's going to do it whichever way He wanted to. But I personally believe that – I believe the Genesis story is true.

David's statement hinted that if convincing intermediate fossils were found, he might be open to the possibility of considering Genesis as an analogy. Still, he was rather hesitant in pronouncing this. He stated near the end of the second interview,

If they could possibly even bring about the fossil records, supposedly the big one that supports it, I mean they'd have to bring about biochemical – they couldn't just say, "Hey, we've found all these fossils that do intermediates." They'd have to go through and show how those – the chemistry came about. It's, that's going to be a lot harder to do.

David thus qualified his earlier statement in which he claimed to be open to considering evolution if intermediate fossils were found. In the later statement, he dismissed that option and claimed that the biochemical challenge must also be addressed. It's as if David created a moving target so that the available evidence for evolution, regardless of how persuasive, was unable to compel a change in his thinking. Without significant change to his authority-bound and dualistic mindset, David may not be capable of making a balanced assessment of evolution's validity.

In contrast, Michael's tested commitment allowed him to accept evolution even with a lack of definitive scientific answers regarding the origins of life. Parks (1986)

notes, “The cognitive style of inner-dependent and tested adult faith remains dialectical” wherein “tensions may be maintained rather than collapsed” (p. 93). In the midst of the ambiguity when the answers are not known, Michael was open to considering that science may eventually find a solution to the abiogenesis issue:

There may be something more that we don’t know about that God designed in the system, not like Intelligent Design . . . ‘cause they use it as almost a philosophy, but there’s something he put in there that helps us evolve in certain ways.

The researcher noted in his reflection journal after the second interview that Michael, in spite of not having all answers, “is ready to let God do God’s thing – he has reached a level of understanding where his faith is not flogged by . . . [inconclusive scientific] revelations.”

#### *Perspective-taking*

The categorical polarization of persons into distinct groups was consistently found in David’s references to evolutionists, such as, “*they* [italics added] don’t question any facts that have been brought up to *them* [italics added].” In contrast to David’s “us” versus “them” mentality, Michael was more inclusive of those who disagreed with him. He lamented that when Christians categorically reject evolution, “it makes *us* [italics added] sound stupid when *we* [italics added] defend creationism till the last against people who can see that at least there’s evidence for evolution . . . and that just turns people away because *we’re* [italics added] being ignorant and stupid.”

David’s “us” versus “them” mentality, as part of his conventional faith, inhibited perspective taking from a disparate point of view. When asked if he had learned anything from people that disagreed with him regarding evolution, David replied, “If they can prove to me that it’s true, I’ll take it. But those people, no matter what you give them, they won’t believe you no

matter what.” From David’s stage 3 perspective, it was difficult for him to imagine that anything constructive could be learned in a discussion with “those people” so different from him.

Michael is different from David in that he did not seek to elicit arguments from others about evolution. Michael lamented how Christians are “ignorant and stupid” when it came to evolution, but he recognized that they feel threatened by what they see in evolution. He said,

Here’s the thing. I could go start an argument probably if I went back to my church and talked to some 70 or 80 year olds and be like, “You need to believe in evolution,” but that’s not how you change things in the church and that’s not productive in any way. All that does is cause division so that’s the struggle there when you’re frustrated with how people are teaching. . . . You can’t always just go contradict because that causes more problems then maybe you had before. It’s a fine line.

Michael demonstrated a willingness to consider others’ perspectives, and judge whether the outcome of arguing with others was worth the associated risks to relationships and beliefs.

Michael and David both firmly held to their beliefs when discussing evolution with others. But Michael alone recognized that others feel the way they do because of their own unique experiences and it was okay to for them to think that, even if Michael considered them wrong. In contrast, David saw his perspective as exclusively legitimate and therefore set out to change anyone who disagreed with him. David’s lack of perspective-taking inhibited him from seriously considering the alternative to his extant creationist beliefs.

### *Fear*

David did not explicitly admit a fear of the evolutionary theory’s effect on society, but many of his statements in both interviews belied an apprehension of the current state of affairs in

American society. Following the second interview, the researcher recorded his impressions about David's perspectives in a reflective journal:

It's one thing to reject evolution based on facts, but I sense that there is something else going on there as well. It's not just [the facts of] evolution but the whole accompanying notion of Darwinism [the social implications of evolution] which possibly makes David retreat into a rejection of the science.

Parks (1986) writes that for a person with a dependent form of dependence, feelings of "rightness, hope, fear, loyalty, disdain, or alarm can be determined by Authority," including "others who serve individually or collectively as trusted mediators of Truth" (p. 54). Acquiescing to accusations that Intelligent Design proponents and political pundits level against evolution, David claimed, "Some of the most terrible, gruesome nations that went through and killed many of their people was based off atheism and Darwinism." Asked if he worries what will happen to the United States if there is greater acceptance of evolutionary theory, David responded,

I really do because I mean if that really starts getting pushed, what's moral? Murder itself could even be considered moral without a higher Being to come in and say, "No, that's wrong. That's evil."

Fowler (1981) notes that persons in Stage 3 can resist "invitations to awareness of and a more conscious responsibility for their beliefs and values. They reaffirm their reliance on external authority and their commitments to their particular values" (p. 162). David appeared to operate in this mode. He had tacitly formed within his mind an ideological construct of the way things should be. His fear of a widespread acceptance of evolution leading to a societal breakdown of morality and a failure of capitalism inhibited an impartial assessment of evolution's validity. Dualistic thinking further led to a categorical rejection of evolution.

When persons critically reflect on the formation of their beliefs and values system and are open to change, they may transition to the next stage in faith development. Michael appeared to have gone through this process. He uses the verb “graduate” to reflect how his thinking had moved beyond his mother’s thoughts about Christianity. He stated, “As far as evolution . . . goes, I’d say that’s my biggest stage of . . . opening up more.” Michael was willing to consider the scientific evidence and when it conflicted with his assumptions about the Bible, he was open to reexamining his own views on scripture. He lamented that creationists don’t do the same:

They’re just forcing creation to fit this mold that the Bible makes and it kind of rams a square into a circle or something like that, you know? Just because they think that’s the easiest for them and that’s what they want to hold on to.

Even at the time of his interviews, Michael remained open to changing his ideas based on the available scientific evidence. When discussing Noah’s flood, Michael commented, “I’m not totally closed minded to that [flood geology], but that’s not what the evidence shows us.” There was no hint of fear or anger in Michael’s comments about evolution interacting with his personal religious beliefs.

To summarize, Michael’s and David’s faith stages played an important role in their mediation of evolution and personal religious beliefs. David acted in conventional faith when he uncritically acceded to arguments made by pundits, many of who are non-scientists. Unable to isolate his fears of atheism from the scientific evidence for evolution, David distorted the disparity between his religious beliefs and mainstream science into a dismissive attack against evolution. He remained protected in his personal world only if evolution was false, the Bible was literally true, and Christianity and its principles were not questioned. David safeguarded for

himself an equilibrated position, but one that was specious and repudiated established scientific evidence.

Michael displayed a tested adult faith whereby he found reconciliation between evolution and his personal religious beliefs. He accepted the evidence that supported evolution and negotiated his beliefs of the Bible's literalness. Although Michael claimed probability arguments cast doubt on protein synthesis by natural means, he was willing to let science find an explanation and allowed God to work through natural processes. In other words, Michael reached an equilibrated position wherein arguments against evolution did not overthrow the preponderance of evidence in support of evolution, and science was not pitted against religion. Michael described his position well: "I believe evolution is probably true, but that doesn't mean that that comes before God. I just think that's the way He did it or the way I incorporate the creation into my beliefs."

The sharp distinctions between the creationism-evolution perspectives of two participants in disparate faith stages that were explored in this section form the boundaries for a wide range of views that were present in this study. When the perspectives of all 15 participants were considered in aggregate, patterns began to emerge that were representative of the larger collection of participants within the study. These patterns are explored in the next section.

#### Introduction to Categories, Themes and Sub-themes

Data analysis revealed patterns and recurring themes in the data. Broad themes were disaggregated into sub-themes. Consequently, the themes and sub-themes are key outcomes of the data analysis of this study. The themes are not meant to stand alone. Rather, the themes are meaningful when viewed within the entire context of the study. Categories are groupings of

themes to facilitate presentation. The categories' relationships to the central research question and sub-questions are discussed further below.

The categories are ordered to facilitate an understanding of participants' experiences in negotiating evolution and personal religious beliefs. Category 1 delineates the primary factors that influenced participants' views on evolution and creationism. Category 2 examines the meaning participants gave to science and religion in their lives. Category 3 identifies the nuances of participants' views on evolution and creationism. Category 4 describes the process of participants' reconciliation of evolution and personal religious beliefs. Category 5 explores the relationship of participants' faith stages to their acceptance or rejection of evolution.

As this study is a naturalistic inquiry, the themes and sub-themes are not quantitative. Instead, descriptive words such as "most," "many," and "some" convey the extent of a pattern to which the theme or sub-theme applies. "Most," in the context of this study with 15 participants, indicates ten and greater, or two-thirds of the participants, but not all participants. "Many" is more than five but less than most, or one-third of the participants. "Some" indicates less than five but still represents a meaningful extent. Each of the themes and sub-themes is extensively discussed later in this chapter where numerical data are presented and support the designations of most, many and some.

Table 4.4 is a summary of the categories and themes. The sub-themes are further delineations under each theme and are presented in the discussion of the categories and themes, which follow Table 4.4.

Table 4.4  
*Overview of Categories and Themes*

Category	Theme
1 – Influences on participants' views of creationism and evolution	<p>1.1. Participants viewed parents as a strong influence.</p> <p>1.2. Participants viewed professors as influential role models.</p> <p>1.3. Participants viewed church, friends, siblings, and spouses as moderate influences.</p>
2 – Participants' perspectives on science and religion	<p>2.1. Participants trusted and valued science as a way of knowing.</p> <p>2.2. Participants trusted and were committed to their personal religious beliefs.</p> <p>2.3. Participants desired a positive relationship between science and religious beliefs in their worldview</p>
3 – Participants' extant ideas about creationism and evolution	<p>3.1. Participants' views on abiogenesis varied</p> <p>3.2. Most participants viewed evolution as a valid explanation for the diversity of life on Earth</p>
4 – Participants' reconciliation of their understanding of evolution and personal religious beliefs	<p>4.1. Most participants' acceptance of evolution was a process of conflict resolution and apprehension.</p> <p>4.2. Four factors facilitated participants' acceptance of evolution: relying on the evidence for evolution; negotiating Genesis as non-literal; recognizing evolution as a non-salvation issue; and observing professors as role models of Christians who accept evolution.</p> <p>4.3. Participants viewed God as active in the world, but were uncertain of the extent of God's role.</p>

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Category	Theme
5 – Faith and reconciliation of evolution and personal religious beliefs	<p>5.1. Participants operating in adult faith were deferential to scientific evidence while some participants operating in conventional faith disregarded scientific evidence.</p> <p>5.2. Participants operating in adult faith stage displayed a nuanced approach to perceived tensions between evolution and their personal religious beliefs while participants operating in conventional faith avoided confronting their perceived tensions.</p>

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*Relationship of Categories to the Study's Central Question and Sub-Questions*

As the interview questions were driven by the study's central research question and sub-questions, the categories were also related to the central question and sub-questions. The central question of this study was: How do Christian biology-related majors at a Christian university reconcile their understanding and acceptance of evolution and their personal religious beliefs?

The four sub-questions were:

1. What factors influence participants' perspectives on evolution and creationism?
2. What are participants' extant views on evolution and creationism?
3. What aspects of evolutionary theory and personal religious beliefs create dissonance for participants?
4. What is the role of participants' faith in reconciling their understanding and acceptance of evolutionary theory and their personal religious beliefs?

Four of the five categories directly relate to the sub-questions. Category 1 is correlated to sub-question 1. Category 3 pertains to sub-question 2 and Category 4 is associated with sub-question 3. Category 5 and sub-question 4 are related.

Category 2 emerged from the data related to sub-question 2 as an important consideration in understanding participants' views towards evolution and their own religious beliefs. If participants have low regard for either science or religion, then there is little incentive to confront any tensions that may exist between their understanding of evolution and their personal religious beliefs. Or if participants, as part of their worldview, completely isolate science and religion from interaction, they may ignore any perceived conflicts between the two domains. But if participants value both science and religion and desire a cohesive interaction as integral to their worldview, then participants will endeavor to confront perceived conflicts. The data showed that most participants desired a positive interaction between science and religion, and Category 2 provides important contextual information for the way participants mediated their understanding of evolution and their personal religious beliefs.

Each of the categories, themes, and sub-themes are discussed in detail below. Evidence, in the form of participants' interview statements, scholarly paper quotations, and the Evolution Attitudes Survey data are used extensively to reinforce the themes and sub-themes.

#### Category 1 - Influences on Participants' Views of Creationism and Evolution

Theme 1.1 states that parents are a strong influence in participants' lives. All 15 participants listed one or both of their parents in the "Key Relationships" or "Authorities" column in their Life Tapestry Exercise. Six female participants articulated an equally close relationship to each of their parents. Five of the female participants felt closer with their fathers than their mother. Only one female participant expressed a closer relationship to her mother. All of the male participants in the study expressed that they were closer to their mothers.

All 15 participants testified to their parents' enduring influence on their lives. Eleven participants conveyed that they continue to seek their parents' opinion, most often in the form of

financial advice. Nine participants in their faith development interview identified one of their parents as a model of a person of mature faith. The following quotations are a sample of participants' expressions of parental influence.

My parents definitely have developed me as person. . . . Just growing up as a Christian, they had standards. (Stephanie, Participant 2)

I think they've had the most influence on my life throughout the whole 20 years. (Megan, Participant 3)

My parents have always been . . . the two people I look up to the most. Like everything that I believe is based off my parents. . . . Even the way I vote is based off the way my parents do because I have that much respect for them. (Diana, Participant 4)

Sub-theme 1.1.1 states that most participants' parents raised them to believe in creationism. Diana, Participant 4, was the only exception to this dominant trend as seen in Table 4.2. Two patterns emerged from the other 14 cases in this study: parents clearly espoused creationism in the home; and participants vicariously perceived their parents' belief in creationism through the church culture in which they were raised.

In eight cases, one or both parents expressed a strong belief in creationism throughout the participants' childhood and expected participants to hold similar beliefs. In five of the eight cases, parents were so fervent in their belief in creationism that they engaged in heated arguments with the participants in their process of accepting evolution. In the other three cases, the participants evaded conflict with their parents by avoiding any discussion about evolution.

In contrast to the eight cases above, six participants perceived that their parents believed in creationism, but primarily because creationism was part of the participants' upbringing in the church. In other words, parents' expression of their belief in creationism was less pronounced

than in the other eight cases. For example, Tiffany, Participant 6, never mentioned her parents' views on creationism, but she was cognizant of the church culture in which her parents immersed her. Tiffany reflected,

Growing up in the church you always hear the Bible story of the Creation, 7 days – well, 6 days and then you take a rest day and Adam and Eve and she came from the rib and he named all the animals – this isn't necessarily in the right order, but you know all the basics.

Elizabeth, Participant 13, is another participant whose parents did not emphatically espouse creationism in the home. Asked if she knew what her parents think about creationism and evolution, Elizabeth replied,

No, to tell you the truth, I don't really think I know what they think about it *now* [italics added]. . . . I just figured my parents believed in creation and to me, evolution was crazy at that time [in high school] so I guess I just thought they wouldn't believe in evolution either.

Apparently in these six cases in which parents did not emphatically espouse creationism in the home, they may not have felt compelled to do so. The participants in these cases were learning creationism in church and in Sunday School. In five of the six cases, the participants did not study evolution while in K-12 schools so the subject may not have been broached in the home. And while the six participants were students at the study site university, none of them apparently mentioned their study of evolution to their parents. Whatever the reason creationism was not espoused in the home, participants vicariously perceived their parents' views on creationism as part of their upbringing in the church.

The three following quotations summarize Sub-theme 1.1.1 where most parents raised participants in a culture that avowed creationism.

I'm pretty safe in saying from the time I was born until high school senior year, the first chapter of Genesis was literal. That's just how I was raised. . . . Nothing was ever questioned. . . . Not that they [my parents] said everything in the Bible is word for word true, . . . but no one ever said the opposite, that it wasn't literal. So I just assumed that it was. (Ashley, Participant 5)

Ever since I've grown up in Sunday School, church, just everything I can remember, it's always, "God created in . . . six literal days." That's how it happened. . . . I don't ever remember anyone saying otherwise. I never heard otherwise. . . . I always assumed that it is an accepted world belief. Everyone . . . who is a Christian . . . believes[s] that Genesis is literal. (Rachel, Participant 8)

My family was . . . very much of the Genesis is the golden rule. God created the earth in seven days. That's how it happened, no questions asked. If you asked questions, . . . you were thinking too hard about it. (Nicole, Participant 11)

Sub-theme 1.1.2 states that many parents actively pressured participants to reject evolution. Many participants recalled the anti-evolution sentiments they had heard from their parents in childhood. Asked about where she acquired her negative view of evolution before enrolling at the study site university, Gail, Participant 1, replied that she assimilated it through conversations she had overheard as a child, "just people talking at church, my parents struggling with it." She added, "[Evolution] was bad because that's how my parents saw it and my grandparents and just you know, 'What is the world coming to?' I remember being very passionate about it being false and wrong."

Rachel, Participant 8, recalled hearing her parents' conversations, such as, "Darwin is a tool of the devil and . . . he's led so many people astray from God and that's just terrible and don't get sucked into that because it's the devil working through him." Rachel added, "I'd be kinda listening in" and soon enough, she found herself saying to her high school friends, "Oh yeah, I can't believe these evolutionist liberals." She commented, "Those two words always went together – liberal and evolutionist!"

Jennifer, Participant 7, also assimilated negative views towards evolution from her parents. Whenever her parents spoke of "evolution stuff," they would pejoratively append, "and that's not right." In high school, Jennifer thought of evolution as "kind of a theory. . . . It was just something . . . good for the scientists, but that's not what happened." She recalled in her junior AP Biology class that the teacher announced, "Well, I teach evolution as a theory, not as a scientific explanation." Jennifer laughed as she recounted, "My mom was real happy that I was having her for my teacher."

For many participants, the anti-evolution sentiments they'd heard in childhood continued while they were learning evolution at the study site university. Several parents expressed displeasure that their daughter or son was learning evolution at a Christian university. For example, when Jennifer, Participant 7, enrolled in the Origins course, she began to share her new ideas about evolution with her parents. She recalled they became increasingly "apprehensive about things." Jennifer could tell by their body language and, as she described, [the] kind of looks they give me whenever I'm like, "Well, what about this [evidence for evolution]?" Because I get real kind of built up about things like this . . . and I'm like, "But this is what I learned in college" [shouting as she says this] and I bring my papers

home and I'm like "Look at this" [pounding the table] and they're like a little skeptical.

. . . You kind of see it in their eyes and they furrow their brow and stuff like that.

Five participants, including Jennifer, reported that they had engaged in heated arguments with their parents over creationism and evolution. The parents denied evolution as a valid theory and charged that evolution is contradictory to the Bible. For example, Rachel, Participant 8, recalled tense exchanges with her father. They would get into arguments and "become angry." She recalls the gist of his comments, "Why are you thinking this way? We sent you off to a Christian school [and] you are learning all this liberal garbage?"

Furthermore, all five participants indicated their parents viewed a literal interpretation of Genesis as a necessary condition for salvation. Rachel remarked, "I have been taught my whole life you can't be both [a Christian and an evolutionist], that's just not how it works." Gail, Participant 1, felt so pressured on the matter that she formulated her scholarly paper as a letter to her father. The genuine emotion of her plea merits quoting at length below. The title of her paper in Origins was "Dear Dad..." and the following are excerpts:

Dear Dad,

I am writing to explain to you what I have learned in my origins class this spring. . . . You and mom have always had a strong belief that God created the earth in six twenty-four hour days as outlined in Genesis one; however, probably much to your horror, this class has challenged that belief. Please keep in mind that this class never once challenged the existence of God. . . . It set out to explain *how* God created the earth.

Later in the paper, Gail implored her father, "Please do not question my walk with God." She explained how theologians "consider Genesis one to be a Hebrew poem," and that the "Bible was not written as a scientific journal." Gail concludes her paper with,

Dad, I know this letter is probably discouraging to you – maybe someday I will be convinced otherwise, but this seems very logical and practical to me. I pray that you will not condemn me in your disappointment, but understand that it is not a contingent factor in my salvation... I pray you have at least been open to this letter and accepting of my stance.

Your Loving Daughter, Gail

Asked why she wrote the paper to her father, Gail responded, “I was . . . just trying to convince him that . . . I hadn’t gone off the deep end, [that] I wasn’t crazy.” Gail considered the paper as “a little therapy session getting everything I wanted to say to my dad out on paper and it just almost felt like I was relieving a burden.” In the two years since she completed the paper, Gail still hasn’t given it to her father.

The emotional stress that many of these participants experienced in forming increasingly independent views about evolution in direct opposition to their parents cannot be understated.

Rachel, Participant 8, remarked that arguments with her father never degenerated into “hatred,” but it did create, as she described, “kinda a space between us.” She wrote in her scholarly paper,

I have to ask God to give me patience to not hate the men who cause me and my dad to argue about origins. I think that if they could just realize that science is not out to destroy God then maybe they would give it a chance.

Sub-themes 1.1.1 and 1.1.2 demonstrate that most participants’ parents raised them to believe in creationism and many parents actively pressured participants to reject evolution while at the study site university. Sub-theme 1.1.3 states that many participants, regardless of how close their relationship with their parents, claimed a worldview that was distinct from their parents’ worldview. Sub-theme 1.1.3 is a qualification of the previous two sub-themes in briefly

exploring many participants' current relationships with their parents and those participants' perceptions of their own unique worldviews.

Whatever past or ongoing conflicts participants may have had with their parents regarding evolution, the data showed that many participants continued to maintain a close relationship to their parents. In seven cases, participants communicated with their parents as frequently as or greater than once a week. As an extreme case, Diana, Participant 4, called her father every other day and her mother three times a day. The following three quotations demonstrate the close relationship several participants had with their parents:

Me and my mom are inseparable since I've graduated. I mean, she's at my house every single night, and we do things on the weekends. (Ashley, Participant 5)

It's just definitely a very close relationship. . . . Even like, weird personal things that most people wouldn't ask their parents, . . . I feel fine talking to my parents about. And even now . . . I can call my parents a couple times a week. (Jennifer, Participant 7)

And my family is a huge commitment that I want to make, that I want to be there for them and make sure they're okay and so I call my dad like everyday, just to talk and to see what's going on. (Rachel, Participant 8)

Ten participants expressed in general terms that their views did not, as John, Participant 12, expressed, "fall in line" with their parents. Michael, Participant 14, talked to his mother "every once in a while," and said, "I love my mom and our relationship is pretty good." However, Michael qualified, "There's always that point where you kind of graduate from just thinking your parents' thoughts about Christianity." Elizabeth, Participant 13, expressed a similar sentiment of "learning to be my own person and not just accepting everything that my parents had taught me." Rachel, Participant 8, who talked to her father "like everyday," said,

When I first came to [the study site university], . . . I was still carrying with me my parents' opinions on things and so I really wasn't thinking for myself. . . . [But] just because me and my dad don't agree on something doesn't mean that the whole world's going to end. . . . I learned that I do have different opinions than my family on certain things and that's okay because they are still family and I have a right to think for myself and to think independently of them still taking their opinions into consideration but really ultimately making my own decision. (Rachel, Participant 8)

Jennifer, Participant 7, who was a single child, remained very close to her parents and said, "I've come to respect their opinions about certain things a lot more. At the same time, I've come to realize that maybe they're not always right in every single thing. . . . It's okay for me to think differently than them." Jennifer and many participants demonstrated an independence from their parents in forming their own unique worldviews.

Summarizing Theme 1.1, participants viewed parents as a strong influence in their lives. In most cases, participants were led to believe in creationism during childhood, either directly from their parents or within the church. Many parents aggressively pressured participants as university students to reject evolution. In spite of past or ongoing struggles over evolution, many participants maintained a close relationship with their parents. However, many participants also claimed a worldview unique from their parents.

Theme 1.2 states that participants viewed professors as influential role models. All 15 participants stated that professors had made a significant impact in their lives. For instance, Diana, Participant 4, stated that science professors helped her find a positive interaction between science and religion in her life. David, Participant 15, credited his Bible professors for strengthening his faith and shaping his ideas about Christianity.

Two patterns emerged in participants' descriptions of their professors' general influence: participants respected professors who were genuine and forthright in presenting evolution in a Christian context; and many participants respected professors who demonstrated a commitment to both science and religious beliefs. The first pattern is further addressed in Sub-theme 4.2.4 in the context of important factors that facilitated participants' acceptance of evolution. Sub-theme 4.2.4 is a specific examination of the reasons Christian professorial role models enabled an acceptance of evolution. In Sub-theme 1.2.1 below, the general qualities of professorial role models are explored.

Sub-theme 1.2.1 states that many participants respected professors who were genuine and forthright in presenting evolution in a Christian context. Seven participants expressed this sentiment. Elizabeth, Participant 13, was asked which aspect about a particular Bible professor made an impact on her – was it his scholarly credentials or was it the manner in which he interacted with the class? Elizabeth replied,

I think it was probably both. I mean he is obviously a very intelligent person [whom] I learned from the very first day in class. And he did seem very genuine and straightforward in just telling us what he believed so I guess it was a little bit of both.

Ashley, Participant 5, made similar comments about the Origins professor:

She has such a humble, low-key sense of spirit that . . . I respect everything that she says and to me she really is true. It was helpful to know that the person standing up there teaching me wasn't trying to number one impress their opinions on to me. They were just giving them to me and that they weren't out to prove something. I really felt like she wasn't trying to prove creationism and she wasn't trying to prove evolution. She was just

presenting things and in turn letting you decide where you stood, but she would give you her opinion.

Rachel, Participant 8, noted that it wasn't enough for the Origins professor to simply claim to be both a Christian and evolutionist – she needed to see it demonstrated from her professor. Rachel explained,

They can say they're Christian and be an evolutionist, but it would really help for Dr. [Origins professor] because she actually showed you. She'd talk about God so passionately and . . . you knew she was speaking from her heart. You knew she believed it and God's love, but then she also talked about evolution and so you kinda had to reconcile the two [Christianity and evolution]. . . . My whole life it was just two things that were separate and they must stay separate, but with her they kinda came together and you had to reconcile them.

The latter half of Rachel's statement leads to Sub-theme 1.2.2, which states that many participants respected professors who demonstrated a commitment to both science and religious beliefs. Six participants valued the influence of professors who authenticated a positive relationship between science and religious faith instead of isolating the two domains from each other. This is reflected by Diana, Participant 4: "Being at a Christian university helped me in a sense that they [science and religion] were always put together." Asked if she saw her science professors as good role models in the classroom, Diana replied,

Oh yeah. . . . Not all of them believe the exact same way obviously and I don't believe the exact same way they do. But it was like someone else was actually okay with the two coexisting. It was cool to see . . . it's okay for them to coexist.

Heather, Participant 9, said it was “compelling” to have “somebody who has looked at both sides, who . . . understands science and also has a relationship with God and understands the Bible.” Asked if she saw that as an important aspect for her professors, Heather replied, “Very much so because they understand the science and yet they have looked at both sides and this is the conclusion they have come to.”

Summarizing Theme 1.2, all participants viewed their professors as influential role models. Many participants appreciated the authenticity and transparency of their Bible professors and the Origins professor. These professors were straightforward in communicating their views on evolution and their religious beliefs. Many participants also expressed that their professors served as examples in developing a positive relationship between science and religious beliefs.

Theme 1.3 states that participants viewed church, friends, siblings, and spouses as moderate influences in their lives. Although the church was mentioned by all fifteen candidates and was coded 90 times as shown in Appendix K, most participants did not refer to the church as a powerful influence in the same manner they referred to their parents and professors. One exception was Stephanie, Participant 2, who attended Bible camps every summer of her childhood and expressed dedication on multiple occasions to the religious training she received from her non-denominational church.

In regards to creationism and evolution, Stephanie remarked her initial views against evolution stemmed mostly from her church youth leaders. Stephanie said the youth leaders at her non-denominational church “were really against it, . . . ‘cause [evolution is] nowhere in the Bible.” She clarified, “I’m sure that’s where I got my [views] against evolution. I’m sure.” So when Stephanie came to the study site university, she didn’t think there was any other Christian way of thinking about evolution than to be “totally against it.”

Other than Diana, Participant 4, who attended a Catholic church, fourteen participants reported they were taught creationism in the church from a young age. Yet when participants expressed apprehension in their encounters with evolution, not a single participant expressed anxiety about the response of their church or pastor. Instead, most were worried about the reaction of their parents.

“Friends” were coded 49 times, but as in the previous discussion regarding the church, friends were not a significant influence for most participants in reconciling their understanding of evolution and their personal religious beliefs. Three participants were exceptions to this trend. Michael, Participant 14, reported that interactions with his close friends had enabled him to become more freethinking. “I had been around . . . all my religion major friends who are more liberal than I was so I was used to hearing that thing [a literal interpretation of the Bible] and I’d gotten adjusted to it,” Michael said. Jennifer and Rachel, Participants 7 and 8 respectively, are the other two exceptions. These two close friends were in several courses together, including Origins, in the spring semester of their junior year. Jennifer said,

I definitely had a lot of theological discussions with Rachel. She was my main confidant during all this and everything. We’d go to Burger King and just sit there and almost – not sacrilegiously – but just blatantly question things and talk about what if, what if, what if. . . . We were definitely questioning things together and so I would definitely consider her someone I went to for guidance basically.

Other than these three exceptions, friends apparently were not a significant influence on participants in their approach to evolution and creationism.

Similarly, siblings did not have a significant influence on most participants. One participant did not have siblings. Of the other fourteen participants, eight were the oldest child in

their family. Nicole, Participant 11, was the only participant who said a sibling made a difference in her way of thinking. Speaking of her older brother while she was still in high school, Nicole said,

“[My brother] started getting into . . . his higher science classes, . . . and we would talk and would be like, “Well, what if things are different than what we thought?” So he planted in my mind that maybe it’s [creationism and evolution] not so black and white.

Only three participants mentioned grandparents as influential in their understanding of creationism and evolution. All three participants reported that their grandparents strongly advocated creationism and a literal interpretation of the Bible. Brittany, Participant 10, was the only participant who said her grandparents fostered in her an anti-evolution attitude by the time she entered college.

Four of the participants were married. During her interviews, Brittany, Participant 10, was undergoing a period of unqualified relativism. Brittany mentioned that her husband was going through the same experience of doubt and questioning of religious beliefs. John, Participant 12, who was married much longer than any other spousal participant, expressed sincere appreciation for the spiritual support his wife gave him during his periods of doubt. Nicole, Participant 11, reported that her husband agreed with her views on evolution. He would take the lead in arguing in favor of evolution against his “fundamentalist” mother and sister, almost to the point of her embarrassment. Michael, Participant 14, indicated that evolution-creationism was not an important issue in his marriage and something he had never discussed with his spouse. In summary, spousal influence on participants’ views of creationism and evolution was minimal.

Compared to the influence of parents and professors, other factors, including church, friends, siblings, grandparents, and spouses, were only moderate influences in most participants' lives during their process of reconciling evolution and personal religious beliefs. Summarizing Category 1, the compelling and significant patterns that consistently emerged from the data were the primary influence of participants' parents and professors. Most parents raised the participants to believe in creationism and many parents aggressively opposed evolution. Participants viewed professors as positive role models who demonstrated a commitment to science and religious beliefs.

#### Category 2 – Participants' Views on the Domains of Science and Religion

Theme 2.1 states that participants trusted and valued science as a way of knowing. Eight participants said they "loved" science or some aspect of science. Many participants expressed the notion that science brought meaning to their lives, as demonstrated in the following quotations:

[Science] definitely influences me probably more so than the average person. Because, . . . into any conversation, I'm always interjecting some trivial bit of science and I get a hard time about that from friends and family. They call me a "scientologist" for the fun of it knowing that's not really what I'm doing, but just joking around. (John, Participant 12)

I'm a nature buff. I look around and think about how things are related and how they came about and how cool that is. (Nicole, Participant 11)

The following statements reveal that most participants viewed science as integral rather than peripheral to their way of thinking:

As far as a worldview goes, I would say it [science] influences a lot because I take the theories and the evidence that science has and I incorporate that. (Michael, Participant 14)

I use science . . . to explain things. When I need something explained that is really difficult to understand, then I look for an answer with science as opposed to anything else. (Diana, Participant 4)

Science . . . helps me to ask questions about the way things are and helps me to look at things closer and to me that brings joy to my life, to be able to notice something and to maybe wonder about it and then to be able to answer that question and figure it out.

(Tiffany, Participant 6)

All 15 participants indicated that they thought science was trustworthy. Twelve participants articulated one or more reasons for their trust in science. Five participants cited the scrutiny of the peer review process in scientific publishing. Four participants noted the verification process that comes through replication of scientific experiments. Three participants appreciated that science is based on observation and evidence. And three participants thought that openness to change in light of new evidence was a positive element of science.

While all participants expressed a trust in science, their trust was not absolute. Ten participants qualified their statements of trust. For example, Gail, Participant 1, said,

Everything is always changing in science so we might find things later that explains something further or maybe changes little things here and there. So I guess I think it is trustworthy, but I'm not going to put all of my trust in it.

Five participants noted that scientists are human and thus have biases or occasionally ulterior motives in securing grant awards. The following interview excerpts illustrate the contention of some participants:

I think you have to be careful about who was doing the research, who was funding the research, . . . how big was the sample size, was it only wealthy white males or did they

take a big slice of humanity and look at everything. . . . You have to be smart about believing certain research. You have to look into it more because you can . . . manipulate science a lot. . . . If it is a good study, [then] science in its purest form is trustworthy.

(Tiffany, Participant 6)

I would call true science . . . fairly trustworthy. But it's a human endeavor and . . . there could be errors in things we don't see. But I would say in general . . . that it would be reasonably trustworthy. (John, Participant 12)

In the Evolution Attitudes Survey found in Appendix F, Item 4 states, "Scientists who believe in evolution do so mainly because they want to, not because of any evidence." Participants who strongly disagreed or disagreed with this statement indicate a trust that scientists are generally unbiased and use evidence to support their acceptance of evolution. The survey data show nine participants strongly disagreed and five participants disagreed with Item 4. David, Participant 15, was the only participant to agree with the statement and indicate a distrust of scientists who supported evolution. David argued, "Science is trustworthy as long as it keeps questioning itself," and claimed evolution had become a hegemony within the scientific establishment. However, David's perspective contrasts with several other participants who considered evolution as science and valued the positive aspect that science, including evolutionary theory, remains open to revision as new evidence appears.

Summarizing Theme 2.1, participants trusted science as a way of knowing. That trust is qualified by an awareness of science as a human endeavor. Participants did not see science as infallible. Still, many participants confidently claimed that scientific thinking was embedded in their worldview.

Theme 2.2 states that most participants trusted and remained committed to their religious beliefs. The researcher asked the question, “How do you feel about the trustworthiness of your religious beliefs?” None of participants asked what was meant by “religious belief” and no definition was provided in the interview protocol. However, participants answered the question without pause. From the context of their answers, participants appeared to interpret personal religious beliefs as double-pronged: core convictions about reality and the fundamental nature of God; and a moral code to decipher a right course of action and what is true. For example, Gail, Participant 1, described her religious belief system, “It’s . . . like my communication with God and what I read in the Bible and what I hold to be true.”

Fourteen participants clearly expressed that they were confident in their personal religious beliefs. Brittany, Participant 10, was the exception. When asked about the trustworthiness of her personal religious beliefs, Brittany replied, “We [my husband and I] are still trying to figure that one out.” However, even in the midst of unqualified relativism, Brittany continued to express a personal belief in God. Brittany hadn’t given up on her beliefs. Instead, she was trying to determine what it was that she actually believed.

John, Participant 12, said his beliefs were “very trustworthy.” This statement in the second interview came one week after he confessed a sense of guilt in the first interview for pondering the question, “Where is the evidence that God is real, that He is a real person when you die?” Although John qualified his rhetorical question with, “I know it’s a natural thing to wonder those kinds of things,” his renewed confidence one week later demonstrated the resilience of some participants’ personal religious beliefs. John wondered about the reality of God and yet he trusted his beliefs. Brittany wondered about her beliefs yet she trusted in the

reality of God. John and Brittany illustrate that while some participants experience doubts about certain aspects of their religious beliefs, they remained committed to those beliefs.

Six participants articulated that belief and trust were inseparable as an integral part of their religious faith. When asked about the trustworthiness of her beliefs, Stephanie, Participant 2, immediately said, “It’s faith. . . Trustworthiness in religion, it just has to be faith.” Nicole, Participant 11, commented,

I trust what I believe. I’m not going to trust everybody out there that says, “God said this and God said this,” but I think that . . . religion is all faith and you have faith in who you believe . . . and so I think in order to have religion, you have to have trust in it.

Although she confessed beliefs about the supernatural are religious claims that cannot be scientifically proven, Ashley, Participant 5, was confident in her beliefs and characterized them as religious faith:

I just feel like the answer, “I believe because I believe” should be sufficient enough. . . I have this feeling that God is not going to let you know everything. I think it is sufficient enough for me to, on certain things, just come to the realization I just believe it because I believe it and that’s where the whole faith, I can’t see it, I can’t touch it, I don’t really know a 100% sure that it’s there, but I just believe it.

Two participants spoke about how their religious beliefs were particularly trustworthy because their beliefs were based on life experiences. Tiffany, Participant 6, said,

I think that your religious views are – well they should be anyway, they should be personal convictions. I mean things that you have, like *my* [italics added] beliefs I feel are things that are tried and true and through my life that they’ve proved. I believe that there

is a God. My life, things that I have experienced in my life show evidence of the existence of God. That's personal to me.

Tiffany's comment highlights an obvious pattern in participants' responses: their beliefs are personal and deeply felt. As participants conversed about their beliefs, they conveyed a sense of ownership. Michael, Participant 14, even joked about this. When asked how he felt about the trustworthiness of his religious beliefs, Michael responded, "Well I trust those because they're *mine* [italics added]." Although participants' views of the domain of science and religion are discussed later in this chapter, the comments of Gail, Participant 1, are germane:

If I had to distinguish between science and religion – religion would be *my* [italics added] foundation, what I stand on and science would be something that I hang on to. . . . I would say that religion is *my* [italics added] core and science is just, it's affecting everything, but it's not what I go to all the time.

To paraphrase Gail's comments and those of several other participants, "Science is something I do or is one way I think, but my religious beliefs go to the core of who I am." Not surprisingly, many participants expressed that religious beliefs were integral to their worldviews. "As a religious person when you have faith, it influences everything you see so you have this looking glass," Michael, Participant 14, said, "that's totally different from anyone who doesn't because that's just . . . one of your first thoughts always, especially when you grow up in it and you're used to it." Elizabeth, Participant 13, noted, "I think that the whole purpose of life is wrapped up in religion and I think that it would be hard for that not to affect your decisions in life."

Although participants were very committed to their beliefs, they also displayed a willingness to change certain aspects. Thirteen participants said their beliefs about the Bible and

creationism had changed significantly since coming to the university. The changes in participants' beliefs and their continuing commitment to believe are investigated in the following two sub-themes.

As explored in Sub-theme 1.1.1, most participants' parents raised them to believe in creationism, which included a literal interpretation of Genesis. Sub-theme 2.2.1 states that most participants in this study no longer held a literal interpretation of the Genesis account of creation, but considered the Bible as important in their life. Two exceptions to this sub-theme were Diana and David, Participants 4 and 15, respectively. Diana was taught by her geologist father to accept evolution. She appeared to take Genesis at face value, claiming the first eleven chapters are literally true and consistent with modern science. David retained a steadfast belief in creationism throughout his university experience.

The other 13 participants negotiated their childhood understanding of Genesis while at the university. Two patterns emerged as the 13 participants discussed Genesis and the Bible: nine participants stated the Bible is not a book of science; and four participants stated that the first chapter of Genesis is literary rather than literal. Of these 13 participants, three participants articulated both statements about the Bible as non-scientific and Genesis 1 as non-literal. The following are samples of these participants' views:

The Bible is not a scientific book. It doesn't say on the front cover, "This is the scientific recording of how the earth was formed." I think it was just a bunch of people and their beliefs, gathering over the years from their experience, from what they've heard and that's what they wrote down. We have proof . . . [of] past things that people have thought, like the earth was flat and that's been disproved. Just stuff like that so I think the Bible could be, I guess, wrong in that sense of how this [earth] was a created, but I don't think

the Bible's purpose was to tell how scientifically it was created. I think it [the Genesis account] was just a statement saying, "Well, we believe God was the ultimate creator and He made this." (Brittany, Participant 10)

The Bible's not literal. First of all, there's two Genesis accounts. They're both different. If they're meant to be literal, why would they be different? It's not at all what God wants to get across to us. He's talking about His character and that nature in those stories and not about the creation. It's not a scientific book. (Michael, Participant 14)

I've seen . . . the differences between Genesis 1 and Genesis 2 where if you really read them closely, . . . they don't both tell the same exact account. Kind of how you can lay them out and see the light and the dark, and the water and the land, and kind of do it in a chart, and you can see how Genesis 1 is a . . . story written with specific literary . . . structure. (John, Participant 12)

The data showed that participants considered the Bible as important in their life, regardless of their altered view of the Genesis account of creation. Of the 13 participants that had negotiated a literal interpretation of Genesis, ten explicitly stated the Bible was very important to them. Each of the other three participants articulated general statements that indicated the Bible was important to them in their life. Elizabeth, Participant 13, illustrates many participants' views about the continuing importance of the Bible in their lives:

[I] used to . . . [think] of the Bible as being literal, that's how everything happened exactly, but I guess I don't think that that's necessarily true now. I think . . . maybe that's God's way of putting what He wants us to know into kind of this story format and to help to be able to wrap our minds around what we need to believe. . . . I look at it differently but it still is as important as it always was.

Asked if the Bible remained valid to her, Elizabeth answered, “In a different sense, but still just as valid as it was before.” Other participants conveyed a sense of the Bible’s significance to them:

I do believe that Bible reading is important and I’ve kinda learned that in past years because when I didn’t read my Bible, it was really hard to figure out what was right – that kinda right and wrong, like what does God want me to do and what does He expect out of me so I do think it is important to read your Bible. (Rachel, Participant 8)

I was raised on the Genesis one account of creation and, even today stand by it one hundred percent. However, I realize that the Bible is not a scientific document and is not to be read literally. (Tiffany, Participant 6, in her scholarly paper)

These quotations illustrate Sub-theme 2.2.1 that most participants no longer held the Bible to be entirely literal, but still considered the Bible as important in their life. The next sub-theme is a parallel to Sub-theme 2.2.1.

Sub-theme 2.2.2 states that participants who accepted evolution maintained their commitment to a Christian life. “Christian life” in Sub-theme 2.2.2 refers to the active expressions of personal religious beliefs, including church attendance, prayer, etc. Evidence of a Christian life was provided by participants’ responses to the faith development interview question, “Do you pray, meditate, or perform any other spiritual discipline?” Additionally, participants spontaneously disclosed their commitment to a Christian life during their discourse.

Sub-theme 2.2.2 applies to the 14 participants, but not to David, Participant 15, who denied evolution. Thirteen participants expressed a commitment to attending church. Two participants held leadership roles in the churches they attended. Three participants referred to personal spiritual experiences in church within the last six months. Brittany, Participant 10, was

the only participant who accepted evolution but was uncommitted about church. During the period of her interviews, Brittany was discouraged about attending church and noted that she had yet to find a good church home near her veterinarian school. However, as she stated in her member check form, Brittany has more recently been encouraged in finding a fellowship group of Christian believers at her school.

The 14 participants associated with Sub-theme 2.2.2 affirmed the value of prayer. Six participants acknowledged that prayer was a key step in making important decisions. Six participants cited the Eucharist as an important ritual in their lives.

Jennifer, Participant 7, is an excellent example of Sub-theme 2.2.2. Jennifer emerged from a period of religious doubt with a renewed commitment to her personal beliefs. During this process, she also came to an acceptance of evolution. Even with some lingering spiritual questions, Jennifer affirmed her commitment to living the Christian life:

And so like when I came back [from my period of doubt], it was kind of like, it's okay to question and it's okay to still pray, and still read your Bible and still participate in Christian things, going to church and all that . . . so I kind of rectified having the questioning time . . . with still being an active Christian. It's not that those two are incompatible or anything.

The testimony of Rachel, Participant 8, offers perhaps the most striking example of how Christians who accept evolution can remain committed to their Christian way of life, in stark contrast to the opinions of fundamentalist naysayers who would cast doubt on that possibility. In her interviews, Rachel shared about heated arguments with her father, who is a pastor in the same denomination as the study site university. Asked why her father was so concerned about her views on evolution, Rachel reflected,

I think he's really concerned about my spiritual life and he wants me to stay on track with God and so I kinda tried to tell him you know, "I'm there and I'm walking and I'm praying and reading the Bible so it hasn't affected me," but it's still, I think it's hard for him to get out of that mindset. I think he's afraid that it will kinda push me away from God instead of getting closer to Him.

While Rachel was home for the summer, her father placed some literature in their church foyer, which Rachel described as "little pamphlets on why evolution is stupid." She finished the story,

I was like, "Dad, don't put that in the church" and he was like, "Why not? I think it's good that people know about it, know that evolution is wrong," and I said, "No Dad, because people have different viewpoints and I don't think just because a person is a[n] evolutionist doesn't mean they aren't a Christian."

Rachel smiled as she recounted, "He took them down after a few Sundays. I was pleased." She never asked him why. During her interview, Rachel indicated she was ready to stop arguing with her father and explained,

I'm just . . . taking a step back and letting him see how I'm walking through my *Christian life* and then maybe later on, he will be like, "Hey, are you still an *evolutionist*? Do you still believe that?" And I'm like, "Yeah, I still do *both* [italics added]."

Summarizing Theme 2.2, participants trusted and remained committed to their personal religious beliefs. Most participants in this study no longer held a literal interpretation of the Genesis account of creation, but considered the Bible as important in their life. In addition, participants who accepted evolution continued to embrace the Christian life in acting out their personal religious beliefs.

Theme 2.3 states that participants desired a positive relationship between science and religious beliefs. All 15 participants expressed a desire for science and religion to co-exist in a compatible relationship, although some participants recognized from their perspective that there were some inconsistencies between science and religion. No participants claimed that science and religion should be isolated and non-interacting. Patterns that emerged in participants' perspectives on the domains of science and religion are discussed in Sub-theme 2.3.1.

Sub-theme 2.3.1 states that most participants viewed and treated science and religion as separate but interacting domains. Participants articulated a variety of possible viewpoints on the domains of science and religion as displayed in the first column of Table 4.5, shown below. Even though no participants claimed that science and religion are separate and isolated as shown in Row 3, that view is included in Table 4.5 because several participants noted that it was not personally viable model.

Participants' active expressions of science and religion did not necessarily match their claimed viewpoints. Participants' active expressions are differentiated in the headings of Columns 2 through 4. For example, Ashley, Participant 5, *claimed* her view was that science and religion are separate but interactive. In her *active expressions* regarding science and religion however, she used religious explanations to solve perceived scientific uncertainty.

Table 4.5 does not represent an exhaustive summary of all possible viewpoints of the domains of science and religion, nor does it portray an objective definition of the proper relationship between science and religion. Instead, Table 4.5 is a collection of the participants' claimed viewpoints and active expressions in this study.

Table 4.5

*Participants' Views and Active Expressions on the Domains of Science and Religion*

View of Science and Religion	Used science and religion to validate each other.	Used religious explanations to solve perceived scientific uncertainty.	Maintained distinct boundaries between science and religion.
Science and religion are integrated.	Diana, Participant 4 David, Participant 15	No participants	No participants
Science and religion are separate but interactive.	No participants	Ashley, Participant 5 Brittany, Participant 10 Elizabeth, Participant 13	Gail, Participant 1 Stephanie, Participant 2 Megan, Participant 3 Tiffany, Participant 6 Rachel, Participant 7 Jennifer, Participant 8 Heather, Participant 9 Nicole, Participant 11 John, Participant 12 Michael, Participant 14
Science and religion are separate and isolated.	No participants	No participants	No participants

Column 1 in Table 4.5 represents participants' statements regarding possible views of the boundaries of science and religion. Row 1 may be represented as a Venn diagram with significant overlap between the circles of science and religion. In Row 2, the circles of the Venn diagram are touching and interfaced, but not overlapping. Row 3 is analogous to the Venn

diagram circles that do not overlap, interface, or touch. In other words, the circles are separate and isolated.

Columns 2 through 4 in Table 4.5 represent participants' active expressions on the domains of science and religion. Column 2 represents participants who regularly used scientific and religious notions to explain each other. In this column, participants reconciled science and religion by intermixing the two. Column 3 represents participants who employed religious explanations to account for perceived gaps in scientific knowledge. In other words, they injected religious explanations into scientific problems. Column 4 represents participants who operationally did not mix science and religion: scientific problems were not solved by religious solutions; and science was not used to provide evidence for religious beliefs. Participants in this last column appeared to have reconciled science and religion by keeping their domains distinct.

Row 3 in Table 4.5 represents the position that science and religion are separate, isolated and non-interacting domains. No participant espoused this view, and four participants explicitly said they thought this position was inappropriate and untenable. Stephanie, Participant 2, said,

Anyone could take science and say, "Oh it has nothing to do with religion," and anyone can take religion and say there is no part of science in it so I think with the science background I have and the religious background I have, I think there's a way for them to exist together. . . . I don't think you have to be real hard on one subject and real hard on the other . . . [that] you can't have both.

All 13 participants in Row 2 in Table 4.5 indicated that prior to attending the study site university, they did not maintain any boundary between science and religion. Instead, science and religion, in their prior view, were integrated and each validated the other. In taking Genesis as literal, many of these 13 participants previously used religious notions to influence and

suppress their understanding of science. From these participants' earlier perspective, the Bible's creation account was supported by science. Through their experiences at the study site university, these 13 participants transitioned to Row 2. This development is explored further in Themes 4.1 and 4.2.

In contrast to the other 13 participants, Diana and David, Participants 4 and 15 respectively, did not transition from an integrated view of science and religion. David claimed, "I believe science does prove God . . . because we can't even go back to the beginning of the Big Bang." Asked later in the interview to respond to some people's conception that science and religion are separate domains, David responded,

Just like I said with the Big Bang, . . . they coincide with each other. They build on each other I believe. Just because we go out and try to prove how God did this, then it doesn't mean that they are separated from each other, [that] we got to keep them apart.

Diana was more explicit in explaining her integration of science and religion: My religious beliefs and my scientific beliefs go hand in hand. I don't ever separate the two. I don't think that they're two different worlds. . . . I don't think that, "Okay, this is science, this is what science says; this is religion, this is what religion says." I think that this world is all one big science and religion ball. . . . It's not one way or the other. It works together. *It has to* [italics added].

Diana's contention that science and religion must work together in an integrated and compatible manner appeared to be a position in which she found equilibrium. In order to remove dissonance, Diana simply stated that science and religion "has to" be in harmony. From David's perspective, science without evolution was completely compatible with his religious beliefs. Although David's stance on evolution was vastly different than Diana's, his manner of finding

equilibrium was similar. David simply adapted his definition of science to remove the dissonance.

Row 2 in Table 4.5 represents the view that science and religion are separate but interfacing domains. The 13 participants who claimed this position as a personal model cited two reasons: science is based on tangible evidence while religion is not; and science and religion ask completely different types of questions. Several of the following quotations demonstrate why most participants claimed the view in Row 2:

They are two separate types of worldviews. . . . The way that they define things are different, because the Christian belief is based solely on faith. For me, there is no evidence, no hard fast evidence that I can see. . . . Whereas science, you have hard fast evidence, something that you can put your hands on and see. (John, Participant 12)

I don't think that they [science and religion] are trying to tell the same message. I think that . . . science explains the how and when and religion is more like who and why. . . . I think they describe different things. (Elizabeth, Participant 13)

While thirteen participants claimed their personal view was that science and religion are separate domains, variations occurred in the way participants actually used science and religion to support their perspectives on evolution. Elizabeth is a good example of some participants' struggle to maintain a clear boundary between science and religion. In the previous quotation, Elizabeth said science and religion serve different purposes. When asked by the researcher if science and religion are mutually exclusive or if they overlap, Elizabeth replied,

They do support each other. . . . But I don't see them as one saying one thing and the other saying, "Well, that can't be true because this is true in religion." So I don't see them as colliding. . . . They do explain the same issues.

Asked for a specific example in her life when she saw science and religion supporting each other, Elizabeth replied after a long pause,

I guess I haven't really had this big moment whenever I was like, "Wow, they do support each other." I guess . . . they don't really support each other, but they're not really in conflict with each other. . . . But in my mind, since they don't conflict, I think that they support each other.

Elizabeth's statements regarding the separate domains of science and religion echo her Origins scholarly paper from two years earlier. At the conclusion of her paper, Elizabeth wrote, "As long as these appropriate boundaries are maintained, interpretations will not be controversial, and all things will remain in harmony." Operating from this vantage point, Elizabeth would align with the last column in Table 4.5.

However, when the researcher reminded Elizabeth of the "harmony" statement in her scholarly paper, she clarified, "You know, it's never complete harmony. There's always the thing about the cellular level but I think in *general* [italics added], it lives in harmony." Although she was unsure about the details of cellular evolution, Elizabeth was "still a little bit bothered" by "evidence against . . . cellular evolution like everything started as one cell." When asked whether these objections to cellular evolution could be proof of God directly intervening in a special act of creation, Elizabeth tentatively replied, "I think that's possible or that you know, I would support that." Elizabeth appeared to violate her own written statement about maintaining the boundaries of science and religion.

Elizabeth was not alone in using religious explanations as a solution to perceived gaps in scientific knowledge. Two other participants operated similarly. Ashley, Participant 5, wrote in her scholarly paper, "Science and religion are two different realms and really only work if each

stays within its intended domain.” Yet, she held the position that God specially created an initial line of species from which the current species evolved. Similar to Elizabeth’s stance, but more pronounced, Ashley’s incredulity of evolution as a comprehensive theory led her to claim that God supernaturally intervened to create an initial line of ten thousand species. Brittany, Participant 10, maintained that religion “is completely different from science and you have to separate it.” However, she was non-committal to maintaining the distinction in the context of abiogenesis, claiming that first life may have appeared by natural or supernatural processes.

To summarize, Elizabeth, Ashley, and Brittany ardently claimed the domains of science and religion should be separate as shown in Row 2. Brittany simply refused to keep the science and religion separate while she was in a time of unqualified relativism. Elizabeth and Ashley’s positions stemmed from a lack of confidence in evolution and a strong belief that God was present in all creation processes. Participants’ pervasive conviction of God’s action in the creation process is further explored in Theme 4.3.

Ten participants claimed that science and religion are separate, and actively maintained distinct boundaries in their discussion of evolution, which is the intersection of Row 2 and Column 4. Michael, Participant 14, proclaimed, “I think that they’re totally compatible. . . I don’t think there’s anything that’s incompatible with science and religion. I think people make it incompatible because they’re scared.” Similarly to Elizabeth, Michael had concerns about abiogenesis. While the two shared a common belief in God as the Creator, Michael alone maintained a distinct boundary between science and religion to await an eventual scientific explanation.

Maintaining clear boundaries between science and religion did not mean the two domains couldn’t interact. Gail, Participant 1, said that science and religion are complementary: “I think

they complement each other. . . . Where one might lack a little bit or not be as clear on something, . . . the other one might make up for it." Pressed for an example, Gail responded, Well, evolution. . . . I believe that God initiated everything – that is my personal belief. I believe yes, God did create everything, just not in its present form. I think He used the laws and things that He put in place originally before He created us to help make us what we are today. So, I guess where the Bible doesn't have a lot of facts or here's how He did it, I think science makes up for that.

Using words like compatible, harmony, and complement, most participants held the position that science and religion are not only reconcilable, but also interacting. Instead of a piecemeal and fragmented worldview, participants desired a comprehensive worldview informed by positively interacting scientific and religious perspectives. Tiffany, Participant 6, demonstrated such a view:

They [science and religion] speak on different levels, [but for] me personally in my life, they agree all the time. I mean the wonders of science that I see all around me, . . . all the scientific laws and theories and the way just . . . everything works together, that's all science. . . . It's all scientific, but to me that speaks of a God who's so amazing that He could put all that together. . . . So . . . they coincide for me.

Tiffany then expressed how important personally it was for her to maintain a cohesive relationship between science and religion:

What to society maybe or to someone who doesn't have a personal relationship with God, . . . they aren't on the same plane. Science doesn't speak of God and even though to me, God works in scientific ways, . . . God doesn't really speak of science. So for society, . . . they [science and religion] don't have anything to say about each other really. But to me,

because I am a scientist and I believe in God, . . . they do [positively interact] to me. . . . I can't imagine being a Christian and a scientist and not having some sort of closure or agreement between the two. I don't see how you could do that.

Jennifer, Participant 7, articulated a position that is a fitting summary to most participants' positions about the relationship between science and religion:

There are two separate windows – science and religion. . . . You can mix the two and they go together just fine and everything. They don't conflict *generally* [italics added] but the stuff that you observe out of the science window isn't the same stuff that you're observing out of the religion window. You know religion is for the why and . . . the what's the purpose, whereas science is the what and the how it works. . . . If you are looking at it to ask the correct questions, they [the science and religion windows] might give you an answer that forms to create one big answer that complements with itself I guess, but you're not going to get the same answers out of both windows because it's two different questions.

The views of Elizabeth, Participant 13, and Jennifer may serve to illustrate the differentiation of participants in the last two columns of Table 4.5. Elizabeth had misgivings about cellular evolution. Jennifer also had lingering doubts about whether evolution could account for the complexity and diversity of life from a single unicell. Elizabeth said science and religion are “generally” in harmony. Jennifer said science and religion do not conflict “generally.” However, Jennifer alone recognized her doubts as scientific and did not insert God’s supernatural intervention as a religious solution. Thus, Jennifer was able to say with confidence:

I can put them [science and religion] in harmony into my mind. I know some people say that they totally conflict and everything's hogwash and one or the other, but I think it

makes sense that they can go together. I have to just . . . look at them within their own context. I can't just totally pull them out of context. If I did that of course, they wouldn't make sense.

Summarizing Sub-theme 2.3.1, most participants viewed science and religion as separate, but interacting domains. However, three participants appealed to religious explanations as solutions to perceived scientific problems. Ten participants operationally maintained distinct boundaries between science and religion.

Sub-theme 2.3.2 states that many participants struggled or had struggled in assessing science as a more reliable way of knowing than religion. As participants progressed through their biology-related programs of study, they became more aware of the capacity of the scientific enterprise to evaluate its claims in the natural world. Many participants perceived a relative lack of empirical evidence in support of their religious beliefs, as explored in Theme 2.2. The epistemological question with which many participants appeared to struggle can be paraphrased, “How do I know what I know is true?”

The turmoil many participants faced in choosing science as a more reliable way of knowing than religion was not predicated on an antagonistic relationship between science and religious faith. Rather, many participants were applying a scientific perspective to their religious beliefs. Nine participants said they struggled with this issue or had struggled with it in the past.

Brittany, Participant 10, who was in a period of unqualified relativism, was one of two participants who appeared conflicted that religion was a less reliable way of knowing compared to science. Prior to this period of doubt at the time of her interviews, she trusted her religious beliefs but “didn’t necessarily have the evidence to back it up.” During her struggle, Brittany said,

My mind's being trained scientifically so I'm thinking I have to have proof or I have to have evidence, but then the other side of me thinks, "Well, maybe you don't have proof. Maybe this is just something you can't prove. Maybe it's just there because it's completely different from science and you have to separate it." So it's kind of a tussle. . . . *It's easier to believe in things that I have proof for* [italics added].

The participants who found closure to their conflict offered two explanations: some questions are unanswerable; and science's reliance on empirical evidence is not transferable to religion. Megan, Participant 3, wrote in her scholarly paper,

The science is not so hard to understand: the evidence is obvious. It is hard to argue with what one can see. However, the realm of the mind, the spiritual, the unknowable is difficult to comprehend or to even think about.

For Megan, the solution to her struggle came in recognizing that there are some religious questions that will remain unanswered. She continued in her scholarly paper,

As hard as it is to admit, we have to come to the conclusion that *we just don't know* [italics in original]. I do not mean that we should not try to figure it out, but that we should not assume that we have all the answers.

Rachel, Participant 8, had already experienced a struggle with religious doubts similar to Brittany's. Rachel explained the dilemma she faced in her junior spring semester while taking Origins and Science, Technology and Society:

When you see science and you see what they've done, then you start to believe in that. Then that sort of throws this other [religious] part of your life out of whack like, "What do I do now?" That's kinda hard because you then want to take your science and apply it

to your religious beliefs and if I can believe that – well, what about this and God and can I prove it?

While Brittany was still in the midst of her “tussle” at the time of her interview, Rachel had resolved that struggle by her senior year. At the time of her interview while in Costa Rica, Rachel explained,

That [junior spring semester] was a time I did go through a doubting, which I think is good because we need to go that and then build yourself up stronger. . . . It definitely helped me . . . then I could figure out that they [science and religion] really didn’t have to disagree and that going back to the Bible, I don’t really see anything here that would conflict with what I believe . . . science is saying. It kinda makes it all the more cooler if you do believe in God and then you have the science and . . . you see this wonderful thing like we’re out here and working [in the Costa Rican rainforest] and you see the nature and a couple of times I’ve done this, I’m like, “That’s amazing that God could create this! That is totally so cool!”

Summarizing Sub-theme 2.3.2, many participants struggled or had struggled with science as a more reliable way of knowing than religion. Two participants were conflicted about this issue at the time of their interviews. Seven participants resolved the issue by recognizing that science’s reliance on empirical evidence does not transfer to religion. Other participants appeared willing to be satisfied that there remain some religious questions that are unanswerable in scientific terms.

The data in Category 2 indicate that participants trusted and valued science as a way of knowing. Similarly, participants trusted and were committed to their personal religious beliefs. Participants who accepted evolution and no longer held a literal interpretation of the Genesis

account of creation maintained a commitment to the Bible and acting out their Christian beliefs. Many participants viewed science and religion as separate but positively interacting domains. Most of these participants were operationally consistent with their views in maintaining clear distinctions between science and religion. However, some participants used religious explanations to solve perceived scientific problems.

#### Category 3 – Participants’ Extant Ideas about Creationism and Evolution

An underlying goal of this study was to explore participants’ views on evolution and creationism. Evolution in the context of this study was constrained to biological evolution, rather than cosmological and geological evolution, in alignment with participants’ general use of the term. Abiogenesis, the emergence of life from non-life, technically is not biological evolution (Scott, 2004). However, participants tended to conflate abiogenesis with evolution. As discussed in Chapter 2, there is not yet scientific consensus on a model that completely describes the sequence of events that led to the earliest life forms. Abiogenesis in this study is germane to the larger discussion of how participants operationalized their view of the domains of science and religion.

Theme 3.1 states that participants’ views on abiogenesis varied. Each participant addressed abiogenesis in response to the question near the end of the second interview, “How do you think life first arose on Earth?” Seven participants however, broached the origin of life issue before the question was asked.

The Evolution Attitudes Survey, shown in Appendix F, was completed at the beginning of the second interview. Survey Item 9 addressed abiogenesis: “It is statistically impossible that life arose by chance.” Participant survey results are also found in Table 4.6, shown below.

Table 4.6

*Participants' Evolution Attitude Survey Results*

Statements	Participant													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Over billions of years all plants and animals on Earth (including humans) descended (evolved) from a common ancestor (e.g., a one-celled organism).	A	U	A	A	D	U	A	A	U	A	A	A	A	SD
2. A supreme being (e.g., God) created humans pretty much in their present form; humans did not evolve from other forms of life (e.g., fish and/or reptiles).	D	U	D	SD	D	U	D	D	D	D	D	D	D	SA
3. There is no real evidence that humans evolved from other animals.	D	D	SD	D	U	D	SD	D	U	SD	D	D	SD	SA
4. Scientists who believe in evolution do so mainly because they want to, not because of any evidence.	D	SD	D	SD	SD	SD	D	SD	SD	SD	D	D	SD	A
5. There is scientific evidence supporting that humans were supernaturally created.	SD	D	D	A	D	SD	D	SD	D	D	SD	D	D	A
6. There is fossil evidence supporting that animals, including humans, did not evolve.	U	D	D	SD	D	D	D	SD	D	D	D	D	SD	A
7. There is no fossil evidence supporting that humans and apes evolved from a common ancestor.	D	D	D	D	D	D	D	U	D	D	U	D	U	SD
8. The methods used to determine the age of fossils and rocks are not accurate.	U	D	D	SD	D	D	SD	D	D	D	D	D	D	U
9. It is statistically impossible that life arose by chance.	U	A	U	D	U	U	U	A	D	SA	D	A	U	SA
10. The Earth is not old enough for evolution to have taken place.	D	D	D	D	SD	SD	D	D	D	D	D	U	U	SA
11. Mutations are never beneficial to animals.	SD	SD	D	SD	SD	D	SD	D	SD	SD	D	SD	SD	A
12. The Second Law of Thermodynamics (order tends towards disorder) shows that evolution could not have happened.	U	D	U	D	U	U	D	U	U	U	D	U	D	A

The row corresponding to Item 9 shows: two participants strongly agreed; three participants agreed; seven participants were undecided; and three participants disagreed. The seven undecideds on the abiogenesis item were greater than any other survey item, with the exception of eight undecideds on the statement, “The Second Law of Thermodynamics (order tends towards disorder) shows that evolution could not have happened.” The next closest number of undecideds was four undecideds on Item 1, about all animals and plants evolving from a common ancestor billions of years ago.

Most participants indicated they simply didn’t understand how the Second Law of Thermodynamics related to evolution. This was not the case with the abiogenesis item, however. Many participants appeared confused or sidetracked by the words, “arose by chance.” Three examples illustrate this confusion. Asked by the researcher why she chose “agree,” Stephanie, Participant 2, responded, “Well, because I think God created everything. Even if it was evolution, it didn’t happen by chance.” The researcher asked, “Is that statement [Item 9] telling you that when it says, ‘by chance,’ that takes God out of it?” Stephanie answered, “Well that’s kind of what I was wondering. I don’t know if they were saying evolution or God.” To Stephanie, “chance” implied removing God entirely from the process, which ran counter to many participants’ views of God’s action in the world.

Elizabeth, Participant 13, agreed with Item 9 that it is statistically impossible that life arose by chance. However, when asked to defend her answer, Elizabeth appeared unsettled and said, “I think that there is a Creator and there is an overall purpose and I don’t think that it was all by chance.” The researcher asked, “You mean Godless, [a] Godless chance? Is that how you’re reading that word there?” Elizabeth responded, “I guess so.” The researcher asked again,

“Where God is taken out of the picture?” Elizabeth replied, “Right.” To Elizabeth, Survey Item 9 negated any role for God in the creation process.

Another example further illustrates the confusion over the abiogenesis statement in the Evolution Attitudes Survey. Nicole and David, Participants 11 and 15 respectively, strongly agreed with the statement. However, Nicole’s and David’s views on evolution and the domains of science and religion were profoundly different. Nicole, who strongly advocated evolution and did not appeal to supernatural intervention at any time in her interviews, said,

I don’t know that there’s enough scientific evidence to go all the way back to the very beginning of time and decide boom, this is how the world and life started. . . . I don’t think that it was random however it did happen.

The words “chance” and “random” are confounding to participants who perceive such terms as depreciating God’s role in the creative process. Because “chance” was used in the Evolution Attitudes Survey, the abiogenesis survey item was not a reliable indicator of participants’ views on abiogenesis in this study. However, the interview data and scholarly paper provided evidence of participants’ views. Rather than settling into specific categories, participants’ ideas about abiogenesis were quite diverse and fell along a continuum. The following is a description of participants’ diverse ideas ranging from a creationist perspective to a strict, scientific position.

Ashley and David, Participants 5 and 15 respectively, rejected the notion that life on earth could arise by a natural process. David, used negative arguments as evidence against abiogenesis and evolution. David claimed that the atmosphere of the “early Earth” could not have supported the emergence of life and added, “That really puts a damper on their single-celled hypothesis where we came from and spontaneous generation per se, which Louis Pasteur disproved back in

– a long time ago.” David apparently did not realize Pasteur’s experiment in 1864 was designed to show that air did not contain a mysterious “life force” (K. R. Miller & Levine, 2002).

David also claimed it is impossible for molecules to self-organize by random processes into proteins and enzymes. “One thing I remember was they [scientists] tried to describe an enzyme,” David said, “as [if] it had come about as a monkey typing, just pressing random buttons on a keyboard.” However, David does not realize this classic creationist argument misappropriates probability and has been discredited (Isaak, 2007; Kitcher, 2007).

Ashley, Participant 5, who ascribed to a personal form of Progressive Creationism in which God started with ten thousand different species, sidestepped the abiogenesis question. When questioned about her undecided response on the abiogenesis survey item, Ashley simply stated, “I don’t think that one thing evolved to every single thing we have today.”

Two participants were willing to support the possibility of supernatural intervention in the appearance of the first life on earth, although they appeared more intent on keeping God somehow involved in the process rather than denying the feasibility of abiogenesis. Elizabeth, Participant 10, sounded almost conciliatory in her statements:

I know that God did it. I don’t necessarily know how it happened. . . . Science hasn’t said anything yet about how that happened but I know that God did it in some way so I guess I do kind of stick God in there and say, “Well, God did it.” I don’t know how, but God did it where science can’t explain it.

Brittany was non-committal in her remarks:

I think God allowed that process to happen and whether it be by dust particles, whether it be by Him or having any living pieces of cell there. . . . It could have been a supernatural basis, but God . . . allows these natural processes too, so I’m not putting it out of my mind

that it was a natural process, but I'm also not putting it out of my mind that it could have been a supernatural process too.

Four participants said that they personally didn't know enough about the abiogenesis issue to have a strong opinion, but were willing to let science stand on its own merit. Nicole, Participant 11, who had said, "I don't think that it [abiogenesis] was random," also admitted, I'm iffy on how the world actually started. . . . That kind of bothers me, but that's because I just don't understand it.

Rather than appeal to God as the primary agent creating life, Nicole confessed she didn't know enough to make an informed decision on the matter. John, Participant 12, demonstrated a similar position:

I still have trouble with going from the primordial soup. . . to where we are now. And, probably the reason for that is I'm not looking at the full picture. I'm just looking at the beginning and the end. . . . I would make an analogy to if you read the beginning of a book and then you had this crazy ending. . . . You read the end and you're like, "There's no way, I'm not even reading out of the same story! There's no way that you can connect those two events." So it's hard to accept, but that's a lack of knowledge on my part."

The remaining seven participants expressed some variant of allowing science to eventually find consensus on an abiogenesis solution. Michael and Jennifer, Participants 7 and 14 respectively, were unsatisfied with the current scientific explanation of abiogenesis, but eschewed a supernatural explanation. Gail, Participant 1, was undecided on the abiogenesis survey item and explained, "I've heard people say that [it is statistically impossible life arose by chance] but I've never personally looked into it so I really don't know." The researcher asked

Gail to respond to some people's view that God's intervention is the explanation where science falls short. Gail responded,

He might have. I'm not going to say that He didn't cause I think God could have done anything that He wanted to, but that doesn't mean that He did. It might be something that we just haven't figured out yet [scientifically].

Rachel, Participant 8, articulated a view similar to Gail's position:

I believe He was there [at the onset of life] and . . . He had the power to do it. . . . But it seems like I would be more inclined to answer just because science has not figured it yet doesn't mean that they won't because hundreds of years ago, we hadn't figured out DNA and we didn't know that.

Summarizing Theme 3.1, participants' views on abiogenesis varied: two participants dismissed abiogenesis; two participants were willing to say that God may have supernaturally created first life on earth; four participants were too uncertain to make definitive statements about abiogenesis; and the remaining seven participants held the position that abiogenesis was a scientific issue that one day may be resolved. One pervasive pattern appeared to underlie participants' ideas on the abiogenesis issue – God was somehow involved in the process, either directly or indirectly. This notion is further explored in Theme 4.3.

Theme 3.2 states that most participants viewed evolution as a valid explanation for the diversity of life on Earth. David, Participant 15, was the only participant who rejected evolution. Ashley, Participant 5, posited that evolution occurred from an initial line of ten thousand supernaturally created species, a quasi-Progressive Creationism view. Thirteen participants espoused evolution as a valid theory in their interview statements.

Item 1 in the Evolution Attitudes Survey stated, “Over billions of years all plants and animals on Earth descended from a common ancestor.” David strongly disagreed and Ashley disagreed with this statement. Nine participants agreed and four participants were undecided.

Stephanie, Participant 2 and one of the four undecided participants, confessed in her interview, “I don’t think my view of evolution is very, very strong, but I don’t think it’s totally weak either.” It’s not surprising that Brittany, Participant 10, was undecided as she was in a period of unqualified relativism, although she made statements in support of evolution throughout her second interview. Jennifer, Participant 7, generally upheld evolution in her interview statements, but also expressed some misgivings about whether evolution could account for the present biological diversity on Earth. “That’s a heck of a lot of mutations,” she said. Still, Jennifer supported evolution to the point of arguing in defense of its validity – to her parents’ dismay. The only surprising undecided was Tiffany, Participant 6, who had come to accept evolution in early high school. She marked undecided on five survey items, more than any other participant. When asked why she had so many undecideds, Tiffany responded she was uncertain of evidence to support the underlying claims in those items. Despite her survey results, Tiffany unequivocally defended evolution, as evidenced by the many supportive statements made in her interviews.

In summary, most participants viewed evolution as a valid explanation for the diversity of life on Earth. Related to this pattern is Sub-theme 3.2.1, which states most participants discontinued a belief in creationism. Diana, Participant 4, never embraced creationism, as her father was a geologist who espoused evolution in the home. David, Participant 15, was the only participant who grew up with a belief in creationism and maintained a commitment to that belief in spite of his experiences at the study site university. Indeed, David appeared to become further

fixed in his Young Earth Creationism and Intelligent Design beliefs during his university studies.

The reasons for David's entrenchment are further explored in Categories 4 and 5.

Sub-theme 3.2.2 states that most participants accepted human evolution. This is evidenced from their interview statements, scholarly papers, and survey data. Survey statements 2, 3, 5, 6, and 7 in the Evolutions Attitude Survey, found in Table 4.6, dealt directly with human evolution. Marking strongly disagree or disagree on these statements would indicate an acceptance of human evolution.

Fourteen participants demonstrated an acceptance of human evolution from their survey results, as seen in Table 4.6. David, Participant 15, was the lone exception. Eight participants either strongly disagreed or disagreed on all five items. Five participants marked disagree with only one or two undecideds.

Diana, Participant 4, strongly disagreed or disagreed on four items, but agreed with Item 5, that there is scientific evidence supporting that humans were supernaturally created. "It's [the human body] so perfect, and it's so intricate," Diana said when questioned about her selection, "that there's not ways to explain everything. So, that's why I think that." Asked if humans suddenly appeared, Diana quickly said, "No, no, no. But . . . there has to be something else, it can't be just random chance." Diana mixed science and religion to assert that there was scientific evidence that God had a hand in creating humans through evolution. David, Participant 15, was the only other participant who agreed with Survey Item 5 that humans were supernaturally created. Interestingly, these two participants couldn't be more diametrically opposed in their views on evolution.

The results from the survey show a clear trend in 14 participants' acceptance of human evolution despite a relatively mixed response to Item 1, which said, "Over billions of years all

plants and animals on Earth descended from a common ancestor.” For instance, Ashley, Participant 5, disagreed with evolution from a common ancestor, but she disagreed with every statement that rejected human evolution. In other words, Ashley discounted evolution from a common ancestor but endorsed human evolution. Similarly, all four participants who were undecided on evolution from a common ancestor indicated by their survey responses that they accepted human evolution.

Human evolution is a relatively recent process within the last 6 to 7 million years (Kardong, 2005). Participants, if they read the required Judd textbook (Judd, 1997), saw ample evidence for human evolution in the Origins course. Understanding and accepting human evolution may require less scientific inference in the minds of the participants than the linking of all living things to a single ancestor billions of years ago. Many participants referred to hominid fossil evidence in their interview statements. For instance, Megan, Participant 3, said, “There’s definitely a lot of fossil evidence . . . so yeah I think that we evolved. . . . I don’t think that God supernaturally created humans. I think that we evolved along with everything else on earth.”

Many participants expressed that human evolution was part of the larger story of evolution. When asked if humans evolved, Gail, Participant 1, said,

For evolution to make sense in my head, we have to have had a common ancestor. If I understand evolution correctly, there has to be some ultimate beginning, which would be a link for all of us.

Ashley, Participant 5, articulated a position that fit with her overall conception that evolution occurred from an original line of species: “I definitely believe in organisms evolving. . . . I believe even back to like Neanderthals to whatever to us. I believe in that, but before that, I’m not sure.” The researcher asked for clarification, “So it sounds like human evolution has

occurred at some point in the past but the connection with the rest of the tree, you are not so sure of?" Ashley immediately said, "Right." When a guest lecturer in the Origins class used skulls to connect humans and primates, Ashley's instinctual reaction was to reject that proposition. Asked why she felt the need to keep the hominid lineage separate, Ashley replied,

For no particular reason. I don't know why I can't really grasp, I don't know. Maybe it's because of the way that we relate to God is that we are made in His image and I don't see Him having that same spiritual relationship with a monkey.

Ashley's personal religious beliefs were influencing her scientific perspectives. Still, her response revealed a deep-seated concern that many participants expressed: the theological ramifications of human evolution. This issue is explored in Sub-theme 4.3.3.

Summarizing Theme 3.2, most participants viewed evolution as a valid explanation for the diversity of life on Earth, including the development of the human species. Most participants discontinued their belief in creationism while at the study site university. One participant maintained a commitment to Young Earth Creationism. Another participant held a personal model of Progressive Creationism with elements of theistic evolution.

Summarizing the remainder of Category 3, while most participants accepted evolution, their views on abiogenesis varied. Some participants rejected abiogenesis as having naturally occurred. Several participants were uncertain regarding the issue. Several participants were skeptical that science had yet found a viable explanation for abiogenesis, agreed with many participants that abiogenesis was essentially a scientific issue. Still, most participants were unwilling to accept any naturalistic solution that they perceived would erase God entirely from the process. Participants' theological perspectives are further explored in the next category.

## Category 4 – Participants’ Reconciliation of Their Understanding of Evolution and Personal Religious Beliefs

The previous category emphasized the scientific aspects of participants’ acceptance of evolution and rejection of creationism. The data show that religious beliefs played an important role in shaping participants’ experiences during their study of evolution. Category 4 focuses on participants’ personal religious beliefs and the reconciliatory process that most participants experienced in accepting evolution. Since David, Participant 15, was the only participant who rejected evolution, his case is less pertinent in Category 4. However, David’s perspectives are used as a counter-example in several themes and sub-themes.

Theme 4.1 states most participants’ acceptance of evolution was a process of conflict resolution and apprehension. Eleven of the 14 participants who accepted evolution discussed an affective response to learning about evolution in the context of their studies at the university. One of the three exceptions was Diana, Participant 4, who accepted evolution during her childhood. The other two exceptions, Tiffany and Michael, Participants 6 and 14 respectively, appeared to be relatively unaffected emotionally in their encounters with evolution. When Tiffany encountered evolution in high school biology class, she said biological evolution simply made sense to her. She remembers, “just kind of thinking all of a sudden that it didn’t have to be that black and white” between evolution and her religious beliefs. However, she still wondered about human evolution. Michael said that once he became more open-minded about the Bible near the beginning of his university experience, there was no reason for conflict. He explained, “It [evolution] didn’t worry me. . . . If it matches the rest of your faith, then there’s not much to be scared of.”

The journey-like process of Theme 4.1 is discussed below, followed by an exploration of the emotional factors accompanying many participants' acceptance of evolution. Fear and anxiety were the primary emotions articulated by the eleven participants who accepted evolution after some process of conflict resolution. One participant spoke about anger, which appeared to be a product of fear and is addressed below. Many participants expressed anxiety over changing their long-held religious beliefs. Many participants also felt anxiety over what their parents would think about their acceptance of evolution. Parents were an important factor in participants' mediation of evolution and personal religious beliefs, as discussed in Theme 1.1, and their role is further discussed in Theme 4.1 in the context of participants' anxiety.

No participant who came to accept evolution reported that the process was abrupt. Instead, most participants indicated the process took several years. Some who learned about evolution in their freshman Zoology class didn't resolve the issue in their minds until their junior or senior year. In many cases, the process was a slow accumulation of scientific evidence from various courses such as Comparative Anatomy and Science, Technology and Society. Many participants reported that Origins was a semester-long process of working through perceived conflicts. Ashley, Participant 5, described her experience in the course: "There you were, a whole semester, just basically ripping your hair out about where you stand."

Concomitant with their science courses, participants were rethinking their long-held religious assumptions in an assortment of Bible classes. Elizabeth, Participant 13, noted, "[In] those [Bible] classes, I just realized how complex everything is. It's not black and white in college. Everything went from black and white in high school to gray in college." Ashley, Participant 5, said her Bible classes were "like a shock." Ashley remarked that negotiating her

ideas about the Bible was especially difficult: “Everything that you’ve held so grounded is kinda being turned upside down.”

Some participants mentioned they had “a-ha” moments along the journey. A few participants encountered a new perspective in a lecture or in a book, and their understanding of evolution and their personal religious beliefs suddenly found greater clarity in the context of each other. However, these advances were steps along an extended journey. Megan, Participant 3, exemplified the journey-like process of accepting evolution. She reflected on learning about evolution in Zoology: “It was kinda like an epiphany almost, just something like, ‘Wow,’ I can believe this and I don’t have to believe in something that I had learned since I was a little kid that I’m not totally sure about.” When asked if anything was keeping her from believing in evolution, Megan clarified,

Well, it took me a while to actually come to the point to where I believed it [evolution].  
 . . . I was kinda leaning towards that but then just the idea of how my parents, what they had taught me when I was a little kid, it was just kinda like I don’t know if I should.

Many other participants also indicated that the process was a tug-of-war experience. They were pulled back and forth in deciding what scientific aspects to accept and how their religious beliefs would mesh with that new scientific acceptance. The comments of Ashley, Participant 5, illustrate the struggle:

I wanted to please both sides of myself. I wanted to please the science part of me but I also wanted to be true to the faith part of me and I wanted to get right in the middle and make sure both were alright and sometimes it’s not possible.

Later in her interview, Ashley also remarked,

I felt like you'd get three steps ahead and you'd be "Alright" and then five back! Because you'd hear something else and you're just like, "Oh, no!" And it was just a constant thought process . . . about where do I stand on this new issue.

Rachel, Participant 8, felt pulled in different directions as a freshman in Zoology. She was seeing through her professor that a Christian could accept evolution, but she was also hearing, "No!" from her parents. Rachael felt so conflicted at the time, she exclaimed, "Oh my gosh, I don't know what to do!"

Jennifer, Participant 7, joked about trying to come to closure on human evolution. She said, "When it [the Bible] says man was created instantaneously, one [evolution] says man was created over time, that was hard, but we eventually worked that one out." Asked what she meant by "we," Jennifer laughed and offered as an explanation, "Well me, myself, and I." Her joke implies the internal, contentious, decision-making process to which many participants similarly alluded.

Jennifer, Rachel and Ashley's statements indicate that emotional turmoil accompanied the process of reconciliation. Another example was Stephanie, Participant 2, who described her evolution encounter in freshman Zoology as the "most upsetting time" in college and her "defining moment of . . . being challenged." She recounted, "I was sitting there and she [the Zoology professor] started talking about it and I was just floored that she could believe in evolution. I was like, 'You call yourself a Christian and you believe in evolution?!" [her voice elevated and sounding incredulous]" Stephanie continued, "I remember walking out of that class so angry. I can still remember how angry I was." Reflecting on her experience, Stephanie offered "disgusted" as a "good word" for how she felt.

Stephanie's angry reaction is a curious response to learning about evolution. Asked if she would have responded similarly at a secular university, Stephanie said, "I probably wouldn't take it as anger or whatever because I would just be like, 'Oh well, maybe they're not a Christian.'"

Stephanie's answer reveals what was so troubling in her mind: her Christian professor's openness to evolution. She wrote in her scholarly paper,

I know the idea of evolution infuriates many Christians today because I was one who was completely against evolution before I came to college. . . . I remember being in a fury when I heard that a Christian college believed in evolution.

Stephanie's visceral anger was apparently provoked by a sudden, unacknowledged fear that a belief she had held so strongly for most of her life was suddenly overturned. As was true with many participants, Stephanie realized for the first time that a Christian could accept evolution. Her professor was a testimony of that possibility.

Though less intense than Stephanie's response, many participants reacted with anxiety to learning about evolution. The data indicate two primary sources of anxiety: participants' awareness that the beliefs they once thought so sacrosanct were beginning to change; and participants' apprehension about how they would defend an emerging acceptance of evolution to their parents.

Ashley, Participant 5, said that learning about evolution "was a culmination of your thoughts for so many years being shattered and then you're picking pieces here and there and adding your own." She expressed a personal sense of shock in first learning that a Christian could actually accept evolution. A look of exasperation came over Ashley's face when she reflected on that new realization her sophomore year when Dr. Denis Lamoureux, an

“evolutionary creationist” and guest lecturer, spoke on campus about theistic evolution. With a laugh of incredulity, she said,

Now do you see what I mean about being blindsided or bombarded with things that for 18 or 19 years you’ve held true? I mean, to me, it’s almost like for 23 years believing that my mom and my dad are my parents and then one day, them saying, ‘No, you’re adopted.’ That’s kinda like what it was to me. Just this truth for so long and then you’re just like, ‘What?!’ *That’s how out of the blue it was to me* [italics added].

Elizabeth, Participant 13, also expressed an initial anxiety over the thought of altering her long-held religious beliefs during the process: “Everything that I’ve learned before, this is maybe not all true! It makes you kind of scared a little bit.” Throughout these participants’ comments is an underlying current of anxiety in becoming aware that some of their religious beliefs were changing for the first time.

Participants who accepted evolution also worried about how they would be viewed by their parents. As shown in Theme 1.1, parents were a strong and continuing influence in participants’ lives during their years at the study site university. Eight participants indicated that they either had experienced conflict with their parents over evolution or were too worried to broach the issue of evolution with their parents. Gail, Participant 1, wrote her scholarly paper as a personal letter to her father to relieve the “burden” of a strained relationship she faced with her father over evolution. “He and I definitely have had lots of different confrontations,” Gail said, “but they’ve gotten a lot better and we’ve both . . . come to an understanding and acceptance of each other’s opinions.”

Gail especially wanted to communicate to her father through her paper that an acceptance of evolution was not a salvation issue. This was a recurring pattern in several participants' comments. Ashley, Participant 5, remarked,

I think they [my family] were just worried that I was gonna just not be a Christian. . . .

And so when I was expressing these different views, it was just like an automatic, "No and I hope that you realize what you're getting [into]." Something like that is kinda the vibe I was getting.

Rachel, Participant 8, wrote in her scholarly paper,

One of the toughest challenges for me regarding evolution is my family. It is extremely difficult to talk to them about this because they are still in the mindset that science is out to destroy Christianity. That is how they were raised and evolution is just nonsense to them.

Megan, Participant 3, still hadn't discussed evolution with her parents in the year since she took Origins. She said, "I'm kinda . . . scared about talking to them, about what I believe [regarding evolution]."

Some participants who accepted evolution expressed a sentiment that they wished they could return to a simpler view of creation, rather than arguing internally within themselves.

Elizabeth, Participant 13, confessed some lingering doubts about accepting human evolution: "It says in the Bible that we came from Adam and Eve and I guess that bothers me a little bit."

Asked if she wanted to believe in a literal Adam and Eve, Elizabeth responded, "Kind of, yes. I think so because . . . that's what we've been taught." After a long pause, she laughed,

But I can get over that. I don't know. I just, it's probably kind of silly, but just a little part of me wants to . . . believe that there was an Adam and Eve and that it did happen just like it says in the Bible."

Jennifer, Participant 7, discussed the internal conflict she felt in coming to accept evolution: "I'd just been arguing so much with myself about it." Jennifer added, I was almost tired of arguing evolution creation, evolution creation, and I was like, "Well maybe, . . . I'll just err on the side of religion," you know? Because I'll be a little more religious and a little less scientific and I might get a little bit discredited in the scientific community, but at least God will like me because I'm religious [laughing].

Though she admitted feeling this way at times in the past, Jennifer displayed a reconciled acceptance of evolution in her interviews. Still, her comments and those of other participants about their experiences support Theme 4.1, which states that most participants' acceptance of evolution was a process of conflict resolution and apprehension. Most participants were anxious about the changes in their own religious beliefs and what their parents would think about their acceptance of evolution.

Theme 4.2 states that four factors facilitated participants' acceptance of evolution. The interview protocol did not specifically ask participants to identify critical factors that they considered were crucial to accepting evolution. However, as the participants recounted their stories, patterns emerged from the data to suggest that four factors were important as part of the process of accepting evolution. Theme 4.2 does not assert that the four factors were a requisite for accepting evolution. Instead, the factors helped move forward the process of accepting evolution. Each of the factors is discussed below in a sub-theme.

Sub-theme 4.2.1 states that the evidence for evolution was an important consideration for most participants who accepted evolution. A common thread evident in many participants' dialogue was their dependence on the scientific evidence. Ten participants specifically said the evidence for evolution was incontrovertible.

Several participants articulated that in the past they took their parents' or teachers' word at face value. However, these participants now demanded from their authority sources evidence to back up their statements. Brittany, Participant 10, who at the time was questioning her long-held assumptions, articulated, "I think that you can't learn something without questioning. Otherwise, I would just be taking what somebody else gave me and making my own belief." As Brittany reminisced about the creationism and anti-evolution notions that she had been led to believe in her childhood, she expressed this reaction: "I was like, 'Do these people know what they are talking about?' I don't know about lies, but I'd think, 'What do they base their evidence off of?' Because they never told me."

Rachel, Participant 8, noticed herself becoming more reliant on evidence to adjudicate her beliefs. She reflected, "When I was younger, I took everything that everyone said at face value and I was like, 'Okay,' and if an adult said it, it must have been true." Rachel said that as an adult, her line of questioning is now: "Why do you think that? Can you prove like more evidence as in why and not just tell me because?"

Rachel and Brittany's comments clarify that many participants had transitioned to relying on evidence to support what they believed and accepted. In the context of science, that reliance was on scientific evidence, and many participants said the evidence for evolution was overwhelming. Therefore, participants were not going to accept evolution just because their science professor accepted it. Elizabeth, Participant 13, was asked if she came to the decision

herself or if her decision was “based on the person in front of the classroom.” Elizabeth responded,

I think it was more of the science. I mean there was so many things that pointed in that direction, but I knew already that God created the world. . . . I just accepted that all of these scientists from all of these different specialties and their evidence supported this idea of evolution. . . . It was just the integration of my belief . . . throughout my life with this evidence [for evolution].

The following excerpts from participants’ interviews demonstrate the importance of evidence in accepting evolution:

I just kept seeing proof and proof and proof that the world was old! (Nicole,  
Participant 11)

There are some animals . . . that are so well adapted to the environment. It’s just like, “Wow, like that’s amazing!” They’re not made anywhere else on earth. . . . You have to acknowledge that it [evolution] happened. (Megan, Participant 3)

I think there’s plenty of proof out there that there’s evolution and you can see it.  
(Stephanie, Participant 2)

All participants in this study had the same access to evidence for evolution. Most participants shared the same courses of study in their biology-related programs. They all shared the same Origins professor. In the modern information age, participants enjoyed ready access to the Internet. David, Participant 15, would have had the same access to evidence as any other participant. However, his deliberation of that evidence was profoundly different from the other participants. This difference in interpretation of evidence is further explored in Category 5.

Sub-theme 4.2.2 states that negotiating Genesis as non-literal was important for most participants who accepted evolution. Most participants had been raised to believe in a literal interpretation of Genesis by their parents. The data show most participants no longer held a literal interpretation of the Genesis account of creation, as demonstrated in Sub-theme 2.2.1. Sub-theme 4.2.2 investigates why a negotiation of Genesis was important for many participants to accept evolution.

All participants discussed the past and ongoing importance of the Bible in their lives. Many participants demonstrated an intimate knowledge of the Bible by referencing and quoting scripture to support their statements. The notion that the Bible is literal was taken for granted by many participants in childhood.

However, participants recognized that a literal interpretation of Genesis could not peacefully coexist with evolutionary theory. Diana, Participant 4, was an exception and her dilemma of forcing a literal interpretation of Genesis to fit evolutionary theory is described in Theme 5.2. In order for participants other than Diana to accept evolution, they had to negotiate their interpretation of the Bible. For example, Megan, Participant 3, wrote in her scholarly paper, “A strictly literal interpretation of the Bible does not mesh with the evidence discovered by science, especially the discoveries made within the past century.”

Eight participants referred to specific experiences in Zoology, Origins, or a Bible course where they studied the chronology of Genesis 1 and 2 juxtaposed and came to recognize the Genesis account of creation as lyrical rather than literal. Nicole, Participant 11, related how her recognition of Genesis as non-literal enabled her to accept evolution:

It was [in] Origins that we talked about . . . how . . . Genesis is lyrical. . . . It's poetic and all of the sudden it made sense to me. I was like, “Well, that's representative of what

happened” and it all clicked into place then. I think that was my “aha” moment. When I discovered that you don’t have to take the Bible literally. I mean you want to get the idea from it and figure out what they’re saying, but the main point was God created the heavens and the earth and in Biblical times they were lyrical. That’s how they learned things and that’s how it made sense to them. As so, I realized that it was poetic.

. . . I was like, “There, we go!” It could have been evolution and the only way that God knew how to describe it to the people was to say, . . . “I did it in seven days,” and it made sense to them.

Nicole’s comments demonstrate the thought process in many participants’ minds that can be paraphrased, “If the Genesis account of creation doesn’t have to be taken literally, then evolution can be accepted.” Furthermore, some participants recognized that an acceptance of evolution would not jeopardize their salvation. This thought process can be paraphrased, “My salvation is unaffected because I can concomitantly accept evolution and remain true to the Bible as it should be interpreted.”

These paraphrased statements are echoed in the comments of Gail, Participant 1. The researcher asked her what had made a crucial difference and when had she felt like she turned a corner in accepting evolution. Gail responded,

It was when she [Origins professor] brought up the fact that, “You know, this isn’t crucial to your salvation and we’re not saying that God didn’t start it all, that God’s not behind it. We’re just saying here are all the natural laws and what God put in place and this is just how you naturally follow it,” kind of thing basically. That’s not what she said verbatim but that’s what I remember. And it was just like, “Oh, okay, so this isn’t saying that

[what] the Bible says is wrong,” especially when she talked about Genesis 1 or Genesis 2 . . . where it’s in the form of a Hebrew poem.

Gail recognized through her professor that evolution did not countermand a belief in God or in the Bible. Gail no longer had to “question . . . [her own religious] faith because of evolution, because it just came down to the fact where that’s not key to salvation.” Gail said a short time later, “Once I accepted it, I was like, ‘Well, let’s go!’”

Gail’s comments link Sub-theme 4.2.2 about Genesis as non-literal with Sub-theme 4.2.3, which posits the importance of many participants’ recognition that an acceptance of evolution and salvation are unlinked. Many participants reported that before attending the study site university, they believed it was impossible to be a Christian and accept evolution. At some point, participants who held that assumption had to evaluate its legitimacy before accepting evolution.

Furthermore, five participants had to deal with parents who were dubious that an acceptance of evolution was uncoupled with spiritual standing and vitality. For example, Jennifer, Participant 7, reported,

I went home to talk to my parents [and] I was like, “Well, my professors are all [in our same denomination] and all Christians.” . . . And so, you use that as your leverage like, “Well, they’re Christians and they believe in evolution.” They believe evolution – they don’t believe in evolution, but you know. “So it must be okay. God’s not gonna strike you down cause they’re still alive” kind of thing.

Jennifer’s joking notwithstanding, many participants had to make an intentional or unconscious break with their previous assumption that an acceptance of evolution placed a Christian’s salvation in serious jeopardy.

Sub-theme 4.2.4 states that observing a Christian professor model a commitment to evolution was important in many participants' acceptance of evolution. The general influence of the professor as a role model was explored in Theme 1.2, which showed participants respected their professors for being genuine, forthright, and demonstrating a commitment to honoring both science and religion. Sub-theme 4.2.4 extends the discussion to explore how Christian professors were an important factor in facilitating an acceptance of evolution.

The data show that participants viewed their professors as validation that a Christian could unapologetically accept evolution. Michael, Participant 14, noted that prior to attending the university, he "didn't know any strong Christian scientists." He added, "There was nobody really who would be able to kind of guide me in that [accepting evolution] at that point [in high school]." Michael, as demonstrated by his discourse, was not the type of student who emulated professors. Still, he recognized the value of a Christian scientist in modeling an acceptance of evolution.

Megan, Participant 3, explained why the Origins professor was so important in her acceptance of evolution. Megan had first learned about evolution while writing a report for a high school biology class. Megan reported that she "paid no attention" to what she wrote and simply completed the assignment for a grade. But at the university, she remarked,

Here are all these Christians around me and a Christian professor who is having this kind of idea and that actually made me open up to it so I think that if I had gone to a public university and had the same teachings, I don't know if I would have been open to accepting it. Maybe I would have just have done the same thing I did in high school when I had to write that paper – just kind of ignore it.

Rather than ignoring evolution, Megan could consider an acceptance of evolution that was so powerfully affirmed through her Origins professor:

Just the fact that I knew that she was a Christian, I knew that she was a believer who really trusted God and to hear her saying things like this, it was kinda like, “Maybe I can believe that too.”

Michael and Megan’s comments represent why an important factor for many participants in accepting evolution was observing role models of Christians who accept evolution. David, Participant 15, once again comes into sharp contrast with the other participants in this study. While he credited his Bible professors for strengthening his faith and shaping his ideas about Christianity, he made no mention of any of his science professors as role models. It apparently didn’t help that the Origins professor refused, as he reported, to carefully read his scholarly paper. Still, because the paper was due at the end of the semester, David had plenty of opportunity to observe the Origins professor. The difference in David’s and other participants’ consideration of their science professors as role models is further explored in Category 5.

Summarizing Theme 4.2, four factors facilitated many participants’ acceptance of evolution. Participants’ science professors modeled how a Christian could embrace evolution. Other important factors in accepting evolution included a reliance on evidence for evolution, a determination of Genesis as non-literal, and recognition that evolution did not jeopardize salvation.

Theme 4.3 states that participants viewed God as active in the world, but were uncertain of the extent of God’s role. Participants repeatedly affirmed God’s involvement in the creation process both in the past and in the present. Furthermore, participants objected to any notion that completely removed God from the creation process. This is further explored in Sub-theme 4.3.1.

Most participants appeared surprised when questioned about the theological ramifications of evolution. These were questions 14 through 19 in the creationism-evolution interview protocol shown in Appendix C. Some participants commented that they had not previously thought about issues of teleology, theodicy, and the nature of the soul. In addressing these issues, many participants endeavored to find equilibrium between their science understanding and their theological convictions. At times, participants demonstrated that finding a balance was not easy. Many participants also struggled to articulate their thoughts on these issues. However, patterns emerged from the data and are discussed in the following three sub-themes.

Sub-theme 4.3.1 states that participants postulated teleological purpose and rejected any notion that explicitly removed God from the creation process. This sub-theme addresses participants' perspectives of God's past and ongoing action in the world, which affects a wide range of topics: miracles; purpose, randomness and chance; and evolution as a theistic mechanism for creation. Most participants labored to articulate clear answers about randomness and the extent of God's intervention in nature. However, several patterns emerged. Each is addressed with supportive excerpts from the participants' interviews.

One emergent pattern was that participants viewed God as setting the universe in motion as evidenced in the following participant quotations.

He [God] didn't say, "I'm going to create a cardinal this way, this big and everything," but in a way He set up the system so that it would work that way to create all these things. (Michael, Participant 14)

God put it into place, but evolution was the mechanism that He used. (Megan, Participant 3)

He [God] is using science. . . . He started this Big Bang and He started this little evolution mechanism thing, . . . like one of those little Goldberg experiments. He just started one little thing and domino-effect things have happened since then. . . . He is watching it, you have to believe, but it's not that He's down here and He just constantly puts His little finger in things and does stuff. But He's kind of like letting science take its natural course. (Jennifer, Participant 7)

Jennifer's quotation points to a second pattern that emerged from the data: many participants said that God could have intervened in changing the course of life on Earth in the past but were uncertain how God would have acted or if God actually did act. The researcher explored participants' responses by posing questions such as, "Did God nudge the asteroid to hit the Earth and wipe out the dinosaurs 65 millions years ago?" and "Did God manipulate DNA to direct evolution?" The following excerpts demonstrate that participants acknowledged God's presence in the creation process but struggled to articulate God's action:

I think He definitely *could have* [italics added] intervened. Maybe He said, "Look at earth, that's a great planet. I can see what that's gonna be at some point in the future. . . . It's gonna be a place that humans would want to live. . . . So let's nudge this comet a little bit closer and make it hit the earth and that brings the last piece of the recipe. The last ingredient for life to the planet and that precipitates life on our planet as we know it. . . . I think *maybe He could have* [italics added]. . . . It would be well within His ability to do that. (John, Participant 12)

I still think He was there making sure everything went right so whether it was through physically changing it, I think probably – I can't see Him physically changing genes or

making them mutate or so I don't know. Maybe that was chance. Then, I don't know, but I still think He was *there* [italics added]. (Stephanie, Participant 2)

John used "maybe" and "could have" to state the possibility of God's role. Stephanie claimed God was present and "there," as if God's presence somehow affected the process. This was a recurrent theme in participants' answers. The following discourse between the researcher and Rachel, Participant 8, demonstrates how some participants appealed to God's presence during the creative process:

Rachel: I just always like to think of Him as always there and working with the gene mutations and if they happen to be random, then that's okay and He's there.

Researcher: What does it mean that He's there?

Rachel: He's there [shouting gleefully]!

Researcher: He's there, what does that mean?

Rachel: He's in the shadows [laughing].

Researcher: Is He tweaking? You're saying He's not tweaking, but He's there.

Rachel: I think He's there, I do. Like I said, like that energy that's kinda holding the laws together, not going in and fixing things but saying, just kinda, I don't know if that makes sense to you at all.

Rachel's comments reflect the importance participants placed on keeping God somehow within the creation process. Some participants used the phrase, "He's guiding it." When Tiffany, Participant 6, was asked to clarify what she meant by "guiding," she appeared perturbed and responded,

Pfff, I don't know! That's like asking if God just had to think matter into existence or if He had to say matter into existence or if He clapped His hands [and matter came] into existence. I mean I don't know. He can guide it however He wants.

Participants' conviction of God's presence and participation in past creation events, albeit indefinite, correlated with their conviction that God continues to act in the present, the third pattern that emerged from the data. Ten participants stated that miracles still occur. Many participants connected prayer with God's direct intervention. The following excerpts demonstrate participants' confidence in God's continuing action in the world:

I think that God has a hand in everything that happens. He helps things along according to His master plan. . . . He's letting the world be as it is. He's letting it evolve. He's letting it happen. . . . Prayer is so He can step into the world. Otherwise I think He's just going to watch it. (Nicole, Participant 11)

I think He does intervene in the world for sure, . . . like miracles and things like that. I don't think any Christian would say there's no miracles. That's part of our faith.

(Michael, Participant 14)

God works in very predictable ways. Now He does have those crazy miracles that go against the normal pattern of how everything works and He could do that all the time if He wanted, but I think most of the time He works through very normal, predictable ways. And I think that evolution just goes along with that. . . . He isn't so much a "zap" kind of thing. He works through it [evolution]. (Jennifer, Participant 7)

Because of participants' certitude of God's past and present action in the world, a fourth pattern emerged from the data: most participants rejected any notion of randomness that removed

God from the creation process. Nine participants made definite statements about randomness. However, their notions about randomness varied.

Many participants connected randomness with a teleological lack of purpose. Eight participants explicitly claimed there was inherent purpose in life, regardless of scientific explanations for origins. None of the other seven participants indicated a purposeless existence in their interviews. Not surprisingly, some participants saw randomness as the anti-thesis of purpose. The word “chance” unsettled many participants on the survey item on abiogenesis as discussed in Theme 3.1.

Some participants were aware that scientifically speaking, natural selection is random. However, they were uncertain about how their theology meshed with the science. When asked how she felt about some people’s claim that natural selection is a random process, Megan, Participant 3, said,

I believe that there’s a purpose for everything that happens. . . . If you believe there’s a purpose, then things can’t be really random. There has to be a reason. . . . But it does seem that mutations are random and some organisms are selected while others aren’t.

Yeah, that’s a hard question.

A few participants appeared more settled on the randomness of evolution. Michael, Participant 14 stated,

The whole concept of it [evolution] is randomness of chance. That has no purpose there. That’s why evolution on its own is not enough. It’s kind of empty, I think. People try to hold on to just the science of it, but I don’t think it’s enough.

When asked to clarify if an acceptance of evolution meant a loss of purpose in life, Michael responded, “I think there’s more than just evolution. Like evolution may be true, but

there's also a God who at least started it or created it and that there's a purpose [in that]."

Michael's statements correlate with his consistent operation of maintaining clear boundaries between science and religion. From Michael's viewpoint, evolution as a scientific construct does not give or take away purpose. Instead, God endows purpose, in Michael's perspective.

Jennifer, Participant 7, also recognized that randomness, in and of itself, does not rob a person of purpose. She stated,

[I] still believe that God has a play in our little lives. . . . I think He works through science and so I think we are basically just random mutations, but I think little mutations can still have purpose while we're down here. It might be insignificant in the long run, but while I'm here, I'm gonna make it worthwhile.

Summarizing Sub-theme 4.3.1, participants postulated teleological purpose and rejected any concept that explicitly removed God from the creation process. Michael and Jennifer rejected the assumption that scientific randomness translates to purposelessness. Many other participants rejected any notion of chance that devalued God's role in creation. Participants viewed God as active but were uncertain about the nuances of God's activity beyond miracles and intervention through prayer.

Sub-theme 4.3.2 states that many participants pragmatically approached theodicy and affirmed the practical aspects of evolution as natural selection. Creationists (e.g., Ham, 1987) treat theodicy as a sin problem: death and destruction are negative consequences that first appeared when Adam and Eve sinned. Since 14 participants came from a creationist background, the researcher expected that this negative connotation of death would be present in some of the participants' answers. Surprisingly, it was not. Stephanie and Rachel, Participants 2 and 8 respectively, were the only participants to broach the creationist perspective.

Stephanie received religious training in Bible camps when she was a child. In regards to theodicy, Stephanie said, “I think death and destruction came in through the Fall [of Adam and Eve].” She referred to a literal Adam and Eve that had evolved like other animals. Stephanie stated, “Animals are there for us to enjoy and animals don’t have a [soul].” Consequently, she was unfazed by the theodicy issue. Stephanie appeared unaware that her statements regarding the initiation of physical death through the “Fall” was inconsistent with the natural selection of animals that preceded a relatively more recent Adam and Eve.

Rachel, Participant 8, also referred to the sin issue but appeared uncomfortable with making that theology mesh with her statements supporting evolution. Rachel said,

You say that nature is survival of the fittest. Well, like humanity is survival of the fittest sometimes and we tend to be pretty brutal to each other too. . . . I guess it kinda takes me back to like when man sinned, *whenever that was* [italics added], I’m still trying to [exasperated sound], but it seemed to affect the whole creation.

Rachel qualified her statements later to insist that nature is not bad. She talked about monkeys and gorillas looking out for each other and cited good things that humans do. “That’s a redeeming quality,” Rachel said, “and I see it in nature too.”

David, Participant 15, who was a Young Earth Creationist, did not mention the Fall and appeared to side-step the theodicy issue. He said, “The whole natural selection thing, I don’t know. It kinda fits in with the free will thing. . . . It doesn’t bother me, but like I’ve said, I’m not an evolutionist.”

Most participants provided a practical response to the researcher’s use of Tennyson’s (Tennyson, 1850/2000) statement, “Nature is red in tooth and claw.” Their answers appeared to

take two forms: that's just the way it is; and survival of the fittest is the means by which nature can progress. The following excerpts are from two participants who espoused the first sentiment:

That's the way nature is. Things are going to die, the most adapted are going to live.

That's the way it is. (Nicole, Participant 11)

The things that I see happen in nature, I don't see as evil or good or bad or unfair or fair. I just see it as nature. That's the way it is. (Tiffany, Participant 6)

Eight participants responded that evolution actually works quite well as evidenced in the following three excerpts:

I think as a system, He's [God's] still logical and it makes sense and like you said, "survival of the fittest" so that life can flourish. Otherwise you'd have all these decrepit messed up animals. (Michael, Participant 14)

I don't know why nature is the way it is – [the] survival of the fittest. But I seem to see it working in other areas, so it seems like it's probably a pretty good system. But that's easy to say as an upright, walking human, and not as a single cell ameba [laughing]. (John, Participant 12)

You can't have life without death. If it was all life and no death, we would all be starving. . . I don't think that makes God a cruel God, it makes God a practical God. (Heather, Participant 9)

Summarizing Sub-theme 4.3.2, most participants approached theodicy from a pragmatic standpoint and affirmed the practical aspects of evolution as natural selection. None of the participants appeared distressed by the theodicy issue.

Sub-theme 4.3.3 states most participants affirmed a belief in the soul, but were uncertain as to the soul's place within the context of human evolution. Fourteen participants discussed the

soul during the course of the second interview. Elizabeth, Participant 13, did not mention the soul, but said, “We were made in a way that we can have a relationship with God.”

Participants described the soul in a variety of ways including reasoning ability, the “seat of emotions,” the “essence of being,” and a non-evolved gift from God. Some participants had difficulty defining the soul. Nicole, Participant 11, stated, “I’m confused as to what a soul really is, but I’m confident that we have one.” Most participants believed the human was composed of a body and soul.

Most participants attached great significance to the soul. Ashley, Participant 5, said, “To me, the soul’s much, there’s so much, not value, but holiness put on it. I mean that is our direct lineage to God.” Tiffany, Participant 6, explained, “It’s that little bit of eternity in us.”

As discussed in Theme 3.2, most participants viewed evolution as a valid explanation for the diversity of life on Earth. Sub-theme 3.2.2 also showed that most participants accepted human evolution. Many participants said the soul was what set humans apart from animals and this is what appeared perplexing to some participants. The dilemma for some participants can be paraphrased, “If humans evolved from animals, when did humans acquire a soul?” The following excerpts reveal their consternation regarding humanity’s inception of a soul:

I don’t know where it came from; I don’t know when it started. I believe it came from God, but that’s because I believe God created us. (Brittany, Participant 10)

That’s what I don’t know. At the point, whenever – there was some point in time when we changed from being a primate to being a human and I don’t know. That’s an issue that always bothers me. . . [But] I don’t sit around and brood over it. (Nicole, Participant 11)

I think one of the biggest questions is when did God come into relationship with [humans]. When had we evolved to the point where God came into relationship with us? You know, so we were given souls. (Tiffany, Participant 6)

But then the question of when we really got our soul, . . . I don't know. I haven't decided on that. (Megan, Participant 3)

As evidenced by the above quotations, most participants were undecided about when humans acquired a soul. Gail, Participant 1, admitted, "That's one of those childhood beliefs that has never been confronted before and so that's something that I still believe – that we all have a soul." Asked if she had thought about the soul issue in the context of human evolution, Gail replied, "Nope, not until you just asked it right then – never, ever."

Most participants who accepted human evolution and believed in a soul did not appear visually agitated over questions regarding the soul. Many participants recognized that these questions were unanswerable and were a matter of religious faith. Jennifer, Participant 7, wrote in her scholarly paper, "Evolution can't account for our souls." Asked to comment on her written statement, Jennifer, marking clear boundaries between science and religion, said, "Science stops and religion takes over."

Summarizing Sub-theme 4.3.3, most participants posited a human soul, but were uncertain as to the soul's place within the context of human evolution, including the point at which humans acquired a soul. However, the matter of the soul did not appear to be a contentious issue for most participants. The theodicy issue, as discussed in Sub-theme 4.3.2, likewise was not a serious concern for most participants who took a pragmatic approach to evolution. Most participants said that evolution was God's practical mechanism for the creation and survivability of species. Additionally, most participants affirmed God's action in the world

but were uncertain of the extent to which God acted in nature, as discussed in Sub-theme 4.3.1. Randomness was a touchstone issue for many participants who rejected any notion that erased God entirely from the creation process. Most participants affirmed a teleological purpose to life, regardless of scientific explanations for origins.

Themes 4.1 and 4.2 addressed the process and important factors that facilitated participants' acceptance of evolution. Scholarly paper excerpts and interview quotations, displayed throughout this chapter, illustrate participants' individual cognitive and affective processes, as manifested in their faith systems. The processes include participants' interpretation of evidence; their capacity for ambiguity; and their inner arbitration of scientific and religious matters. The unique ways participants processed these aspects are the focus of the next category.

#### Category 5 – Faith and Reconciliation of Evolution and Religious Beliefs

Table 4.3 summarizes participants' faith using Parks' descriptions of college students' faith (Parks, 1986) and Fowler's faith stages (Fowler et al., 2004). The purpose of this section is not to rank participants' faith or to discuss the relative merits of participants' faith scores. Instead, the purpose is to demonstrate the emergent patterns in Category 5 in which faith played a role in participants' reconciliation of their understanding of evolution and their personal religious beliefs.

In cross-referencing faith stages with participants' acceptance of evolution in this study, it became clear that a participant's acceptance of evolution cannot be correlated with a minimum faith stage for three reasons. First, only one participant was a young earth creationist. More data about the faith dynamics of several participants with Young Earth Creationism perspectives would be needed. Second, the very nature of participants' perspectives on evolution defies categorization. For instance, Ashley, Participant 5, espoused elements of a quasi-Progressive

Creationist model. However, she accepted evolution, albeit from an initial line of specially created species. The complex perspectives that emerged in this naturalistic study resist quantification and numerical correlation.

The third reason that an acceptance of evolution cannot be correlated with a minimum faith stage score is that factors other than faith affected participants' acceptance of evolution. For example, Diana, Participant 4, accepted evolution as a child because her father taught evolution to her. At the time of her interviews, Diana operated in conventional faith with a Fowlerian faith score of 3.2. She did not accept evolution because of a conventional faith or a prior faith stage. But, Diana's conventional faith affected how she reconciled perceived tensions between her understanding of evolution and her religious beliefs. Consequently, the effect of participants' faith on their reconciliation of evolution and personal religious beliefs is explored in this category.

Earlier in this chapter, the faith stages of Michael and David, Participants 14 and 15 respectively, were compared to explore the connections between how they made meaning of the world and how they viewed creationism and evolution. This analysis revealed sharp distinctions in the way two participants with similar backgrounds but disparate faith stages approached ambiguity, perspective taking and fear. In this section, the purpose is to explore the general trends in the data which reveal the effect of participants' faith on their reconciliation of evolution and their personal religious beliefs.

Since participants' faith stages fell along a continuum, drawing clear distinctions between adjacent participants on the continuum is unreasonable. Instead, contrasting the perspectives of participants in a conventional faith stage to the perspectives of participants in an adult faith stage, as in David's and Michael's comparison, accomplishes the purpose of exploring how faith

development affects participants' reconciliation of evolution and personal religious beliefs.

Additionally, the perspectives of participants in young adult faith, the intermediate stage between conventional and adult faith, elucidates matters. This method will serve as the framework in exploring the new two sub-themes.

Theme 5.1 states that participants who operated in adult faith were deferential to the scientific evidence for evolution while some participants who operated in conventional faith disregarded the scientific evidence. As scientific evidence is the key factor in this sub-theme, the contrast is drawn between two participants who viewed the same evidence in opposite ways.

David, Participant 15, operated in a conventional faith stage and rejected evolution based on his perception that evolution lacked scientific merit. Asked if he had a good understanding of evolution, David replied,

I feel I understand it very well. . . . and the evidence behind it, that's disagreeing with it.

And so I've been reading this stuff for a long time with all my science classes too. I believe I really know the information very well.

David took science classes similar to the rest of the participants who accepted evolution. However, some aspect was different in the manner David approached evidence and the credence he allowed the evidence. As noted in the faith stage comparison with Michael, David avoided any ambiguity that he associated with an acceptance of evolution. David also feared what he perceived were the dire consequences of Darwinism, including the moral breakdown of society.

In order to maintain a safe zone, David created a mental filter to trap only evidence that supported his assumptions. His presumptions drove what evidence for evolution he would consider rather than permitting evidence to inform his assumptions. Therefore, instead of considering the preponderance of evidence for evolution, his focus was fixed on information that

he found against evolution. In fulfilling the Origins course requirements, David processed information about evolution, but it didn't stick to his filter – the evolution evidence passed on through. David practically admitted as much in his scholarly paper, "I follow . . . [the] Bruce Lee Philosophy. 'Keep what is useful, discard what is useless.'"

Other participants noted this filtration mode was possible. Megan, Participant 3, said she wrote an evolution paper in high school for the grade and didn't "let it impact" her "in any way." Gail, Participant 1, remarked she could have completed freshman Zoology without paying any attention to evolution had she perceived an "attack" against creationism from her professor. Gail said, "I would totally close up and like, 'I'm done.'"

Gail's comment demonstrates that the mental filter applies not only to evidence, but also to whom a person trusts. Rather than dismiss her Zoology professor, Gail was open-minded to the professor's instruction. In contrast, David's mental filter obviated the very same professor Gail had as a freshman. Nevertheless, David's filter accepted information from authorities such as pundits and scientists whose ideas had been discredited in the scientific community.

David's mental filter is in marked contrast to the mental operations of Jennifer, Participant 7, who functioned in an adult faith stage. Jennifer wrote in her scholarly paper, I doubt that everything I want to believe will make perfect sense and will fit in the exact boundaries of a place I have carved out for it. *But I can't force something to fit that doesn't* [italics added]. I could change my view to allow for it to fit, but sometimes that's a lot harder than it seems.

Jennifer recognized that reconciling an acceptance of evolution and her religious beliefs was a difficult task. In Origins, her mental schema with its "carved" boundaries was confronted with evidence for evolution. Jennifer was in the crucible of cognitive and affective dissonance.

She could “force something,” perhaps by changing her perception of the evidence in order to leave her existing mental structures unchanged. This act of assimilation would leave her existing schema preserved (Renner & Stafford, 1979).

However, Jennifer, acting in adult faith, chose the more difficult task and did what she recognized she must do: change her view of evolution to fit the evidence. The act of accommodation represented a change in her existing schema (Renner & Stafford, 1979). Boeree (2003) writes, “Even one’s grip has to accommodate to a stone, while clay is assimilated into our grip” (¶ 5). The evidence for evolution, in Jennifer’s hand, was a stone. The evidence for evolution, in David’s hand, was clay.

Participants who operated with adult faith were not the only ones to accommodate evolution in their worldview. John, Participant 12, operated with young adult faith. John related that he felt like his thought life was analogous to the history of science when scientific revolutions such as the Copernican model effected great change in a relatively short time. When asked to clarify how that analogy applied to his life, John responded,

I just have these times where there’s no effort on my [part], . . . where there’s no new understanding . . . for me. And then I have these times where I gain this new knowledge, and I have to come to grips with, “Well, how does that change my faith or not? Does that kind of mesh together with what I already believe, or does it turn it all upside down, and now I have to weave something completely different.

John’s willingness to “weave something completely different” is his accommodation of the scientific evidence. John continued talking about how the last three years had “definitely changed things” for him. He credited his change to:

Really understanding the true nature of science and how . . . you discover things, and interpret evidence and all those kinds of things that go along with that. And how science is always changing, that it's not just, "Okay this is what we believe," that there aren't beliefs in science and that there's just *evidence* [italics added] and you either accept it or you don't.

Operating in a conventional faith, David avoided ambiguity and change by filtering evidence and authority sources to leave his worldview intact. Operating in young adult and adult faith respectively, John and Jennifer operated in deference to the scientific evidence, even when it required them to examine their religious beliefs in order to accommodate an acceptance of evolution. Similarly, other participants had to perform the same functions in overturning their creationist beliefs to arrive at an acceptance of evolution.

Theme 5.2 states that participants operating in adult faith displayed a nuanced approach to perceived tensions between evolution and their personal religious beliefs, while participants operating in conventional faith avoided confronting their perceived tensions. Theme 5.2 relates to the previous theme. Jennifer and John perceived tensions between evolution and personal religious beliefs, but willed themselves to seek reconciliation of those tensions. In stark contrast, participants in conventional faith stage tended to avoid confrontation or tended to be dismissive of perceived conflict.

Diana, Participant 4, operated in conventional faith. She asserted that the domains of science and religion were inseparable. Regardless of whether this view is right or wrong, the salient matter is the basis by which Diana made this claim. Diana insisted,

*It has to* [italics added]. It's kind of like how, even just science and technology. Science drives technology. Technology drives science. Religion drives science. Science drives

religion. Because they have to co-[exist], they can't – you can't prove something and then be like, "Well, the Bible says that's not true."

Collapsing the domains of science and religion into "one big science and religion ball" appeared to be how Diana avoided ambiguity. Combining science and religion may have initially placated her anxiety, but it required Diana to gloss over the inherent tensions that existed within such a facile position. Diana struggled, for example, to articulate her position on Genesis:

I don't think you should just null and void chapter one through eleven. No, it's not like that. I think that science starts at day one, Genesis one and the Bible starts at Genesis one, and there's no just taking that part out. It's not – I think that it all happened, and it all happened in some way shape or form, and there's a way to explain it. *There has to be* [italics added], and I believe that. And I think that it's something that I would have to study way more into. But, I'm just – I don't know. I just – I don't know. I'm just okay with it. I don't know. It's just okay. It's okay for – I don't know. I really don't.

Defending a forced amalgamation of science and religion was apparently a difficult task for Diana. Heather, Participant 9, was transitioning from a conventional faith towards a young adult faith. She appeared to avoid ambiguity by simply dismissing contentious issues regarding evolution and personal religion belief. As part of her unqualified relativism form of cognition, Heather's defense mechanism was to use some form of the phrase "it didn't matter." During a four-minute span in her interview, she used the phrase seven times. The following is an excerpt from her statements:

It just didn't matter, it didn't change the fact that He was God and that He did it. It didn't matter to me whether He used evolution or if it just magically appeared, it just didn't

matter. And I didn't really change. Even from Origins, I was just like they don't really matter. I mean it still really doesn't.

Later in the interview, Heather was asked if her acceptance of evolution had affected her view of God. Heather responded, "Not really a whole lot. It just hasn't really crossed my mind I guess. I don't know." Heather used the phrase "I don't know" 35 times in her second interview. She used the phrase nine times in normal usage such as, "I don't know very much about the end of his [Darwin's] life historically." She used the phrase four times in the context of innocuous statements such as, "So I don't know, all growing up evolution was a bad thing." But when it came to discussing contentious issues, Heather used the phrase 22 times. The following discourse demonstrates Heather's approach to difficult issues.

Researcher: So do you believe that we have a soul then?

Heather: Well, that's another one of those weird things.

Researcher: Because I just heard you say it [earlier].

Heather: Right, well and do other things have souls? No one knows so *I don't know* [italics added].

Researcher: What about you? Do you believe that animals have souls?

Heather: *I don't know* [italics added], I don't see why not. I mean just because they can't do all the things humans can doesn't make us better than other creations, more valuable.

Researcher: So is it too hard to define the soul?

Heather: I don't, that's one of the parts of Origins where I was just like, "I have no idea." I don't think—if there is a soul, I don't think God just said humans have souls and all of sudden we have a soul. I don't think it's a physical thing, it's a, *I don't know* [italics added].

Many participants used repetitive phrases such as “you know,” “like,” and even “I don’t know.” Heather’s multiple usage of “I don’t know” is unique in this case. She is stating that she indeed does not know, but there appears to be little effort to find resolution within her statements or in the tenor of her comments. Heather’s responses to questions about the soul contrast with Rachel’s, Participant 9, who operated in an adult faith stage. When asked if animals had a soul, Rachel immediately recognized the conundrum:

That’s tricky! I’m not sure. Because growing up, what I was kinda taught was that’s what sets us apart. We have a soul and nothing else has a soul and I was like, “What does that mean to have a soul? Does that mean we get to go to this wonderful place called heaven and the animals don’t?” But that doesn’t make a lot of sense to me cause they are also His creation so do they get to go [to heaven] too? Does it mean that . . . since we have a soul, we can have a special relationship that the animals can’t have? That would seem more logical to me that we can have a different kind of relationship. Because of our thought processes, . . . we are able to communicate in a different way with God and understand Him at a different level.

By the end of her statement, Rachel appeared more settled in deciding that humans have souls, rather than animals. Rachel’s comments are a filmstrip of her mental processes: she recognizes the conflict; she weighs what she once believed as a child with a more recent understanding that humans and animals are directly related within God’s creation; and she is able to form a decision that recognizes both views. These mental processes, both cognitive and affective, are her adult faith system in action.

Summarizing Theme 5.2, evolution and religious beliefs represented a dichotomy in many participants’ minds. A noncombatant definition of dichotomy is “division into two parts,

kinds, etc.; subdivision into halves or pairs" (dichotomy, n.d.). For conventional faith stage participants who encounter a conflict between evolution and their religious beliefs, their response may be paraphrased, "When perceived dichotomies exist, dismiss the issue or collapse them to remove the tension." For adult faith stage participants who encounter a conflict between evolution and their religious beliefs, their response may be paraphrased, "When dichotomies exist, operate within the tension and find ways in which both halves can contribute to your worldview."

### Summary of the Research Findings

The results of the data show that although most participants believed in creationism in childhood, most participants came to accept evolution through their experiences at the study site university. Most participants accepted human evolution. However, one participant maintained a commitment to Young Earth Creationism. One participant espoused a quasi-Progressive Creationist model in which God engendered biological diversity through evolution from an initial line of specially created species.

In dealing with issues that touched on both science and religion, most participants operated from the perspective that science and religion are separate and interacting domains. However, three participants turned to religious explanations to account for perceived gaps in scientific solutions and thereby overlapped the domains of science and religion. Two participants operated from the framework that science and religion are integrated and insisted that science correlates with a literal interpretation of Genesis.

Most participants no longer held a literal interpretation of Genesis but maintained a commitment to the Bible and acting out their Christian beliefs. Participants' parents were a strong influence in their lives, but most participants claimed to have a worldview that was

distinct from their parents' worldview. Participants who accepted evolution reported that study site university professors were important role models in their reconciliation of evolution and personal religious beliefs. Other factors that facilitated an acceptance of evolution were negotiating Genesis Chapters 1 and 2 as non-literal; discerning an acceptance of evolution as a non-salvation issue; and relying on evidence for evolution.

Participants' faith played a role in how they deliberated the evidence for evolution and the tensions they perceived between evolution and their personal religious beliefs. One participant operating in conventional faith disregarded evidence for evolution. Several conventional faith stage participants dismissed contentious issues or collapsed dichotomies in an effort to avoid ambiguity and perceived tensions. However, participants operating in young adult and adult faith tended to confront their perceived tensions and worked towards a reconciliation of their understanding of evolution and personal religious beliefs.

This study's findings serve a heuristic purpose as an exploration into the complex processes by which Christian university students approach learning about evolution and seek reconciliation between evolution and their personal religious beliefs. The rich description of this naturalistic study lends insight to researchers and educators seeking an understanding of those complex processes.

## CHAPTER 5

### SUMMARY, OUTCOMES, AND RELEVANCE FOR AUDIENCES

Chapter 5 summarizes the methods used, presents the outcomes and describes the implications that emerged from the research questions, and offers recommendations for further research. The researcher's purpose in this study was to explore how Christian biology-related majors at a Christian university perceive apparent conflicts between their understanding of evolution and their religious beliefs, and how their faith, as a structural-developmental system for ordering and making meaning of the world, plays a role in the mediating process. The central research question was, "How do Christian biology students at a Christian university reconcile their understanding and acceptance of evolution and their personal religious beliefs?" The four sub-questions were:

1. What factors influence participants' perspectives on evolution and creationism?
2. What are participants' extant views on evolution and creationism?
3. What aspects of evolutionary theory and personal religious beliefs create dissonance for participants?
4. What is the role of participants' faith in reconciling their understanding and acceptance of evolutionary theory and their personal religious beliefs?

#### Summary of the Methodology

This naturalistic research study utilized a case study design. Participants were undergraduate biology-related majors or recent biology-related graduates from a Midwest Christian liberal arts university who had completed the evolution course, Origins. Seven undergraduates, who were seniors, and eight recent graduates, who had graduated within the last two years, participated in the study. Data were collected through two semi-structured interviews,

a Life Tapestry Exercise (Fowler et al., 2004), an Evolution Attitudes Survey (Ingram & Nelson, 2006), and a position paper on evolution as an assignment in the Origins course. The first interview examined participants' faith structures. The second interview focused on participants' attitudes about science and religion and views on creationism and evolution.

The interview data were transcribed and coded for repeating words, phrases and ideas. Data analysis revealed patterns that were organized into five categories with themes and sub-themes. Table 5.1 shows the timeline of the entire study. The outcomes of this study, detailed in Chapter 4, are summarized following Table 5.1.

Table 5.1

*Study Timeline*

	December 2006	January to February 2007	March to April 2007	May to June 2007	July to August 2007	September to October 2007
Pilot Study		-----				
Observation of Origins			-----			
Main Study Interviews and Data Collection			-----			
Transcription			-----			
Member Check of Transcriptions and Portraits				-----		
Coding and Construction of Categories and Themes					-----	

## Summary of the Research Findings

Most participants were raised to believe in creationism, but came to accept evolution through an extended process of evaluating the scientific evidence in support of evolution, negotiating the literalness of Genesis, recognizing evolution as a non-salvation issue, and observing professors as role models of Christians who accept evolution. Participants remained committed to their personal religious beliefs despite apprehension that accompanied the reconciliation process in accepting evolution. Participants' faith, their system of composing and making meaning of the world, played an important role in how participants reconciled their understanding of evolution and their personal religious beliefs.

## Discussion of the Results

The results of this study are organized into five categories reflecting the patterns that emerged in the data analysis. The categories, while useful in organizing the data results, are not mutually exclusive. Instead, themes and sub-themes from multiple categories are interrelated and form a collective representation of the study findings. The following is a narrative of the principal findings of the study, organized by category to facilitate reference to the more detailed descriptions in Chapter 4.

Category 1 focused on the factors that influenced participants in their perceptions of creationism and evolution. Participants cited their parents as a strong influence. Most of the participants' parents raised them to believe in creationism. However, the participants in this study claimed worldviews that were distinct from their parents' worldviews. Many participants cited their professors as having a significant influence in their acceptance of evolution, especially in modeling a commitment to reconciling science and personal religious beliefs. Other influences

such as church, friends, and siblings were much less influential in participants' acceptance of evolution.

Category 2 addressed participants' perspectives on science and religion. Participants expressed a trust in science as a valid and useful way of knowing. Many participants noted that science is contingent on empirical evidence and thus is a more reliable way of knowing than religion. However, all participants articulated a commitment to and trust in their personal religious beliefs. During their courses of study at the university, most participants relinquished a literal interpretation of the Genesis account of creation. Still, these participants considered the Bible as important and affirmed their commitment to Christian living, including the spiritual disciplines of Bible reading, the practice of prayer, and church attendance. Participants desired a positive relationship between scientific and religious beliefs in their worldview, as modeled by some of their university professors.

Category 3 dealt with participants' extant views of evolution and creationism. In recognizing the Genesis account of creation as literary rather than literal, most participants abandoned their belief in creationism and affirmed evolution as a valid explanation for the diversity of life on the earth. Additionally, most participants accepted human evolution.

Category 4 focused on participants' reconciliation of evolution and personal religious beliefs. Most participants conveyed that coming to an acceptance of evolution was a process of conflict resolution and apprehension. Many participants in their childhood were led to believe in a strict, literal interpretation of Genesis, which made a Christian acceptance of evolution inconceivable within many participants' minds. During many participants' struggle to reconcile evolution and their personal religious beliefs, their parents ardently pressured them to reject evolution. Several participants admitted that they avoided the mention of evolution to their

parents for fear of how their parents would react. Parental pressure, whether fully realized or indirectly perceived, contributed to the tension that many participants experienced in seeking to resolve their understanding of evolution and their personal religious beliefs.

For many participants, the process of coming to an acceptance of evolution was a deeply personal journey. Many participants articulated the struggle they faced in reforming old patterns of thinking, including belief in the direct, interventional role of God in creation and a literal Genesis account. Learning about evolution was not the only source of participants' personal conflict. For the first time in their lives, many participants realized in their religion courses that the Bible can be understood in other ways than a strict, literal interpretation. Thus, coming to an acceptance of evolution was not a simple matter of considering the scientific evidence and judging its merits. Instead, many participants had to reorder and sort through competing interests in deciphering how evolution could fit within their worldview. On one hand, participants desired consonance in their emerging scientific habits of mind. On the other hand, participants aspired for integrity and coherence of personal religious beliefs.

Four aspects emerged from the data that were key factors for many participants in coming to an acceptance of evolution. First, most participants expressed that the evidence for evolution was undeniably valid. Second, negotiating the Genesis 1 and 2 as non-literal enabled most participants to consider an alternative scientific account for creation – evolutionary theory. Third, many participants came to realize that an acceptance of evolution did not jeopardize their salvation. Fourth, many participants cited the role model of their professors' commitment to both evolutionary theory and Christian beliefs.

Coming to an evolution did not diminish participants' beliefs that God continues to be active in the world. However, most participants were uncertain of the nature of God's role in the

creation process. Participants affirmed a personal sense of teleological purpose and asserted that natural selection was a practical and useful mechanism for creation. Although most participants accepted human evolution, they were undecided about how the notion of the soul fits within the evolutionary framework.

Category 5 addressed the impact of participants' faith stages on their reconciliation of evolution and personal religious beliefs. At the time of the study, participants' faith stages fell along a continuum between conventional faith and adult faith. Participants who operated in a conventional faith stage tended to see the world in black-and-white terms and operated with uncritical assumptions assimilated from childhood and in acquiescence to external sources of authority, including friends, parents, and charismatic leaders. Participants who operated in an adult faith stage were willing to accept the ambiguity of life wherein complex questions seldom have clear answers. Adult faith stage participants demonstrated an internalized source of authority while simultaneously considering the perspectives of others. Persons who operate in young adult faith, as a transitory stage between conventional faith and adult faith, wrestle over what constitutes truth and what sources of truth are trustworthy.

In this study, several participants operated in an adult faith and were deferential to scientific evidence for evolution. Adult faith participants displayed a nuanced approach to perceived tensions between evolution and their personal religious beliefs. Conversely, participants who operated in conventional faith tended to avoid confronting their perceived tensions.

The results of this study are further detailed in the categories, themes and sub-themes in Chapter 4. As this investigation was a naturalistic study, the findings are primarily descriptive in nature. However, persons who desire a better understanding of how Christian biology-related

majors at a Christian university reconcile their understanding of evolution and their personal religious beliefs may see relevance in the rich descriptions and findings reported herein. The researcher's reflections about the relevance of this study are discussed in the next section.

### Reflections and Relevance

Merriam (1998) suggests that the focus of a study report principally depends on the intended audience. The findings of this study are relevant to four sets of readers: Evangelicals; Christian university professors; secular university professors; and researchers.

Evangelicals, defined in Chapter 2, include religious persons and groups that affirm the "born-again" Christian experience; the authority of the Bible; the gospel commission to evangelize; and the centrality of Jesus' death and resurrection (Noll, 1994). Fundamentalists are a subset of Evangelicals who adhere to a strict, literal interpretation of the Bible (Marsden, 1991). Creationists reject evolutionary theory in favor of the Biblical account of creation. Many creationists claim that evolution is so antithetical to the Bible that an acceptance of evolution constitutes a wholesale rejection of Christian beliefs and lifestyle (e.g., Ham, 1987; MacArthur, 2001). The participants in this study were biology-related majors at a Christian university. Each professed to be a Christian. Most accepted evolution. The participants' narratives – their expressed notions of evolution and personal religious beliefs – are especially germane to the discussion of whether and how a Christian university student can accept evolution. Therefore, the study's results are of interest to creationists, fundamentalists, and Evangelicals who desire a better understanding of how Christian university students reconcile evolution and their personal religious beliefs. Parents of Christian university biology-related majors are also informed by the results of this study.

Additionally, this study offers relevance to professors both at Christian and secular universities. The term “university professor” is not limited to biology or science-related professors. Instead, “university professor” refers to any professor who desires to help students reconcile evolution and their personal religious beliefs.

The defining role of the Christian liberal arts university is to help students find coherence between religious beliefs and other ways of knowing, including science (Holmes, 1987; Poe, 2004). However, many university students who are Christian struggle when they encounter evolution in a science course (K. B. Miller, 2003). Chapter 2 details the wide range of studies in the research literature that assess students’ views of evolution at secular universities. In contrast, relatively few studies exist that explore how Christian university students view evolutionary theory. The results of this study show clearly that Christian university professors can play a key role in biology-related majors’ acceptance of evolution. Therefore, Christian university professors who wish to better understand the dynamic process in which biology-related majors come to an acceptance of evolution, and the potentiality of professors’ own role in the process, may find this study’s findings to be relevant.

Finally, secular university professors and researchers who wish to better understand the extant views of Christian biology-related majors when they encounter evolution at secular universities may find relevance in this study. Although this study focused on the reconciliation process for biology-related majors within a Christian university setting, the nuances of Christian students’ resistance to learning evolution are germane to a secular university environment. According to a 2004 study on the spirituality of college students, 26% of freshmen at colleges and universities across America considered themselves to be born-again Christians (Astin et al.,

2003). Other studies have shown that a large number of college-bound Christians choose to attend secular colleges and universities (e.g., Henderson, 2003).

Most research on secular university students' views of evolution has focused on understanding (e.g., Lord & Marino, 1993); academic achievement (e.g., Ingram & Nelson, 2006); acceptance (e.g., Rutledge & Warden, 1999; Sinatra et al., 2003); and pedagogy (e.g., Scharmann et al., 2005). None of these studies focused on an in-depth exploration of Christian students' views.

A few studies (e.g., Jackson et al., 1995; Ebenezer, 1996) have explored the evolutionary views of a variety of Christians at secular universities, including professors, graduate students, and pre-service teachers. Two studies (Brem et al., 2003; Dagher & BouJaoude, 1997) investigated the perspectives of Christian students who attended secular universities. The Dagher and BouJaoude study, which explored views of Christian and Muslim biology majors in Lebanon, was the only naturalistic inquiry study.

This study contributes to the research literature by showing how Christian biology-related majors at a Christian university in the United States view evolution. Additionally, this study explores the processes in which Christian biology-related majors at a Christian university come to an acceptance of evolution. As such, secular university professors seeking to better understand Christian students who are struggling to accept evolution may find relevance in this study.

### *Limitations*

The limitations for this study, discussed in Chapter 1, include a case study of Christian biology-related majors from a single Christian institution. The relevance of the study results are informed and bounded by its limitations. Transferability, described in Chapter 3, is the degree to which the study results can be transferred to other settings or contexts (Lincoln & Guba, 1985).

The intent of this study was to provide a sufficiently rich, detailed account enabling readers to determine how closely their situation corresponds to this study's circumstances.

Chapter 4 describes the study site institution and Origins course in detail. Additionally, participants' narratives offer insight to the variety of experiences that shaped their views towards evolution, both in childhood and during their tenure as university students. The unique aspects of the study site and participants condition the relevance for Evangelicals, including those with fundamentalist views. In other words, the study's relevance is not construed to include all Christian university or secular university settings. Evangelical readers may make transferability judgments to determine the extent to which the findings apply to a particular situation.

Christian and secular university professors may also consider this study's transferability to their particular situations. Christian universities vary in their approach to creationism and evolution and some schools promote only a creationist perspective (B. J. Alters & S. M. Alters, 2001). While no aspect of the study site suggested that it was atypical of Christian universities committed to the teaching of evolution in non-opposition to religious belief, each university may be unique in its particular approach to the teaching of evolution. Many participants in this study cited the Origins course and its professor as having a significant impact on their views towards evolution. Again, the study's relevance is balanced by the degree of transferability of the study setting to specific environments at other universities.

The following discussion of the study's relevance is organized according to potential audiences: Evangelicals; Christian university professors; secular university professors; and researchers. Specific relevant aspects are discussed with attention given to findings from prior research. Relevance for practice and further research are also addressed.

### *Relevance for Evangelicals*

This study's findings have two messages for Evangelicals who are interested in better understanding how Christian biology-related majors at a Christian university reconcile evolution and personal religious beliefs. First, the findings demonstrate that Christian biology-related majors at a Christian university who accept evolution can remain committed to their religious beliefs. In this study, an acceptance of evolution did not diminish participants' view of God or the importance they placed on the Bible. Second, many Christian biology-related majors at a Christian university seek wholeness and coherence in their lives by endeavoring to be true to both science and their religious beliefs. Each of these is discussed below.

Many proponents of Young Earth Creationism, described in Chapter 2, claim that societal acceptance of evolution leads to a moral breakdown of society (e.g., MacArthur, 2001; H. M. Morris, 1976). Ham (1999) claims that "evolutionary/long-age ideas totally undermine" the foundations of Christianity and lead students to seeing the Bible as "just an outdated religious book" (p. 27). Theistic evolution, the notion that God created through evolution, is not immune from creationists' assertions of evolution's inescapable dangers. Gitt (1995) warns, "The doctrines of creation and evolution are so strongly divergent that reconciliation is totally impossible. Theistic evolutionists attempt to integrate the two doctrines, however such syncretism reduces the message of the Bible to insignificance" (p. 51). Many participants in this study reported that their parents echoed similar declarations.

Contrary to these creationist claims, the acceptance of evolution by participants in this study did not lead to a rejection of the Bible or a loss of personal religious beliefs. Instead, many participants said that their understanding and acceptance of evolution gave them a greater appreciation for God as Creator. For example, Megan, Participant 3, wrote in her Origins

scholarly paper as a junior, “At some point, I have to decide whether these ideas change my relationship with and/or my view of God. So far, God is still my Creator and my Savior, the One who is in charge of everything and that is all that really matters.” When she was interviewed as part of this study a year later, Megan acknowledged that God could have created according to the Genesis account, but then rhetorically asked, “Why couldn’t He also do it this way [through evolution]?” She added, “There’s a lot more evidence to back up this claim [evolution]. . . . I just kinda realized maybe God could do it this way too and that just made Him even more powerful.”

Heather, Participant 9 noted, “I see God through science, but it’s . . . understanding creation and understanding what He has done [that] makes God come alive.” Brittany, Participant 10, said, “I didn’t think of God not being in it [evolution]. It made me think more of God in it. It made me think God is this amazing – how can He make such amazing creatures?!” Michael, Participant 14, in his Origins scholarly paper entitled, “Evolution: A Beautiful Way to Understand God,” wrote, “Understanding these scientific theories give [*sic*] us a special way to see God. Learning scientifically about these areas only allows for a better understanding of God and His vast power in the amazing way He has created this universe.”

No participant expressed a disregard for the Bible. Instead, many participants noted that they had learned to approach the Bible with revised interpretive tools. John, Participant 12, described his interpretive lens as “understanding how the Bible was written, and the purpose that it was written, and the audience that it was written to, and . . . their cultural understanding of science in their day.” Negotiating Genesis 1 and 2 as non-literal did not reduce participants’ respect for the Bible. Many participants noted that the Bible was not meant to be a scientific textbook. Rather, the Genesis creation story, as Michael, Participant 14, explained, “tells us why

God created us, . . . why He wants us to live in relationship with Him and things like that. It tells us characteristics about God and things of that nature.”

Of course, an Evangelical may allege that participants who accepted evolution are not “real” Christians. However, the data show that these participants remained committed to their religious beliefs and to a Christian way of living, including Bible reading, praying, and attending church. Many participants sought to assure their parents that they hadn’t “gone off the deep end” in accepting evolution, as Gail, Participant 1, described it. Gail said she wasn’t trying to convince her parents to accept evolution, but rather to have them understand her perspective. Gail expressed relief when she reported, “We [my father and I] have both come to an understanding and acceptance of each other’s opinions and . . . that doesn’t have to change our relationship, and that we can still respect each other even though we don’t agree on this . . . one topic.”

This study’s findings contrast with other studies that explored university students’ attitudes on evolution. Dagher and BouJaoude (1997) studied Lebanese Christian and Muslim biology majors and reported that several students rejected evolution solely on the basis of their religious beliefs. For some, perceptions of evolutionary theory as a purely mechanistic philosophy and of evolution as brutal survival of the fittest were antithetical to their religious worldview. Dagher and BouJaoude note, “For these students, the theory of evolution not only challenges their account for creation but violates an image of the world their beliefs and values afford them” (p. 440). Unfortunately, Dagher and BouJaoude do not divulge what percentage of their participants rejected evolution based on its perceived implications.

Brem et al. (2003) conducted a survey of 135 university students’ perceived implications of evolution. The participants represented a wide variety of majors at a major, public university

in the Western United States. Fifty-six percent of the study participants were Christian, and at least half of these were currently active in their religious beliefs. Sixty-seven percent of the participants were non-science majors. Brem et al. report that participants' perceptions [of evolution] were "overwhelmingly negative," regardless of religious affiliation or non-belief. Brem et al. write, "There is a significant direction to the perceived impact [of evolution]: an increase in selfishness and racial discrimination, and a decrease in a sense of purpose, feelings of self-determination, and spiritual beliefs" (p. 193). Brem et al. also determined that "greater exposure to information about evolution," regardless of one's pro- or antievolution views, led to a "bleaker view [of evolutionary theory]" (p. 194).

In this study, only one of the fifteen participants rejected evolution. David, Participant 15, vigorously defended Young Earth Creationism and used Intelligent Design arguments to dispute evolutionary theory. He also denounced evolution for what he perceived as its moral debasement and corrupting influence on societal values. In contrast, fourteen participants did not attach negative implications to evolutionary theory. Participants who accepted evolution affirmed God's role in the creation process while reiterating their own teleological purpose. They supported evolution as a practical mechanism for the creation of new species and rejected any association with a negative view of theodicy.

This study's findings significantly contrast with the Brem et al. (2003) findings. The message for Evangelicals is clear: Christian biology-related majors at a Christian university who accept evolution can persist in an abiding belief in God, a commitment to the Bible, a dedication to the Christian life, and a positive view of teleology and theodicy.

The second point of relevance for Evangelicals is that many Christian biology-related majors at a Christian university seek wholeness and coherence in their lives by endeavoring to be

true to both science and their religious beliefs. This sentiment is a rejection of two other possibilities: a creationist conflation of science and religion and a complete isolation between science and religion. First, most participants in this study recognized that creationism was an improper conflation of science and religion. Most participants understood that altering science to fit a Biblical account of creation was a violation of scientific principles. Ignoring the overwhelming evidence for evolution was not an option for most participants who were developing scientific habits of mind. Second, most participants viewed and treated science and religion as separate, but interacting domains. Two participants used science and religion to validate each other. One of these participants embraced creationism. The other participant supported evolution, but struggled to explain how some of the accounts in Genesis 1 through 11, such as the worldwide flood, could be supported by science. These two participants forced an integration of science and religion that was scientifically untenable. Three participants used religious explanations to solve perceived scientific uncertainty. This included invoking God's direct intervention to supernaturally create life on an ancient earth. Although these three participants supported evolution, they also conflated science and religion by inserting God into perceived scientific gaps and outcomes that they deemed too implausible to have occurred by natural processes.

In contrast, ten participants maintained distinct boundaries between science and religion while acknowledging God's role in creation. These participants affirmed God as the ultimate cause behind all natural laws and physical processes that produced the broad diversity of life on the earth. Seeing God as the ultimate cause rather than the direct or proximate cause in scientific processes did not diminish these participants' view of God as Creator.

Although these ten participants recognized science and religion as separate and unique ways of knowing, they asserted that science and religion could interact in positive ways. In other words, science and religion were not completely isolated. Jennifer, Participant 7, espoused such a position, claiming that science and religion are like two separate windows through which to view the world. What is observed through the science window is distinct from what is observed through the religion window because, as Jennifer noted, “religion is for the why and . . . what’s the purpose, . . . whereas science is the what and the how it works.” She also noted, “If you are looking at it [the world through these windows] to ask the correct questions, they might give you an answer that forms to create one big answer that complements with itself.” In summary, most participants asserted that science and religion are separate but positively interacting and claimed that as long as a person maintained proper boundaries in their application of science and religion, conflicts between the two could be resolved.

Many participants expressed frustration that a proper view of the domains of science and religion was sorely lacking in the Evangelical community, as evidenced by what they observed in their parents and in their churches. Brittany, Participant 10, was disappointed by those in the church who led her to believe in childhood that “Darwin’s bad, Darwin’s evil, evolution did not happen, there is no way, God did everything.” She added, “I guess that was . . . [my] biggest problem – thinking they were just telling me things that they didn’t know why they said it.” Michael, Participant 14, expressed,

I don’t know why the church is so scared of this stuff. . . . I think they’re getting better definitely, but there’s still people out there that just make up stuff because they’re scared that it’s going to change something – that the truth will change something. It . . . really

frustrates me when growing up, . . . you pretty much get the idea of evolution is wrong and . . . the evidence they make up is false.

Again, an evangelical Christian may allege that this study's participants are misguided in their understanding of the separate domains of science and religion and claim instead that religion always trumps science, that scientific findings are always subservient to Biblical explanations (e.g., Lubenow, 1978) and therefore, evolution is invalid. This type of thinking is what many participants lamented: antievolution dogma so rigid as to disallow the possibility that evolution may be God's mechanism for creation. The message of this study's findings is clear: if Evangelicalism is to remain relevant to Christian university students who understand science and religion as separate but positively interacting domains (e.g., National Academy of Sciences, 2008), then evangelical churches must more consistently provide role models for young people to see that science and religion, when properly understood, are not in conflict.

#### *Relevance for Christian University Professors*

Christian university professors may view this study's findings as relevant to their work in three ways: the importance of the professor as role model; the necessity of helping students properly understand the domains of science and religion; and the role of faith in reconciling evolution and personal religious beliefs.

Participants in this study repeatedly cited their religion and science professors as having significant impact on their lives in terms of reconciling evolution and their personal religious beliefs. This is not to suggest that other university professors did not have an influence. Rather, it says that religion and science professors had the most impact.

Popular literature contains many resources that champion the teacher as a potential role model to shape and inspire student learning (e.g., Palmer, 1997). The findings of this study

underscore the importance of Christian university professors who demonstrate integrity to both science and religion. Given participants' frustration at growing up without seeing Christians who modeled a coherent and positive commitment to science, it's not surprising that many participants viewed their professors as important role models. Megan, Participant 3, cited the example of her Origins professor as a genuine Christian who confidently accepted evolution, which helped lead her to think, "Maybe I can believe that too."

In this study, many participants expressed a respect for professors who were genuine and forthright in presenting evolution in a Christian university setting and yet were not overbearing or dogmatic. Gail, Participant 1, said her biology professor's presentation of evolution in Zoology was non-confrontational and "never felt like an attack." Ashley, Participant 5, appreciated her Origins professor for not trying to prove either creationism or evolution. Ashley said, "She was just presenting things and in turn letting you decide where you stood, but she would give you her opinion."

Participants also appreciated professors who, instead of glossing over difficulties that may exist in reconciling evolution and personal religious beliefs, were willing to deal with the complexities of the issue. Gail noted that her professor was aware of the typical religious struggles Christian students faced in learning evolutionary theory. Gail paraphrased her professor as saying, "You know, this isn't crucial to your salvation and we're not saying that God didn't start it all, that God's not behind it [evolution]." Gail explained that this was an important step in her recognition that an acceptance of evolution "is not saying that what the Bible says is wrong."

No study was found in the literature that provided research-based guidance for how professors should specifically approach the teaching of evolution within the context of a Christian university. However, this study's findings are consonant with the imperatives given by

scholars (e.g., Holmes, 1987; Poe, 2004) who are familiar with the Christian higher education goal of helping students find ways in which religious faith and learning interact in positive ways. Holmes writes,

Students need . . . to gain a realistic look at life and to discover for themselves the questions that confront us. They need to work their way painfully through the maze of alternative ideas and arguments while finding out how the Christian [religious] faith speaks to such matters. They need a teacher as a catalyst and guide (p. 46).

This study reinforces the important role that Christian university professors serve in authenticating how Christians can accept evolution, and in helping biology-related majors work through the process of conflict resolution and apprehension in reconciling evolution and their personal religious beliefs.

A second point of relevance for Christian university professors is to recognize the necessity of helping students properly understand the domains of science and religion. An understanding of the unique ways in which science and religion construct knowledge is not exclusively a Christian higher education issue, but is a universal necessity for scientifically literate citizens (National Academy of Sciences, 2008). The research literature is replete with studies that reinforce the importance of understanding the nature of science as a unique way of knowing (e.g., Backhus, 2002; Bybee, 2004; Dagher & BouJaoude, 1997). Additionally, Scharmann et al. (2005) recommend helping students achieve an adequate understanding of the nature of science prior to evolution instruction.

A point of relevance in this study is to address the nature of religion in addition to the nature of science as a means to better understand their respective domains. While some secular university professors may be disinclined to discuss the nature of religion within a classroom, the

Christian university is a setting where religious issues can and should be openly discussed, even within the context of science (Holmes, 1987; Poe, 2004). In other words, Christian university professors may presume greater liberty and responsibility to go beyond discussion of the nature of science to compare and contrast the domains of science and religion.

The participants in this study who demonstrated the most nuanced understanding and unqualified acceptance of evolution were those students who engaged science and religion as non-overlapping domains. While a separation of science and religion may appear synonymous with compartmentalization, most participants did not isolate the two domains. Scientific findings provided many participants with a greater respect for God's creative abilities.

In this study, two participants completely collapsed the domains of science and religion. Three participants used religious explanations to solve what they perceived as scientific uncertainties in evolutionary theory. These three participants intimated the least certitude regarding evolution or held qualified positions about evolution. Creationists and Intelligent Design proponents focus on what they posit are gaps in evolutionary theory and evidence (e.g., Behe, 1997). From a Christian standpoint, however, inserting God into alleged gaps in current scientific knowledge is poor theology because as science eventually finds solutions and evidence that narrows the gaps, God becomes a diminishing God (Drummond, 1904; K. B. Miller, 2003; Olsen, 2006).

Proper science requires using a naturalistic rationale to explain processes in the natural world (National Academy of Sciences, 2008). In other words, scientific phenomena must be explained by natural causes, which are testable and are independently verifiable. There is no scientifically testable method that can confirm or disprove explanations that involve supernatural agents. As such, the National Academy of Sciences has defined science as: "The use of evidence

to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process” (2008, p. 10).

One Christian view is to recognize God as the ultimate cause behind all natural laws while using scientific explanations as direct, proximate causes (Goodman, 2008; K. B. Miller, 1999; see also the corollary of primary and secondary causes, Peters & Hewlett, 2003). Instead of appealing to God from a position of scientific ignorance, this view posits God as the ultimate creator of the natural laws, allows science the freedom and latitude to find naturalistic explanations as proximate causes, maintains the proper domains of science and religion, and eliminates the threat of the erosive “God of the gaps” theology (K. B. Miller, 2003).

Therefore, a point of relevance for Christian university professors is to engage biology-related majors in discussing the proper boundaries of science and religion. Doing so may help them become more receptive to learning about evolution. Abiogenesis is a pertinent topic for such discussions. Some scientists suggest that abiogenesis is distinct and separate from evolutionary theory (e.g., Scott, 2004). B. J. Alters and S. M. Alters (2003) note that while some educators claim that “discussions of prebiotic events are simply not appropriate for studying the *biological* [italics in original] theory of evolution” (p. 100), other educators favor the inclusion of abiogenesis as an integrated approach to science teaching. B. J. Alters and S. M. Alters also observe, “Americans hold numerous misconceptions about these topics [e.g., abiogenesis] that contribute to their rejection of evolution” (p. 100). Therefore, Christian university professors’ inclusion of abiogenesis in the context of evolution instruction may yield fruitful results for biology-related majors in their proper understanding of the domains of science and religion and their acceptance of evolution.

Abiogenesis was not explicitly discussed in the Origins course that was observed as part of this study. However, eight pages of detailed scientific information in the course textbook (Judd, 1997) was devoted to abiogenesis. Abiogenesis was given only cursory mention in another course textbook (Kardong, 2005). It became apparent in participants' interviews that they were aware of the abiogenesis issue, either through creationist literature or what they read in the Origins course textbooks. Seven participants brought up abiogenesis before the researcher posed the question, "How do you think life first arose on Earth?" in the creationism-evolution interview.

Seven participants avoided a supernatural explanation and held the position that although abiogenesis was not yet fully understood, it could one day be scientifically resolved. Four participants were too uncertain to make definitive statements about abiogenesis. Four participants insisted that God must have intervened directly in an act of special creation to form the first life on Earth.

Many participants expressed concern over bio-chemical, scientific mechanisms that contained random processes to explain the emergence of life on earth. Many participants perceived this as a direct threat to God's role as Creator. Ironically, the randomness of genetic variation did not trouble most participants during the creationism-evolution interview, but randomness in abiogenesis was apparently a stumbling block to many participants. These findings suggest that abiogenesis could be addressed more directly in the Origins course.

A full bio-chemical explanation of abiogenesis does not appear necessary. Instead, a discussion of the present state of scientific understanding and the Christian view of ultimate and proximate causes may lead Christian university biology-related majors to better understand the function of scientific explanations and the proper boundaries of science and religion. For many

of the participants in this study, separating the domains of science and religion was not a perfunctory task. Many participants arrived at the university as freshmen with the notion that science was authenticated only in deference to religious assertions. Purposeful efforts by Christian university professors to clarify the domains of science and religion may help Christian university biology-related majors reconcile evolution and their personal religious beliefs.

A third point of relevance for Christian university professors is to recognize the role of faith in Christian university biology-related majors' reconciliation of evolution and their personal religious beliefs. Faith, defined in Chapter 2, is a person's system for ordering and making meaning of the world. As discussed in Category 5 section of Chapter 4, the researcher's purpose in this study was not to correlate participants' faith stages with the degree to which they accepted evolution. Instead, participants' faith was explored to draw inferences as to how faith played a role in reconciling their understanding of evolution and their personal religious beliefs. The data show that participants who operated in adult faith were deferential to the scientific evidence for evolution, while participants who operated in conventional faith tended to disregard the scientific evidence if it ran counter to their preexisting ideas about creationism or the Bible. Additionally, the data show that participants who operated in adult faith displayed a nuanced approach to perceived tensions between evolution and their personal religious beliefs, while participants who operated in conventional faith tended to avoid confronting their perceived tensions. Christian university professors may find relevance in these trends in the data.

David, Participant 15, was the only participant to categorically deny evolution. The following discussion focuses on David not because of his rejection of evolution per se, but because of the intriguing role that his faith played in his approach to creationism and evolution. David appeared to essentially function in conventional faith stage. He operated with a mental

filter that collected only ideas and purported evidence that supported his existing notions of creationism. Incontrovertible evidence in support of evolution apparently easily slipped through David's filter without serious consideration.

David was familiar with Intelligent Design arguments regarding the irreducible complexity of biological systems such as blood-clotting mechanisms and the bacterial flagellum (Behe, 1996), which he posited could not be explained by evolution. The researcher, in an effort to remain neutral and not broach the fact that science currently has valid explanations for these mechanisms (K. R. Miller, 1999; Pallen & Matzke, 2006), asked David how he would react if science found a naturalistic explanation to these systems. David referred to a historical example to state his response:

If they prove it right, I mean everyone from Galileo's time, they didn't want to believe the earth wasn't the center of the universe and he proved that false. . . . So I mean, if I go to not take those, then I cannot call myself a scientist. If they provide the facts and give them—show they are true, then—and I don't take them, I can't consider myself a scientist.

A careful inspection of David's statements reveals that he never says he would accept the evidence, even if shown to be "true." Ironically, David's reference to Galileo is fitting. Several of Galileo's most vocal critics in the early seventeenth century refused to look through Galileo's telescope (Drake, 1957; Sobel, 2000). However, several prominent Jesuit astronomers looked through the telescope and "did not deny the evidence of their senses" (Sobel, p. 40) and affirmed Galileo's heliocentric ideas. It appeared as if David is unwilling to look through the telescope.

As discussed in Chapter 4, the reasons for David's rejection of evolution are threefold: avoidance of ambiguity; lack of others' perspective taking; and fear. These three aspects are

facets of conventional faith (Parks, 1986). All participants in this study who came from a creationist background and eventually accepted evolution spoke of the tension and apprehension they experienced in seeking reconciliation between evolution and their personal religious beliefs. David appeared to avoid any recalibration of his thinking that might lead him to acknowledge ambiguity and face uncertainty in his existing beliefs. David was unable to consider the perspectives of others – to see things from their vantage point. His lack of perspective-taking hampered an examination of alternatives to his own existing ideas about creationism and evolution. Finally, David rejected evolution out of unrecognized fears that capitulation to “Darwinism” was akin to being complicit in the moral breakdown of society.

Christian university professors seeking to facilitate students’ acceptance of evolution in reconciliation with religious beliefs may wonder how to work with students like David. This study demonstrates that Christian university professors are important role models in helping biology-related majors reconcile evolution and their personal religious beliefs. In David’s case however, the mental filter that screened for evidence also screened for sources of authority whom he deemed trustworthy. David did not appear willing to seriously regard the role model of his Origins course professor, a Ph.D. trained entomologist and a Christian with nearly 40 years of teaching experience.

Still, an awareness of how Christian biology-majors operate in terms of faith development may be a useful tool for Christian university professors. Lownsdale (1997) writes that faith development theory is a framework “with which to better understand people, and from which people have strengths, and limitations, in their comprehension of the ultimate environment” (p. 56). A professor does not necessarily need to perform a full-scale, extensive Fowlerian faith development interview and analysis to gain some sense of the faith stage in

which a student operates. There exist survey instruments such as the Faith Styles Scale (Barnes, Doyle, & Johnson, 1989) and the Faith Development Scale (Leak, Loucks, & Bowlin, 1999) that determine faith stage scores. However, the validity of these relatively short assessments has been questioned (McDargh, 2001; Parker, 2006). Additionally, a formal faith assessment may appear disproportionately intrusive or extraneous to a classroom of biology-related majors. Objective measures such as surveys also fail to capture the rich and intricate narratives and experiences that shape students' faith.

The most effective way in which a Christian university professor may proceed in assessing the interaction of a students' faith with their learning of evolution is to do what good teachers already do: ask insightful questions, listen carefully to how students respond, and seek to understand how they construct their knowledge. "Learning is enhanced when teachers pay attention to the knowledge and beliefs that learners bring to a learning task, use this knowledge as a starting point for new instruction, and monitor students' changing conceptions as instruction proceeds" (National Academy Press, 2000). The simple question, "How do you know that?" may be a good starting place to elicit Christian biology-related majors' reflections on the basis of their truth claims. Students' responses are indicators of their faith development. The extensive quotations and faith stage descriptions of participants in this study are a valuable asset in understanding the confluence of content knowledge, beliefs, and attitudes in the learning of evolution at a Christian university setting.

In addition to understanding, patience may be an important quality in working with Christian university biology-related majors operating in conventional faith. As in other structural-developmental theories such as Piaget's stages of cognitive development (Renner & Stafford, 1979), a professor cannot merely "tell" students to operate at the next faith stage in an

effort to have them accept evolution. Most of the participants in this study indicated that coming to an acceptance of evolution was a gradual process that occurred over many years and across several biology courses. The data in this study indicate that many biology-related majors' faith developed over the course of their tenure as students at the university. For many participants who transitioned to young adult faith and adult faith stages, their faith gave them greater facility to accept evolution. Inversely, dealing with the conflict and apprehension many participants experienced in encountering evolution concomitantly helped facilitate their faith stage transition.

Parrott and Steele (1990) poignant note, "The teacher is [also] in the midst of his or her own developmental journey [of faith]" (p. 264). Parrott and Steele suggest that professors operating in an adult faith or higher stage are optimum for effecting learning and growth in conventional faith students. Parrott and Steele write, "We must be aware of how students see us integrating [faith and learning] and invite them into the process. We do this by modeling how we think about the issues." Obviously, professors, sets of students, and learning environments are different. Therefore, Christian university professors must consider faith issues in the light of their own unique circumstances.

Summarizing the relevance of Christian biology-related majors' faith, the Christian university professor must display patience and an individualized understanding of students' faith in helping them progress towards an acceptance of evolution. Perry (1999) aptly uses the metaphor of an "epistemological *Pilgrim's Progress*" to describe the "adventure of the spirit" that is the college student's "moral" development (p. 49). Perry is opposed to forcing growth in college students' moral development. Instead, as Knefelkamp writes in his introduction to Perry's book, college students should "be seen as courageous human beings" who need

“company and understanding along the way” (Perry, 1999, p. xiii). Like Perry, Fowler (2004) is emphatic in his declaration about faith development in the classroom:

***It should never be the primary goal of religious education simply to precipitate and encourage stage advancement*** [emphasis in original]. Rather, paying attention to stage and stage advancement is important in helping us shape our teaching. . . . Movement in stage development, properly understood, is a ***byproduct*** [emphasis in original] of teaching the substance and the practices of faith (p. 417).

This study’s findings show that learning about evolution is a catalyst for faith disequilibrium for many Christian biology-related majors. For Christian university professors, the key is not to coerce faith change, as if that were possible. Rather, the relevance of this study is that Christian university professors should model the operations of a faith that reconciles evolution and personal religious beliefs and retains an integrity to both science and religion.

#### *Relevance for Secular University Professors*

This study’s relevance for Christian university professors may also apply to some secular university professors, depending on the transferability to their particular situation. Specific points of relevance include the importance of role models; delineation of the domains of science and religion; and recognition of the role of Christian students’ faith in their reconciliation of evolution and personal religious beliefs. Each point of relevance is discussed in the context of a secular university setting.

Several factors pertain to the applicability of this study’s findings to a secular university. Contrary to the Christian higher education mandate for professors at Christian universities (Holmes, 1987), secular professors need not have an intrinsic interest in the religious perspectives of their students. This study focused entirely on the perspectives of Christian

students at a Christian university. However, a variety of religions may be represented in a secular classroom. Secular university professors must judge whether it is appropriate to address Christian concerns about evolution in the classroom.

The study's findings demonstrate the importance of a Christian role model in Christian university biology-related majors' reconciliation of evolution and their personal religious beliefs. Most participants reported that they had no idea before arriving as freshmen at the study site university that a Christian could accept evolution as God's mechanism for creation. Many Christian creationist students at a secular university would have the same confined perspective.

A point of relevance for secular university professors interested in helping Christian creationist students in their classrooms come to an acceptance of evolution is the importance of Christian role models who reconcile evolution with their religious beliefs. A number of religious organizations have publicly stated support for evolution (see National Center for Science Education, 2002). While it may be helpful to make Christian creationist students aware of religious groups that support evolution, this study's findings indicate the importance of the individual role model, personified in a Christian who is also a scientist. This is particularly important for conventional faith stage students who are beginning to look for other sources of authority in their transition to young adult faith. Michael, Participant 14, noted that "one of the major problems" he faced in childhood was not knowing "any Christians with an educated perspective" on the science of evolution. Secular university professors who interact personally with creationist students may elect to recommend books written by Christian scientists that include personal testimonies of viewing evolution from a positive Christian perspective (e.g., Collins, 2006; Falk, 2004).

Another point of relevance of this study for secular university professors is to recognize the necessity of helping students properly understand the domains of science and religion. Discussion of this matter is appropriate for public education, and many resources exist that define the issue (e.g., National Academies of Sciences, 2008). Some professors (e.g., M. U. Smith, 1994) read statements to their classes to draw clear distinctions between science and religion prior to learning about evolution. The study's findings reinforce the importance of such practices, including a thorough discussion of the domains in application to natural phenomena such as abiogenesis.

A final point of relevance for secular university professors is to recognize the role of students' faith in their reconciliation of evolution and personal religious beliefs. This recommendation, already discussed in the previous section, may be more difficult for a secular university professor to apply in a large class (e.g.,  $n = 100$  in an upper-level evolution course, Ingram & Nelson; 2006) than for the Christian university professor in the relatively small class setting that was representative in this study. Still, even if only realized in individual conversations between professor and student, faith implications have merit for secular university professors interested in helping Christian creationist students come to an acceptance of evolution.

In summary, the relevance of this study for Christian university professors may also apply to secular university professors. The unique aspects of this study at a Christian university condition the appropriateness and transferability to a secular university setting.

#### *Relevance for Researchers*

A surprising outcome of this study was the adverse reaction of many participants to random processes in abiogenesis. Randomness to Christians appears to be a double-edged sword.

First, many Christians misunderstand random processes in nature as extremely improbable events (Kitcher, 2007). Creationists exploit people's misunderstanding of randomness by claiming that assembly of the first proteins on the ancient earth is akin to a tornado producing a 747 jet out of a junkyard (Hoyle, 1983; see refutation in Isaak, 2007). Second, randomness can be made to appear to devalue the role of God in the creation process. Although there were minor examples of a few participants viewing random processes as improbable in this study, many more participants expressed reservations about how random processes might eliminate God's place in the universe.

Adverse reaction to randomness was most apparent in the Evolution Attitudes Survey (Ingram & Nelson, 2006). Survey Item 9 stated, "It is statistically impossible that life arose by chance." Many participants interpreted "arose by chance" to imply a direct challenge to God's role in the creation process. A Christian understanding of ultimate and proximate causes precludes misunderstanding in this context. Nevertheless, many Christians decode words like "chance," "spontaneous," and "random" as anti-theistic.

Ingram and Nelson (2006) do not discuss their reasoning in the construction of Survey Item 9. If their purpose was to assess students' acceptance of abiogenesis only, the statement may have some unintended negative implications perceived by Christian students. Of the 255 students in Ingram and Nelson's study, 32% were undecided on Survey Item 9 in the post-course survey. In this study, 47% of the 15 participants were undecided. Ingram and Nelson acknowledge the possibility that "students interpret the survey statements differently than we do" (p. 18). This indeed may have been the case with Survey Item 9. An interesting alternative would be to assess responses by Christians to a similar question without the cumbersome code words and stated in the affirmative: "Life arose on Earth by natural processes."

In summary, the findings of this study suggest that researchers who investigate attitudes about evolution must be cautious in constructing survey items and questionnaires. Without the benefit of follow-up exploration afforded in semi-structured interviews, Christian students' misinterpretations may jeopardize the validity of questions that are intended to be religiously neutral.

#### Recommendations for Further Research

The findings of this naturalistic inquiry indicate that the study design, methodology, and data analysis were efficacious in facilitating an understanding of how Christian biology-related majors at a Christian university reconcile evolution and their personal religious beliefs. The findings also resulted in practical points of relevance for Evangelicals, Christian and secular university professors, and researchers. The compelling outcomes of this study suggest potentiality for further application to other situations, including a longitudinal study of Christian biology-related majors, the study of Christian biology-related majors at secular universities, and the study of university students who are not majoring in a biology-related field. Each of these recommendations for future research is discussed below.

The data for this research were collected in a relatively short duration of time. The two semi-structured interviews were held within a two-week time period. Many of the recent graduates who participated in this study wrote their Origins scholarly paper two years prior to the research interviews. However, most of the recent graduates and undergraduates indicated that their views of creationism and evolution had remained relatively unchanged since the Origins course. Apparently, the greatest change in participants' views occurred between their freshman year and the completion of the Origins course. All participants who came to accept evolution commented on the journey-like nature of their process of conflict reconciliation.

While the semi-structured interviews yielded rich insights into the faith processes at work in participants' lives, interview data consisted largely of participants' recollections of events and reconstructions of their transitions of thought. This offered the benefit of hindsight as participants could reflect on changes. However, another possibility for further research is to study a group of Christian university biology-related majors from their freshman year to the completion of Origins over a span of three to four years. The results of this study demonstrate that sampling would not be difficult in finding students entering as freshmen who operate in conventional faith and disavow evolution. Semi-structured interviews could be given at key junctures in their courses of study, including the mid-semester point in their freshman fall semester, the end of their sophomore year after several biology and religion classes, and finally at the conclusion of the Origins course. Additionally, participants could journal their experiences, thoughts, and emotions during this time.

Each set of interviews would explore participants' faith development, attitudes toward science and religion, and views on creationism and evolution. Successive interview protocols may have to be slightly adapted for poignancy and to reduce the effect of repeated inquiry. However, the relatively long duration of time between interviews would mitigate the threat of repetition to the study's credibility.

Some challenges confront the recommended study. University students are notorious for changing majors. Attrition is also a concern. Finally, a longitudinal study represents a significant commitment from participants. In this study, fifteen of the eighteen potential participants who were contacted agreed to participate and complete the study. This relatively high 83% participation rate was most likely due to the trust and rapport the researcher had with the

participants, all of whom had taken courses from the researcher. The benefit of an established trust would be greatly reduced when sampling for freshman participants.

Multi-year, longitudinal studies of individual university students' faith are not readily found in the research literature. Holcomb (2004) assessed the faith stages of 240 Christian university freshmen and graduating seniors in an effort to determine how well Christian universities cultivate change in students' faith development. In contrast, this recommended study would investigate participants' faith development and views regarding creationism and evolution for a relatively small sample of Christian biology-related majors' over a period of three to four years. The recommended study could potentially yield greater insight into faith transitions and its connection with changing views on creationism and evolution.

A second recommendation for research is to apply this study's design to investigating biology-related majors who are Christians at a secular university where an upper-level course on evolution is part of the curriculum. The recommended study would offer a fascinating comparison and contrast to this study, especially regarding the factors that influence participants' views towards evolution. The findings of the recommended study would also have broader transferability and greater relevance to secular universities. Challenges to performing the study would include identifying potential participants and receiving permission from university gatekeepers.

A third recommendation for future research is to apply this study's design to investigating the views of university students who are not majoring in a biology-related field and are Christians at either a Christian or secular university. This would greatly increase the pool of potential participants and offer some unique insights, especially in participants' views on the domains of science and religion. However, the pilot study in this research demonstrated that

participants who do not have a significant understanding of evolution struggle to articulate their views on evolution. Both pilot participants were juniors who had completed several biology courses. However, neither had completed the Origins course and their lack of familiarity with evolutionary concepts inhibited them from providing well-constructed answers. Pilot participants' responses were significantly less detailed than the main study participants' responses. Still, modification of the creationism-evolution interview protocol would enable an investigation of university students who are not majoring in biology-related fields and could offer significant insights into their perception of evolution in the context of their personal religious beliefs.

A final recommendation for future research is to perform an in-depth case study of the Origins course professor at the study site university. The professor made a profound impact on the perspectives of many participants in this study. Seven participants directly attributed their openness in considering evolution to the influence of the Origins course professor. The proposed case study could investigate the professor's faith development, her pedagogical approach in the classroom, and her perspectives on teaching creationism and evolution. Additionally, her former Origins course students could be interviewed to elicit information about the professor's influence on their perspectives.

In summary, the research design and methodology of this naturalistic inquiry could be adapted into a longitudinal study of Christian biology-related majors at a Christian university, extended to an investigation of Christian biology-related majors at secular universities, and broadened to the study of university students who are not majoring in a biology-related field. Each of these recommended studies would add greater insight into how Christian students at Christian and secular universities reconcile evolution and their personal religious beliefs.

## Researcher's Reflections

The findings of this study reveal the rich dynamics of Christian biology-related majors' faith at a Christian university. In spite of the conflict and apprehension these students faced in seeking ways to reconcile evolution and personal religious beliefs, they demonstrated resiliency in their belief in a personal God. As many participants transitioned to young adult faith and adult faith, their religious beliefs became more nuanced. However, an unshakable conviction of the reality of God in their life carried them through times of doubt and discouragement.

Many participants similarly displayed a firm commitment to scientific integrity. Participants weren't scolded or coerced by anyone into accepting evolution. Their grades in the Origins course were not contingent on an affirmation of evolution, but rather on their understanding of evolution. Participants who came to accept evolution did so because they felt compelled by the evidence, as science had become a way of thinking for them.

A well-respected science educator writes, "Science does not occur in a vacuum" (Lederman, n.d.). In this study, personal religious beliefs had a great bearing on how participants viewed evolution. The study results demonstrate that Christians who view science and religion as distinct but complementary ways of knowing can embrace evolution as God's mechanism for creation.

Participants in this study were unsure about how to deal with the theological implications of evolution. K. B. Miller writes, "For most people the scientific questions are only superficial and often a diversion. The real issues are philosophical and theological" (personal communication, October 31, 2007). Much work remains for the Evangelical church in working out the theological implications of creation by evolution.

### A Final Thought

The conflict of the religious and scientific debate regarding evolution continues to persist on a national scale. Creationists remain entrenched in their view that science must be subservient to a strict, literal interpretation of the Bible. Additionally, evolution is portrayed as anti-theistic and incompatible with Christian belief. Meanwhile, accumulating evidence continues to increasingly support evolutionary theory as the best scientific explanation for the diversity of life on Earth. Christians who view science as a reliable and valid way of knowing must eventually determine whether or not they will accept evolution. The results of this study demonstrate that the religious conflict over evolution need not persist on a personal level – Christian biology-related majors at a Christian university were able to retain a belief in God and accept evolution, thus reconciling their understanding of evolution and their personal religious beliefs.

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## **Appendix A - Faith Development Coding Criteria**

The following coding criteria describe Stages 2 through 4, the stages most pertinent to university students (Holcomb & Nonneman, 2004; Parks, 1986). The criteria is specified in the *Manual of Faith Development* (Fowler et al., 2004) and supplemented by other sources on faith development (Fowler, 1981; Parks, 1986).

## Stage 2 Mythic Literal Coding Criteria

Form of Logic	Social Perspective Taking	Form of Moral Judgment	Bounds of Social Awareness	Locus of Authority	Form of World Coherence	Symbolic Function
Concrete Operational <ul style="list-style-type: none"> <li>▪ Constructs groups and classes, compares like and unlike things</li> <li>▪ Describes events in terms of cause and effect relationships</li> <li>▪ Uses space and time to order objects and events in series</li> <li>▪ Can distinguish the world from one's own perceptions</li> <li>▪ Conversationally takes into account the other's perspective</li> </ul>	Concrete Perspective <ul style="list-style-type: none"> <li>▪ Recognizes that the other may have a different perspective but not explicitly aware of the other's inferiority (thoughts and feelings) being different from one's own</li> <li>▪ May be judgmental in characterizing other's disparate perceptions</li> </ul>	Reciprocity <ul style="list-style-type: none"> <li>▪ Makes moral judgments based on one-on-one (rather than Stage 3 group) reciprocity</li> <li>▪ Follows rules when they serve one's own interests</li> <li>▪ Attempts to resolve conflicts by exchanging favors or services to satisfy one's own needs</li> </ul>	"Those like us" <ul style="list-style-type: none"> <li>▪ Expands family or primal group to teachers, friends, school authorities, ministers, etc.</li> <li>▪ Emergence of a peer group but peer group not the locus of identity seen in Stage 3</li> </ul>	External <ul style="list-style-type: none"> <li>▪ Aware of own needs and desires to weigh against authority claims (reciprocity)</li> <li>▪ Authorities are those who can exert concrete influence on the individual</li> <li>▪ Authority roles are conventional society-roles</li> <li>▪ Images of others are concrete, literal and immediate</li> </ul>	Narrative-Dramatic <ul style="list-style-type: none"> <li>▪ Focuses on the concrete and empirical</li> <li>▪ Sees physical events in terms of causality</li> <li>▪ Separates fantasy from reality</li> </ul>	One Dimension-Literal <ul style="list-style-type: none"> <li>▪ Distinguishes between the symbol and that which it represents but based on a literal relationship between the two</li> <li>▪ Stories and myths taken literally and one-dimensionally</li> <li>▪ Groups symbols and events to create narratives</li> </ul>

### Stage 3 Synthetic-Conventional Coding Criteria

Form of Logic	Social Perspective Taking	Form of Moral Judgment	Bounds of Social Awareness	Locus of Authority	Form of World Coherence	Symbolic Function
<p><b>Early Formal Operations</b></p> <ul style="list-style-type: none"> <li>▪ Makes simplistic deductions but cannot construct systems or subject hypotheses to rigorous testing</li> <li>▪ Relies on convention over reason</li> <li>▪ Tacit thinking, unable to name process of finding an answer</li> </ul>	<p>Mutual and Interpersonal</p> <ul style="list-style-type: none"> <li>▪ Constructs the interiority of another person (e.g., "How does she feel about that?) but is limited or stereotypical</li> <li>▪ Orients towards meeting "generalized" other's expectations,</li> <li>▪ Hold ideas in undifferentiated ways</li> <li>▪ Does not "second-order" reflect about the processes of thought itself</li> <li>▪ Tends towards stereotyping</li> </ul>	<p>Interpersonal</p> <ul style="list-style-type: none"> <li>▪ Moral judgments strongly associated with one's group valuing interpersonal harmony and consensus</li> <li>▪ Outsiders are either like "us" or stereotypically wrong</li> <li>▪ Identifies with personal relationships but does not construct a self distinct from these</li> <li>▪ Significant others are not self-selected</li> <li>▪ Allows others to determine the "me"</li> </ul>	<p>Composite of groups driven by interpersonal relationships</p> <ul style="list-style-type: none"> <li>▪ Widened boundaries shifting toward peer groups and away from family</li> <li>▪ Outside groups seen in stereotypical terms</li> <li>▪ Displays values in accordance with a group such as loyalty, honesty, sincerity, etc.</li> </ul>	<p>Group</p> <ul style="list-style-type: none"> <li>▪ Authority established by group consensus, real or imagined</li> <li>▪ Tacit appeal to social conventions for authority figures with personal charisma</li> <li>▪ Selects authorities based on feelings and appearances</li> <li>▪ Easily influenced by authority figures with personal charisma</li> </ul>	<p>Tacit System</p> <ul style="list-style-type: none"> <li>▪ Blends together conventional ideas and beliefs of significant group</li> <li>▪ Little or no reflection on the generalized implications of one's own system of thoughts and beliefs</li> <li>▪ Contradictions with other's worldviews are excluded rather than explicitly dealt with</li> <li>▪ May see oneself in a heroic, fantasized role</li> </ul>	<p>Multi-dimensional Symbolism</p> <ul style="list-style-type: none"> <li>▪ Symbols are powerful in evoking emotional responses without thought to the ideas or concepts that underlie the symbols</li> <li>▪ Little critical awareness of use of symbols</li> <li>▪ May resist an analysis of symbols</li> </ul>

## Stage 4 Individuative-Reflective Coding Criteria

Form of Logic	Social Perspective Taking	Form of Moral Judgment	Bounds of Social Awareness	Locus of Authority	Form of World Coherence	Symbolic Function
<p><b>Formal Operational</b></p> <ul style="list-style-type: none"> <li>■ Reflects and performs operations on thinking</li> <li>■ Concerned with system boundaries, definitions, and making distinctions</li> </ul>	<p>Formal and Systematic</p> <ul style="list-style-type: none"> <li>■ Sees others in terms of their thought system or worldview</li> <li>■ Compares, justifies and maintains own worldview with respect to those of others</li> <li>■ Displays an “I” that is separate from relationships</li> <li>■ Conceptually formulates and analyzes relationships with others achieving a “critical distance”</li> <li>■ Reasoning is linear and deductive</li> </ul>	<p>Social Order</p> <ul style="list-style-type: none"> <li>■ Oriented towards doing one’s own duty to maintain a social system or order</li> <li>■ Displays a limited “prior to society” perspective (not fully abstracting the principles on which society is founded)</li> <li>■ Explicitly and rationally defends moral judgments</li> </ul>	<p>Ideological Compatibility</p> <ul style="list-style-type: none"> <li>■ Insiders and outsiders judged on ideological compatibility with own ideology</li> <li>■ Authority chosen norms and insights (dichotomizes social realm into those who are compatible and incompatible)</li> <li>■ Relationships to authority are rational and explicit</li> <li>■ Locates authority in ideas, systems and institutions rather than persons</li> </ul>	<p>Individuative</p> <ul style="list-style-type: none"> <li>■ Authority accepted or rejected based on compatibility with own ideology</li> <li>■ Authority figures may go beyond persons to include laws, traditions or customs</li> <li>■ Relationships to authority are rational and explicit</li> <li>■ May collapse tensions and paradoxes in one direction to maintain coherence of ideological system rather than persons</li> </ul>	<p>Explicit System</p> <ul style="list-style-type: none"> <li>■ Critically reflects on own worldview</li> <li>■ Sees own worldview as an explicit system and desires it to be consistent, coherent and comprehensive</li> <li>■ Seeks to establish and maintain system boundaries by emphasizing similarities over differences</li> <li>■ May dichotomize symbols derived from the meaning behind the symbols (and not the symbols themselves)</li> <li>■ Symbols recognized for their function</li> </ul>	<p>Symbols De-mythologized</p> <ul style="list-style-type: none"> <li>■ Symbols are separated from symbolized</li> <li>■ Symbols are translated into explicit conceptual meanings</li> <li>■ Power of symbols</li> <li>■ Resists the threat of relativity</li> </ul>

## Appendix B - Parks' Model of Faith Development

	<b>Conventional Faith</b>	<b>Young Adult Faith</b>	<b>Adult Faith</b>	<b>Mature Adult Faith</b>
<b>Form of Cognition</b>	Authority-bound Dualistic (Tacit)	Unqualified Relativism	<u>Commitment in Relativism</u>	Confirmed Commitment
		Probing Commitment (Ideological)	Tested Commitment (Explicit)	
<b>Form of Dependence (Affect)</b>	Dependent/Counter -dependent		<u>Inner-dependence</u>	Interdependence
		Fragile Inner-Dependence	Confident Inner- Dependence	
<b>Form of Community (Social Dynamics)</b>	Conventional	Diffuse	Ideologically Compatible Community	Self-selected Class or Group
				Open to "others"
<b>Nelson's (1999) Corresponding Modes of Cognitive Growth</b>	Dualistic	Multiplicity	Contextual Relativism	Commitment
<b>Fowler (1981) Stages of Faith</b>	Stage 3 (Synthetic Conventional)		Intermediate (Stage 3-4)	Stage 4 (Individualive Reflective)
				Stage 5 (Conjunctive)

## **Appendix C - Interview Protocol**

### **Interview 1 – Faith Development**

#### **Life Tapestry/Life Review**

1. Reflecting on your life, identify its major chapters. What marker events stand out as especially important?
2. Are there past relationships that have been important to your development as a person?
3. Do you recall any changes in relationships that have had a significant impact on your life or your way of thinking about things? Please describe the changes and the impact?
4. How has your image of God and relation to God changed across your life's chapters? Who or what is God to you now?
5. Have you ever had moments of intense joy or breakthrough experiences that have affirmed or changed your sense of life's meaning? What happened to you at these times? How have these moments affected you?
6. Have you experienced times of crisis or suffering in your life, or times when you felt profound disillusionment, or that life had no meaning? What happened to you at these times? How have these experiences affected you?

#### **Relationships**

7. Focusing now on the present, how would you describe your parents and your current relationship to them? Have there been any changes in your perceptions of your parents over the years? If so, what caused the change?
8. Are there any other current relationships that seem important to you? Please describe them.

9. What groups, institutions, or causes, do you identify with? Why do you think that these are important to you?

### **Present Values and Commitments**

10. Do you feel that your life has meaning at present? What makes life meaningful to you?

11. If you could change one thing about yourself or your life, what would you most want to change?

12. Are there any beliefs, values or commitments that seem important to your life right now?

13. When or where do you find yourself most in communion or harmony with God or the universe?

14. What is your image or model (an idea or a person) of mature faith?

15. When you have an important decision to make, how do you generally go about making it?

Can you give me an example? If you have a very difficult problem to solve, to whom or what would you look for guidance?

16. Do you think that actions can be right or wrong? If so, what makes an action right in your opinion?

17. Are there certain actions or types of actions that are always right under any circumstances?

Are there certain moral opinions that you think everyone should agree on? What are the sources of these moral actions and opinions?

### **Religion**

18. Do you think that human life has a purpose? If so, what do you think it is? Please describe how you think there is a plan for our lives, or how we affected by a power or powers beyond our control?

19. What does death mean to you? What happens to us when we die?

20. Do you consider yourself a religious person? What does this mean to you?
21. Are there any religious ideas, symbols or rituals that are important to you, or have been important to you? If so, what are these and why are they important?
22. Do you pray, meditate, or perform any other spiritual discipline?
23. What is sin, to your understanding?
24. How do you explain the presence of evil in our world?
25. If people disagree about a religious issue, how can such religious disagreements be resolved?

### **Interview 2 – Conflicts in Evolution and Religious Belief**

#### **Science and Religion**

1. How do you feel about the trustworthiness of science?
2. How does science influence the way you see the world and make decisions?
3. How do you feel about the trustworthiness of your religious beliefs?
4. How does religious belief influence the way you see the world and make decisions?
5. You've talked about your own sense of the trustworthiness of science and the trustworthiness of your religious beliefs. Have you ever found that science and your religious beliefs agree, that they say the same thing?
6. Have you ever found that science and your religious beliefs disagree, that they say the opposite thing?

#### **Evolution and Creationism**

7. Think about your present views regarding evolution and creationism. If you can think about how you came to these views as a journey, tell me the story of your journey. Go as far back to the beginning as possible. Who were the people that were part of that journey? What were the key events? Take your time if you want to think about it first.

8. Tell me about how well you feel you understand the scientific view of evolution.
9. How would you define the scientific view of evolution?
10. How would you define Biblical view of creationism?
11. Is there anything in creationism and evolution that you have difficulty finding credible? Tell me about it. [As a follow-up, ask, “How do you think life first arose on Earth?”]
12. Have you ever come across anything in your learning about evolution that contradicted your religious beliefs?
  - How do you handle the conflict?
13. Have you had any disagreements with others about your views on creationism or evolution? Tell me what happened. What was it like for you – how did it make you feel?  
[If participants can't describe a relevant situation, set up the hypothetical situation of a friend with an opposing view and ask for a response. Check the completed survey to formulate an opposing view.]
14. Has learning about evolution changed any of your views about God?
15. Has learning about evolution changed the way you think about the Bible?
16. Are there any persons you would have a difficult time telling about your views on evolution and creationism? Tell me about those persons and why it would be difficult to talk to them about evolution and creationism.
17. A famous poet once wrote, “Nature is red in tooth and claw.” Some people characterize evolution as “survival of the fittest.” How do you feel about these statements?
  - How does this view of nature relate to your views about God?

18. Some have claimed that evolution, as a process of mutation, variation and natural selection, is a completely random, a matter of chance. How do you feel about the claim that the diversity of life on the planet is a product of random events?

- How does this relate to your views about God?
- How does this relate to you as a human having a purpose in life?

19. Did God intervene at any time, in any way to bring humans onto the scene? If so, how?

- What, if anything make humans different from the animals?

20. I appreciate your candid answers to these questions. How are you feeling emotionally at this point?

- Do you feel that any of your views about creationism and evolution have changed during the course of this interview? Tell me about any changes.

#### **Additional question for recent graduates**

21. How has your views regarding evolution and creationism changed or remained the same since graduating? Please explain.

## Appendix D - Sample Faith Development Scoring Sheet

Themes / Interview Questions	Inter-act #	Scoring Criteria	Stages						$\Sigma$
			1	2	3	4	5	6	
A/Form of logic	Breakthrough	42-44	Early formal-operational		3				3
	Crises	52-62	Early formal-operational, few systematic reflecting		3				
	Changes in self	118-120	See above, tendency of stereotyping		3				
	Decisions	135-42	Rather complex decision procedure, while orientated at external authorities		3				
B/Perspective taking	Current relationships	78-90	Important contacts within the 'we-group'		3				3
	Past relationships	14-20	Conventional, constructing the 'generalised other'		3				
	Parents	64-75	Perception mother rather stereotype, father little more differentiated		3				
C/Form of Moral Judgement	Right action	144-148	Multi-perspective attempts, but without systematic elaboration		3				2,5
	Sin	210	based on instrumental reciprocity, involving concrete consequences		2				
	Evil	212-218	based on instrumental reciprocity, involving concrete consequences		2				
	Religious conflicts	220-24	Conventional, based on interpersonal values		3				
D/Social awareness	Marker events	2-12	Restricted to in-group		3				3
	Changes in relationships	22-28	Identity derived from in-group-involvement		3				
	Groups	96-102	Valuing interpersonal relationships and in-group-involvement		3				
E/Locus of authority	Your life meaning	110-116	God as concrete person of authority		2				2,66
	Beliefs	122-142	trust in and accommodation with group authority		3				
	Always right	150-159	Rather tacit fusion of group-derived and of 'internal' values		3				
F/Form of World Coherence	Mature faith	130-134	value orientations centering around interpersonal concerns		3				2,75
	Purpose of human life	161-177	synthesis of conventional values and of attitudes of the in-group		3				
	Death	179-81	synthesis of conventional values and of attitudes of the in-group		3				
	Religious Person	183-185	Embedded in the narrative, from which can derive prediction and control		2				
G/Symbolic Function	Image of God	30-40	embedded in its stories and myths without having a reflective distance on them		2				2,5
	Harmony	126	Conventional interpretations of religious symbols which orient toward interpersonal qualities		3				
	Symbols, Rituals	187-199	groups symbols and events together to create a narrative		2				
	Spiritual discipline	201-208	Conventional interpretation of religious symbols which orient toward interpersonal qualities		3				
									2,34

## Appendix E - Life Tapestry Exercise

Take a moment to look over the work sheets that you have in front of you. After you have looked at the chart for a few minutes, turn back to this page for some explanation of the categories at the top of the work sheet.

1. **Calendar Years from Birth.** Starting at the left column of the work sheet, number down the column from the year of your birth to the present year. You may wish to number the columns in two, three, or five year intervals to represent distinct periods in your life.
2. **Age by Year.** This column simply gives you another chronological point of reference. Fill it in with the same intervals you used for calendar years on the left-hand side of the chart.
3. **Place--Geographic and Socioeconomic.** Here you may record your sense of place in several different ways. It could be the physical place you lived in at different times in your life, including the geographic area where you lived, or it could be your sense of your position in society or in the community. Record your sense of place in whatever way it seems most appropriate to you.
4. **Key Relationships.** These can be any types of relationships that you feel had a significant impact on your life at the time. The persons mentioned need not be living presently, and you need not have known them personally. (That is, they could be persons who influenced you through your reading or hearing about them, etc.)
5. **Uses and Directions of the Self.** Here you can record not only how you spent your time but also what you thought you were doing at that time.
6. **Marker Events.** Here you may record the events that you remember which marked turning points in your life—moving to new place, death of a loved one, marriage or divorce in the family, etc. A major event occurred and things were never the same again.
7. **Events or Conditions in Society.** In this column we ask you to record what you remember of what was going on in the world at various times in your life. Record this as an image or phrase, or a series of images and phrases, that best sums up the period for you.
8. **Images of God.** This is an invitation for you to record briefly, in a phrase or two, what your thoughts or images of God--positive and negative--were at different times of your life. If you had no image of God or cannot remember one, answer appropriately.
9. **Centers of Value.** What were the persons, objects, institutions, or goals that formed a center for your life at this time? What attracted you, what repelled you, what did you commit your time and energy to, and what did you choose to avoid? Record only the one or two most important ones.
10. **Authorities.** This column asks to whom or what did you look for guidance, or to ratify your decisions and choices at various points in your life.

As you work on the chart, make brief notes to yourself indicating the insights or thoughts you have under each of the columns. It is not necessary to fill out the columns in great detail. You are doing the exercise for yourself, so use shorthand or brief notes. This first worksheet is yours to keep.

After you have finished your work with the chart, spend some time thinking about your life as a whole. Try to feel its movement and its flow, its continuities and discontinuities. As you look at the tapestry of your life, let yourself imagine it as a drama or a play. Where would the divisions naturally fall? If you were to divide it into chapters, how would these be titled? When you have a sense of how your life might be divided, draw lines around these areas on the chart and jot down the titles on the side of the work sheet.

Transfer your organized work to the second worksheet, including the chapter divisions and titles. ***Bring the second worksheet to your interview.***

This is the unfolding tapestry of your life at this particular time. In the coming days or months you may want to return to it for further reflection, or to add to it things that may come to you later. Some people find that the Life Tapestry Exercise is a good beginning for keeping a regular journal or diary. You may find too, that if you come back to this exercise after some time has passed, the chapters and titles in your life will be different as you look at them in light of new experiences. We hope you have enjoyed doing this exercise.

Adapted from the *Manual of Faith Development Research* (Fowler et al., 2004)

## Sample Life Tapestry Exercise Worksheet

Worksheet Two (please bring this to the first interview)

Year	Your Age	"Place" Geographic & Socio-Economic	Key Relationships	Uses and Directions of the Self	Marker Events	Events & Conditions in Society & the World	Images of God	Centers of Values & Power	Authorities
1983-1989	0-6	home, big sister	family, Sisters, kids	outside, fun, growing, Gymnastics	-	-	-	play-imagination	Parents
1990-1995	7-12	elementary school, friends, Soccer	family, sisters, neighbors, playing soccer	learning, playing, soccer, playing	Started School & Soccer "no"	Oklahoma City bombing	Storybook character	Church, play, School	Parents
1996-1998	13-15	middle School, new friends	family, sisters, new soccer team, new friends	youth group, school, Soccer, hand	b-ball middle school missions trip	-	God as Jesus Scared	Church, School, Soccer	Parents & Friends
1999-2002	16-19	High School challenging classes, conflicts	family, young friends, youth group	driving high school moved into town	9/11	deeper relationship w/ God who has a plan for me God's will	Church, School, Soccer	Coaches, God parents, friends, youth pastor	Soldiers, profs, teammates, parents, friends, self
2002-2005	20-22	solo, divergent interests	friends, reliance on God, teammates	soccer, college, death, environment,垂死的	I war in Iraq	God as my Father always w/ me	Church, School, Soccer	God, teaching, environmental responsibility	God
2005-2009	22-26	2005-2009	God, co-workers, housemates, co-counselors	making outfit, teaching, hiking, living life	no longer an athlete outta room New York teacher	God as Creator - life outside the building	Job, teaching, relationship w/ God	God, coworkers, bosses	God
2009-2011	26-28	2009-2011	complete	College	Dad's Surgery	God as companion, friend	School	self	God, profs
Sept-Dec 2009	23	living alone	reliance on God friends						God, bosses, profs, parents
2007-2011	23	adjustments	mom + dad, co-workers	writing towards a goal			God as provider	working school church	

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## Appendix F - Evolution Attitudes Survey

### Survey

**Instructions:** For the following statements, choose undecided if you neither agree nor disagree, or if you are unsure. The responses are abbreviated SA (strongly agree), A (agree), U (undecided), D (disagree), and SD (strongly disagree). Please circle your response.

Statements					
1. Over billions of years all plants and animals on Earth (including humans) descended (evolved) from a common ancestor (e.g., a one-celled organism).	SA	A	U	D	SD
2. A supreme being (e.g., God) created humans pretty much in their present form; humans did not evolve from other forms of life (e.g., fish and/or reptiles).	SA	A	U	D	SD
3. There is no real evidence that humans evolved from other animals.	SA	A	U	D	SD
4. Scientists who believe in evolution do so mainly because they want to, not because of any evidence.	SA	A	U	D	SD
5. There is scientific evidence supporting that humans were supernaturally created.	SA	A	U	D	SD
6. There is fossil evidence supporting that animals, including humans, did not evolve.	SA	A	U	D	SD
7. There is no fossil evidence supporting that humans and apes evolved from a common ancestor.	SA	A	U	D	SD
8. The methods used to determine the age of fossils and rocks are not accurate.	SA	A	U	D	SD
9. It is statistically impossible that life arose by chance.	SA	A	U	D	SD
10. The Earth is not old enough for evolution to have taken place.	SA	A	U	D	SD
11. Mutations are never beneficial to animals.	SA	A	U	D	SD
12. The Second Law of Thermodynamics (order tends towards disorder) shows that evolution could not have happened.	SA	A	U	D	SD

## **Appendix G - Participant Informed Consent Form**

**Project Title:** Evolution and Personal Religious Belief: Christian University Biology Students' Search for Equilibration

**Approval Date of Project:** November 13, 2006

**Expiration Date of Project:** November 12, 2007

**Principal Investigator:** Dr. Larry Scharmann (KSU faculty member)

**Co-Investigators:** Mark Winslow (Ph.D. Graduate Researcher)

Dr. John Staver, (KSU Faculty Emeritus)

**Contact Name and Phone for any Problems/Questions:**

Dr. Larry Scharmann, Principal Investigator, (785) 532-6938, lscharm@ksu.edu

**Institutional Review Board Chair Contact/Phone Information:**

- Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.
- Jerry Jaax, Associate Vice Provost for Research Compliance and University Veterinarian, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

### **Purpose of the Research**

The purpose of this research is to explore how biology majors at a Christian university perceive the apparent conflicts between evolution and religious belief and how their faith plays a role in the mediating process.

### **Procedures:**

#### **Interviews**

The researcher (Mark Winslow) will interview you in a neutral location such as a library at a predetermined time. Two interview sessions, each about one and a half hours long will be scheduled with an intervening period of three days to one week.

The interviews consist of 20-25 questions in a semi-structured format. A short survey about evolution will be given before the second interview. You have the right to decline answering any question during the interview. You may be asked to wear a lapel microphone provided by the researcher. Interviews will be audio recorded and used for transcription. You will be given a copy of the transcript to check for accuracy and asked to return the transcript after making corrections and adding additional information, if desired.

## **Documents**

**Life Tapestry Exercise:** You will be requested to complete a Life Tapestry Exercise before the first interview. In this exercise, you chronicle important events, persons, and relationships in your life. The exercise should take about a half hour to complete.

**Scholarly Paper:** You will be asked to bring the “scholarly paper” you wrote as a final report for the biology course Origins to the first interview. Your paper will become part of the data for this study. The researcher will read your paper before the second interview and may ask you some clarifying questions at that time.

## **Alternate Procedures**

There is no alternative procedure in this research that might offer an advantage to you as a participant.

## **Length of Study:**

Participation in this study will require three to four hours of your time.

## **Risks and/or Discomforts Anticipated:**

Your participation, non-participation or withdrawal from this study will have NO effect on your relationship with the researcher or on any course grade (past, present or future). There are no physical risks or discomforts associated with this research. If you feel emotionally uncomfortable with any question during the interview, you have the right to decline providing an answer. If you want to see an on-campus counselor following either interview, Kimberly Campbell is glad to meet with you (see the accompanying letter).

## **Benefits Anticipated:**

There is no financial remuneration for your participation in this study. You may find the Life Tapestry Exercise and interviews beneficial. Candidly talking about your faith and your ideas regarding evolution and personal religious beliefs may be a rewarding experience.

## **Extent of Confidentiality:**

Your identity in this study will be kept absolutely confidential. You will be asked to select a pseudonym in place of your name in the transcripts and study’s findings. All references to the identities of your family, friends, and location will be masked in the transcripts and findings to safeguard your privacy.

The research assistant, Cara Dikes will transcribe the interview audio recordings. Although your name will not be used during the interview, there is a possibility that the research assistant, a student at this university, will learn your identity. The research assistant has been given a strict set of rules and has signed an agreement form to ensure the confidentiality of your information. You may obtain a copy of the research assistant’s signed agreement form by request.

All data from this study will be securely stored. Computer files and documents will be stored in password-secured locations. Audiotapes and original transcripts will be stored in a locked cabinet in the researcher’s office. The information in this study may be published in journals or shown in public or scientific presentations but your privacy will be absolutely preserved.

**Opportunity to Ask Questions:**

You are welcome to ask questions about this study prior to participation or at any time during the study. Please contact the researcher or the principal investigator using the contact information above if you have any questions regarding this research, your rights as a participant, or any research-related grievance. If your questions have not been properly addressed by either the researcher or principal investigator, you are welcome to contact the Kansas State University Institutional Review Board using the contact information above.

**Freedom to Withdraw:**

Your participation in this research is absolutely voluntary. You are free to withdraw participation at any time without any penalty or loss of benefits to which you are otherwise entitled. In addition, there is no negative consequence to your relationship with the researcher. If you choose to withdraw, please provide the researcher with a signed letter simply stating that you choose to withdraw.

**Terms of Participation:**

I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

Participant Name: \_\_\_\_\_

Participant Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Witness to Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## **Appendix H - Member Check Form**

### **INTERVIEW VALIDITY/MEMBER CHECK**

August 8, 2007

Dear Research Participant,

Thank you for participating in my research and taking the time to complete two interviews with me. Enclosed are two transcripts for your optional review. The transcript is a verbatim copy of our dialogue and identifying information is masked out to protect your identity. Your name will be replaced with a pseudonym in the final draft of transcript. It is **not** required that you read through the transcripts and they are yours to keep. If you read the transcripts and wish to provide feedback, instructions are given below.

***Most importantly***, a portrait is also enclosed. The purpose of the portrait, as I write in my thesis, “is to give voice to the participants in saying, ‘These are the events that have made me who I am and my perceptions of creationism and evolution.’” Most of the portrait narrative is your actual words from the interviews and the Origins paper with very little commentary on my part. My objective is to give the reader an inside perspective of what’s going on in your head. A pseudonym will replace your name in the final portrait that goes into my thesis.

***In particular, I would appreciate any feedback you might provide regarding your portrait. Does it accurately capture your thoughts and feelings regarding creationism and evolution?***

Please feel free to provide corrections, clarification and other feedback by writing comments on the back of this page and add additional pages as necessary. You can alternatively email your comments to [mwinslow@snu.edu](mailto:mwinslow@snu.edu) and return this signed form in the mail. If you would like to discuss your feedback in person, feel free to email me to arrange an appointment.

Enclosed is a self-addressed, stamped envelope you can use to return this form. ***Please return within two weeks.*** Again, thank you for your willingness to participate in my research.

Sincerely,

Mark Winslow

**Directions:** Please initial the two items below and add comments, if necessary. Then return this form in the self-addressed, stamped envelope within two weeks of receipt.

           *Initialize* I have read my portrait and have been given the opportunity to provide feedback.

Portrait Comments:

           *Initialize* I have received both transcripts from my interviews with the researcher and have been given the opportunity to make corrections and provide feedback.

Transcript Name & Line #	Comment/Feedback

Participant Name: \_\_\_\_\_

Participant Signature: \_\_\_\_\_ Date: \_\_\_\_\_

# **Appendix I - Classroom Observation Participants Informed**

## **Consent Form**

**Project Title:** Evolution and Personal Religious Belief: Christian University Biology Students' Search for Equilibration

**Approval Date of Project:** November 13, 2006

**Expiration Date of Project:** November 12, 2007

**Principal Investigator:** Dr. Larry Scharmann (KSU faculty member)

**Co-Investigators:** Mark Winslow (Ph.D. Graduate Researcher)

Dr. John Staver, (KSU Faculty Emeritus)

**Contact Name and Phone for any Problems/Questions:**

Dr. Larry Scharmann, Principal Investigator, (785) 532-6938, lscharm@ksu.edu

**Institutional Review Board Chair Contact/Phone Information:**

- Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.
- Jerry Jaax, Associate Vice Provost for Research Compliance and University Veterinarian, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

**Purpose of the Research**

The purpose of this research is to explore how biology majors at a Christian university perceive the apparent conflicts between evolution and religious belief and how their faith plays a role in the mediating process.

**Procedures: Classroom Observation**

The researcher (Mark Winslow) will observe the Origins class and take observation notes during the spring semester of 2006. The researcher's participation in the class is minimal, with the exception of solicited comments from the course instructor. A short survey about evolution may be administered at the beginning and the end of the course.

**Alternate Procedures**

There is no alternative procedure in this research that might offer an advantage to you as a participant.

**Length of Study:**

Classroom observation of Origins will occur during the spring semester of 2006..

**Risks and/or Discomforts Anticipated:**

Your participation, non-participation or withdrawal from this study will have NO effect on your relationship with the researcher or on any course grade (past, present or future). There are no physical risks or discomforts associated with this research.

**Benefits Anticipated:**

There is no financial remuneration for your participation in this study. .

**Extent of Confidentiality:**

Your identity in this study will be kept absolutely confidential. All references to your identity will be masked in the observation fieldnotes and findings to safeguard your privacy.

All data from this study will be securely stored. Computer files and documents will be stored in password-secured locations. The information in this study may be published in journals or shown in public or scientific presentations but your privacy will be absolutely preserved.

**Opportunity to Ask Questions:**

You are welcome to ask questions about this study prior to participation or at any time during the study. Please contact the researcher or the principal investigator using the contact information above if you have any questions regarding this research, your rights as a participant, or any research-related grievance. If your questions have not been properly addressed by either the researcher or principal investigator, you are welcome to contact the Kansas State University Institutional Review Board using the contact information above.

**Freedom to Withdraw:**

Your participation in this research is absolutely voluntary. You are free to withdraw participation at any time without any penalty or loss of benefits to which you are otherwise entitled. All references (masked) in the notes pertaining to you will be deleted.

There is no negative consequence to your relationship with the researcher. If you choose to withdraw, please provide the researcher with a signed letter simply stating that you choose to withdraw.

**Terms of Participation:**

I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

Participant Name: \_\_\_\_\_

Participant Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Witness to Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## **Appendix J - Research Assistant/Transcriber Confidentiality**

### **Agreement Form**

#### **Identification of Project**

Evolution and Personal Religious Belief: Christian University Students' Search for Equilibration

#### **Purpose of the Research**

The purpose of this research is to explore how science majors at a Christian university perceive the apparent conflicts between evolution and religious belief and how their faith plays a role in the mediating process.

#### **Agreement**

I, \_\_\_\_\_, the Research Assistant/Transcriber, agree to:

1. keep all the research information shared with me confidential by not discussing or sharing the research information in any form or format (e.g., disks, tapes, transcripts) with anyone other than the researcher.
2. keep all research information in any form or format (e.g., disks, tapes, transcripts) secure while it is in my possession. This includes:
  - using closed headphones when transcribing audiotaped interviews;
  - keeping all transcript documents and digitized interviews in computer password-locked files;
  - closing any transcription programs and documents when temporarily away from the computer;
  - keeping any printed transcripts in a closed manila envelope and secure location, immediately giving it in person to the researcher after use;
  - and deleting (and emptying from trash) any communication containing data in an email program.
3. return all research information in any form or format (e.g., disks, tapes, transcripts) to the researcher when I have completed the research tasks.
4. after consultation with the researcher, erase or destroy all research information in any form or format regarding this research project that is not returnable to the researcher (e.g., information stored on computer hard drive).

Research Assistant/Transcriber \_\_\_\_\_ Date: \_\_\_\_\_

Adapted from the Usability Study for the University of Alberta Web site (University of Alberta, 2003)

## **Appendix K - Summative Content Analysis of all Interview Transcripts and Documents**

*Summative Content Analysis of all Interview Transcripts and Documents*

Code	n of Units	n of Participants
Influences		
Author or pundit	15	5
Bible	162	15
Christian adult or mentor	19	9
Church	90	15
Friend	49	13
Middle/high school class	22	12
Middle/high school teacher	13	5
Parent	125	15
Professor	40	13
Sibling	7	3
Spouse or boy/girlfriend	22	7
University course	59	15
Upbringing, “It’s how I was raised.”	47	14

Code	<i>n</i> of Units	<i>n</i> of Participants
Expressed emotions and attitudes		
Anger or frustration	24	7
Conflict with others about evolution	82	13
Fear or anxiety	12	11
Indifference, “The issue or question doesn’t matter to me.”	25	12
Love of science	19	11
Pressure or feeling of conflict	75	15
Trust in religion	27	15
Trust in science	26	15
Conceptions of science and evolution		
Abiogenesis, origin of life	34	13
Believe vs. accept, “I believe in evolution.” vs. “I accept evolution.”	30	15
Big Bang Theory	28	15
Definition of evolution	48	15
Domains of science and religion	78	15
Evidence	71	15
Faking it, “I learned evolution for the test but I don’t believe it.”	10	5

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Code	<i>n</i> of Units	<i>n</i> of Participants
Religious ideas and the theological implications of evolution		
Adam and Eve	30	11
Atheism	17	6
Faith, “My religious faith is in what is unseen.”	10	7
Free will	17	10
Intelligent Design	11	5
Salvation	20	7
Soul	22	14
Supernatural intervention, “This is how God works in the world.”	20	7
Teleology	25	15
Theodicy	22	14
Unanswerable questions, “I’ll never know the answer to that.”	26	11
View of God, “This is who God is.”	103	15
View of humans, “Humans are unique from animals because . . .”	46	15

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## Appendix L - Peer Debrief Letter of Support

September 13, 2006

To Whom It May Concern:

I have been asked by Mark Winslow to be a peer debriefer during his dissertation process. This letter serves as notification that I am willing to participate in this capacity.

The following reflects my background and qualifications to be a peer debriefer for Mr. Winslow:

- . I have an earned doctorate from a major state university. My dissertation, which had a qualitative research design, was nominated by my committee for the university's Graduate Research Award.
- I have conducted several post-doctoral research projects which incorporated qualitative designs.
- I have been a peer debriefer for three other doctoral students, and I am currently a peer debriefer for another doctoral student who is completing his degree from a major state university.
- I have served on five doctoral committees, three of which reviewed and approved dissertations that were qualitative designs.
- I have taught an introductory course on qualitative inquiry, and I am in the process of designing another course on qualitative inquiry for a new doctoral program beginning at a local university.

I am willing to meet with Mr. Winslow on at least a bi-weekly basis during the data analysis and interpretation. My intention is to provide constructive suggestions and probing questions that will help him to examine, clarify, and verify his interpretations and perceptions of his analysis of the data and subsequent theme development. My position is one who is interested in the research process and has no links to either the dissertation topic or participants.

Please feel free to contact me if you should have further questions.

Sincerely yours,



Sue Anne Lively, Ed.D.

## **Appendix M - Peer Debriefefer Audit Report**

March 27, 2008

To Whom It May Concern:

This letter serves as a report on the research audit that I completed on Mark Winslow's dissertation.

### **Audit Documents and Materials**

I received the following items from Mark Winslow in four large three-ring binders:

#### **Researcher Produced Documents**

- 1 copy of a November, 2006 research proposal entitled, *Evolution and Personal Religious Belief: Christian University Students' Search for Equilibration*
- 1 memo from Mr. Winslow to the dissertation committee dated Nov. 20, 2006, regarding methodology adjustments following the Nov. 13, 2006 proposal meeting
- 1 final draft of the dissertation entitled, *Evolution and Personal Religious Beliefs: Christian University Biology Students' Search for Reconciliation*

#### **Permissions**

- 15 signed Participant Informed Consent Forms from the main study participants
- 15 signed Member Check Forms from the main study participants
  - The researcher made the necessary adjustments in the final draft per the comments on the member check forms.
- 1 copy of the researcher letter to study site gatekeeper requesting permission to conduct research on campus
- 1 copy of the gatekeeper approval letter from the Dean of Arts and Science
- 1 copy of the study site IRB approval letter
- 1 copy of the researcher's Kansas State University IRB form
- 1 copy of the Origins course roster for Spring 2007 showing 12 in-class students enrolled
- 12 signed Course Observation Participants Informed Consent Form from students in the Origins course, Spring 2007
- 2 signed Participant Informed Consent Form for 2 pilot study participants

#### **Transcription**

- 1 copy of the Faith Development interview protocol
- 1 copy of the Creationism-Evolution interview protocol
- 3 signed Research Assistant/Transcriber Confidentiality Agreement Forms from the transcribers
- 1 copy of the transcription instructions for transcribers
- 1 copy of a transcriber/participant table containing information about which transcriber transcribed which participants' interview data

## **Main Study Data**

- 15 completed Evolution Attitudes Surveys from the main study participants
  - 1 spreadsheet of a survey analysis
- 15 completed Life Tapestry Exercise from the main study participants
- 1 set of field notes of Origins course observations from 20 class sessions (Spring 2007)
- 13 Origins course papers from the main study participants
- 2 jump drives with audio files of pilot study and main study interviews and member checks
- 15 Faith Development transcripts with researcher notes in the margins, one for each main study participant
- 15 Creationism-Evolution transcripts with researcher notes in the margins, one for each main study participant
- 15 post-interview reflections, one for each main study participant

## **Pilot Study Data**

- 2 completed Life Tapestry Exercise
- 2 completed Evolution Attitudes Survey
- 2 Faith Development scoring sheet (spreadsheet) analysis for 2 pilot participants
- 1 copy of research reflections and insights on interview process
- 2 Faith Development transcripts with researcher notes in the margins, one for each pilot study participant
- 2 Creationism-Evolution transcripts with researcher notes in the margins, one for each pilot study participant

## **Coding Procedures**

- 15 spreadsheets of code references for the main study participants
- 1 spreadsheet of all code references aggregated and counted
- 1 spreadsheet analysis of “Bible” code
- 1 set of an evolving code lists demonstrating how the codes changed with time, were consolidated, subsumed, etc. with accompanying research notes
- 1 copy of the aggregated codes alphabetized in a single document, 294 single spaced pages of codes (e.g., abiogenesis, Adam and Eve, Anger, etc.), including researcher notes in the margin
- 1 copy of researcher reflections including self-reflections and anticipated outcomes prior to research, ongoing contemplation during data gathering

### **Faith Stage Analysis**

- 1 copy of *Manual for Faith Development Research* (Fowler, Strieb, & Keller, 2004)
- 15 Fowler faith scoring sheets (spreadsheets) for the main study participants
- 1 aggregated spreadsheet of Fowler faith stages for all 15 participants
- 1 aggregated spreadsheet Parks' faith stage summary for all 15 participants together

### **Category and Theme Formation**

- Category 1- Influences: 5 spreadsheets including participant information about parents, professors and "other factors."
- Category 2 - Domain of Science and Religion: 6 spreadsheets including information about love of science, trust in science, trust in religion, change beliefs, Christian life, and domains.
- Category 3 - Evolution and creationism: 5 spreadsheets including information about abiogenesis, scientists, misgivings about evolution, and human evolution
- Category 4 - Reconciliation of Evolution and Personal Religious Belief: 3 spreadsheets including abiogenesis, 4 factors in process of reconciliation, and theological ramifications of evolution.

### **Personal Communication**

- Email communication between Mr. Winslow and K.R. Miller (10/31/2007) and W. Hanson (3/10/2008)

## **Audit Procedures**

### **Verification of Documents**

- Mr. Winslow supplied me with a checklist of all of the above.
- I went through the entire checklist, checking off the items found, and making comments/notes in the margins of the checklist concerning the quality of the process that would confirm the dependability and reliability of the study.

### **Transcriptions**

- I was provided flash drives with the audio recordings of the participants' interviews.
- Using the transcriptions provided in Binders 2 and 3, I read as I listened in part to five interviews (chosen randomly). Length of time listening and reading was approximately 20 – 25 minutes per interview.
- As I read and listened, I made notes concerning the accuracy of the transcriptions.
- Additionally, I read his reflexive notes concerning the interviews and the transcriptions.

## **Review of Code Lists, Research Reflections, Faith Development Analysis, and Category Analysis**

- In addition to checking to make sure that all these documents exist, I also reviewed them carefully in order to see whether or not I could follow the sequence and timeline of his research and to determine whether or not I could understand his process of theme development.
- I made comments/notes in the margins of the checklist concerning his data analysis.

### **Dissertation**

- I read the dissertation in its entirety.
- I made notes concerning links to the data in the findings and conclusions and the accuracy of the quotes.

## **Audit Findings**

### **Verification of Documents**

- All documents listed on the checklist were found, very well organized, and the sequencing/timeline of the project was easy to follow.

### **Transcriptions**

- The transcriptions of the interviews are well done with good attention to accuracy.
- There are some revisions to the participants' initial interviews that were made during the member checks. In addition to being recorded and transcribed, these are carefully noted, signed-off by the participants, and catalogued.
- The coding is well done and thorough for each transcription. His reflexive notes imbedded in the coded transcription provide a window into his analysis of the data.
- In Mr. Winslow's reflexive notes with his transcriptions and the reflexive notes in his code book, he writes about reviewing the transcripts with the tapes and correcting any errors found. This indicates to me his desire for accuracy and the high level of intimacy he has with the data.

## **Review of Code Lists, Research Reflections, Faith Development Analysis, and Category Analysis**

- I am particularly impressed with the coding and category analysis process. From the first listing in his code book (with 14 categories) to his last listing (with four categories), it is easy to follow his thoughts and analytical processes as he chunked codes and blended categories. His written comments in the margins are also insightful.
- Included in the code books are his reflexive comments. These comments concerning transcriptions, coding, chunking, and theme development provide a transparent view of his data analysis process and decisions.
- An important component of the data is the analysis of the documents that the participants produced (essays). As he read each essay, he made notations in the margins, and

underlined important words or phrases. Furthermore, this is an important part of the triangulation for the study.

- The use of spreadsheets, tables, and word processing applications appear to be very useful data displays as he gathered, organized, and analyzed the data.

#### Dissertation

- Mr. Winslow presents a very specific description of his background and interests in the research topic. This important self-profile is critical for clarification of bias.
- The description of the process of data analysis is accurately described.
- Throughout the findings and conclusions of the dissertation there are direct links to the data including accurate quotes from both the interviews and document analysis.

### AUDIT CONCLUSIONS

After a thorough review of Mr. Winslow's process of data collection, data analysis, and the product of the dissertation, it is my opinion that he established rigor and trustworthiness of his carefully designed and executed study. This has been accomplished by:

- An outstanding audit trail that is meticulously organized, thoroughly documented, well maintained, and easily followed.
- Data analysis that is thoughtful, analytical, specific, and thorough. Of particular note are the code books, extensive reflexive notes in the code books and embedded throughout the transcriptions, and theme development.
- Credibility of the study that is a result of the extreme care that was given to accuracy of the transcriptions and other data, including member checks, peer debriefing, triangulation, clarification of bias, and this external audit.
- Clear connections to the data throughout the study show that the findings are grounded in the data.

Respectfully submitted,

*Sue Anne Lively*

Sue Anne Lively, Ed.D.