SCIENCE EDUCATION
IN THE
BOY SCOUTS OF AMERICA

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Rachel Sterneman Hintz, M.A.

* * * * *

The Ohio State University
2009

Dissertation Committee:
Professor Barbara Thomson, Advisor
Professor John Harder
Professor David Haury
Professor Garry McKenzie

Approved by
Dr. Barbara S. Thomson
Advisor
College of Education and
Human Ecology
ABSTRACT

This study of science education in the Boy Scouts of America focused on males with Boy Scout experience. The mixed-methods study topics included: merit badge standards compared with National Science Education Standards, Scout responses to open-ended survey questions, the learning styles of Scouts, a quantitative assessment of science content knowledge acquisition using the Geology merit badge, and a qualitative analysis of interview responses of Scouts, Scout leaders, and scientists who were Scouts.

The merit badge requirements of the 121 current merit badges were mapped onto the National Science Education Standards: 103 badges (85.12%) had at least one requirement meeting the National Science Education Standards. In 2007, Scouts earned 1,628,500 merit badges with at least one science requirement, including 72,279 Environmental Science merit badges.

“Camping” was the “favorite thing about Scouts” for 54.4% of the boys who completed the survey. When combined with other outdoor activities, what 72.5% of the boys liked best about Boy Scouts involved outdoor activity.

The learning styles of Scouts tend to include tactile and/or visual elements. Scouts were more global and integrated than analytical in their thinking patterns; they also had a significant intake element in their learning style.
Earning a *Geology* merit badge at any location resulted in a significant gain of content knowledge; the combined treatment groups for all location types had a 9.13% gain in content knowledge. The amount of content knowledge acquired through the merit badge program varied with location; boys earning the *Geology* merit badge at summer camp or working as a troop with a merit badge counselor tended to acquire more geology content knowledge than boys earning the merit badge at a one-day event. Boys retained the content knowledge learned while earning the merit badge.

Scientists, Scout leaders, and Scouts felt that Scouts learned science through participation in the Boy Scout program, both in the merit badge program and also through activities, trips, outdoors, in meetings, and through rank advancement. On an open-ended questionnaire, 75.2% of Scouts reported that doing merit badges helped them do better in school. Scout leaders indicated that the overall Scouting environment introduced boys to science. Scout scientists credited Boy Scouts with providing experiences that interested and/or helped them in their scientific careers.
Dedicated to my Father

In grateful appreciation for his challenge, support, encouragement, and love.
ACKNOWLEDGEMENTS

I would like to thank my husband, Jim Hintz, for his unfailing love, support, prayers, and encouragement. I could not have done this without you.

I would like to thank my children, Eden and Paul, for their support and love, for taking on extra responsibilities to help me get through my graduate studies and dissertation, and for their understanding when I missed events or swim meets.

I would like to thank my Mom and Dad, Rev. Paul and Anne Sterneman, for their love, prayers, and encouragement. Here is the third installment of your trilogy.

I would like to thank my brother, Dr. Thomas B. Sterneman, and my sister, Dr. Ruth Sterneman Julian, for their support, insight, advice, editing, and encouragement.

Thank you to:
Dr. Barbara Thomson, my advisor. Thank you for always being positive and encouraging, as well as a friend just a phone call away.

Dr. Carol Landis. Thank you for encouraging me and challenging me to develop in all areas of education, technology, and presentations, and for your friendship.

My Committee Members:

Dr. Garry McKenzie, a King Scout from Canada, for his geology and Scouting expertise;

Dr. John Harder, for grounding me within challenging sciences; and
Dr. David Haury, for his inquiry expertise.

The Scout Councils that provided letters of support for the research.

The locations that allowed me to conduct research.

The Boy Scout Leaders and Scouts who participated and were committed to this research project.

The Scout scientists who participated in the research,

  Dr. Lonnie G. Thompson,
  Mr. Sherman Lundy,
  Dr. Jason Sonnenberg,
  Dr. Leo Porchia.

Ms. Jeni Squiric, my statistician. Thank you for all your statistical knowledge and help.

The OSU Graduate School – for providing the Alumni Grant for Graduate Research and Scholarship (AGGRS).

This work could not have been completed without the assistance and knowledge of all these people.
VITA

1976.................................................................B.S. Biology, Indiana University

1978 .............................................................M.M. Canadian Theological Seminary

1980...............................................................M.A. Wayne State University

1980-1982......................................................High School Science Teacher, Heritage Christian School, Indianapolis, IN

1989-1995......................................................High School Science Teacher, Taylor High School, Katy, TX

2006......................................................................Student Teacher Supervisor, The Ohio State University

2006-2009.........................................................Graduate Research Associate, The Ohio State University, Byrd Polar Research Center

PUBLICATIONS


FIELDS OF STUDY

Major Field: Education

Science Education

Minor Field: Research Methods in Human Resources Development
TABLE OF CONTENTS

ABSTRACT ...................................................................................................................... ii
DEDICATION.................................................................................................................... iv
ACKNOWLEDGEMENTS ................................................................................................... v
VITA .................................................................................................................................... vii
LIST OF TABLES ............................................................................................................. xvii
LIST OF FIGURES .......................................................................................................... xviii
CHAPTERS:

1. INTRODUCTION ........................................................................................................... 1
   Scout Oath ....................................................................................................................... 1
   Scout Law ....................................................................................................................... 1
   Outdoor Code ................................................................................................................ 1
   1.1 Background of the Problem ..................................................................................... 2
   1.2 Statement of the Problem ......................................................................................... 4
   1.3 Purpose of the Study ................................................................................................. 4
   1.4 Theoretical Framework ........................................................................................... 5
   1.5 Research Questions .................................................................................................. 8
   1.6 Importance of the Study .......................................................................................... 9
   1.7 Definition of Terms ................................................................................................. 11
   1.8 Limitations ............................................................................................................... 18
   1.9 Delimitations .......................................................................................................... 19
2. REVIEW OF THE LITERATURE ................................................................. 21

2.1 Boy Scouts ......................................................................................... 21

2.1.1 Boy Scout History ......................................................................... 21
  Origins .................................................................................................. 21
  Service ................................................................................................. 22

2.1.2 Boy Scout Organization ................................................................. 22

2.1.3 Boy Scouts and Science Education ................................................. 23
  Scouts in Science ................................................................................. 24
  Scout Science Activities ...................................................................... 25
  Participation ......................................................................................... 26

2.1.4 Boy Scout Leadership .................................................................... 27
  Scouts ................................................................................................. 27
  Scoutmasters and Adult Leaders ......................................................... 28
  Mentors or Counselors ....................................................................... 30

2.2 Educational Theory .......................................................................... 32

2.2.1 Scoutmaster Beliefs ...................................................................... 32
  Children learn through experiences - Experiential learning and Prior
  Knowledge .......................................................................................... 33

  Science participation will help in school .......................................... 36

  Children learn naturally when they are outdoors ............................. 42

  Children learn through hands on activities .................................... 49
Geology Merit Badge Participants .................................................. 109
Learning Styles Participants ....................................................... 109
3.5.2 Merit Badge Pamphlets ...................................................... 110
3.6 Data Collection ..................................................................... 110
   Locations ................................................................................. 112
   Interview and Written Methods ............................................... 136
3.7 Data Analysis and Verification .............................................. 136
   Qualitative .............................................................................. 136
   Quantitative ........................................................................... 137
3.8 Ethical Considerations ......................................................... 137
3.9 Assumptions and Limitations of the Study ......................... 138
3.10 Summary ............................................................................ 141
4. RESEARCH FINDINGS ............................................................ 142
   4.1 National Science Education Standards ............................... 142
   4.2 Open Ended Survey Questions ......................................... 149
      4.2.1 Self-reporting ............................................................... 149
      4.2.2 Survey Questions .......................................................... 149
         Merit Badges Survey Question ......................................... 150
         Favorite Thing in Scouting ............................................... 157
   4.3 Learning Style Research ................................................... 170
   4.4 Interview Data ................................................................. 174
   xii
4.4.1 Science ........................................................................................................... 174
  Definition of Science ......................................................................................... 174
  What Scientists Do ............................................................................................. 179
  Comparison of Merit Badge Work and Work of Scientists ......................... 182
  Science in the Boy Scouts ................................................................................ 186
  Merit Badges and Activity ................................................................................ 187
  Boy Scout Science May Be Taught Subtly ....................................................... 189
  Camping ............................................................................................................. 190
  Experiences ....................................................................................................... 194
  Merit Badge Work Different From Schoolwork ............................................ 197
  Merit Badges Help in School ........................................................................... 198
  Experiences Help in School ............................................................................. 202
  Boy Scout Participation Helps with Grades In School ................................ 203
  Career Information Provided .......................................................................... 204
  Importance of Merit Badge Experiences ..................................................... 205

4.4.2 Methods Used in Boy Scouts ................................................................. 210
  Scout leadership ............................................................................................... 210
  Single-sex Education ....................................................................................... 216
  Learning styles .................................................................................................. 219
  Self-Efficacy ..................................................................................................... 230
  Fun .................................................................................................................. 235
BIBLIOGRAPHY .................................................................................................................. 267

APPENDIX A ...................................................................................................................... 283

COMPARISON OF BOYS TO GIRLS ............................................................................. 283

APPENDIX B ...................................................................................................................... 286

NATIONAL SCIENCE TEACHERS POSITION STATEMENT ................................. 286

APPENDIX C ...................................................................................................................... 289

MERIT BADGE REQUIREMENTS .................................................................................. 289

Appendix C.1 Merit Badge & Rank Requirements Mapped Onto the 5-8 National Science Education Standards ................................................................. 297

Appendix C.2 Merit Badge & Rank Advancement Requirements Mapped Onto the 9-12 National Science Education Standards ........................................... 305

APPENDIX D ...................................................................................................................... 306

ENVIRONMENTAL SCIENCE MERIT BADGE REQUIREMENTS ....................... 306

APPENDIX E ...................................................................................................................... 310

QUOTES FROM OPEN ENDED SURVEY QUESTIONS ............................................. 310

APPENDIX F ...................................................................................................................... 321

LEARNING STYLE STATISTICS ................................................................................... 321

Appendix F.1: Learning Styles of Scouts ................................................................. 322

Appendix F.2: Cluster Analysis Results of the Learning Styles of Scouts .............. 323

Appendix F.3 Distances Between Final Cluster Centers ........................................... 324

Appendix F.4: Number of Scouts in each Learning Style Cluster ......................... 324

Appendix F.5: Cluster Analysis Statistics Learning Styles of Scouts .................. 325
Appendix F.6: Cluster Analysis for the Best Learning Modality for Scouts..... 326

APPENDIX G.................................................................................................................. 327

TESTING INSTRUMENT .................................................................................................. 327
LIST OF TABLES

Table 2.1: Comparisons between Scouting programs...........................................23
Table 2.2: Science in Scouting vs. Science in Traditional Schools.......................65
Table 3.1: Research Design...................................................................................111
Table 4.1: Answers to open-ended question, “Does it help you do better in school?”
   by Scout Rank.................................................................................................150
Table 4.2: Scout Types in Three Clusters...............................................................172
Table 4.3: Locations where Scouts Encounter Science.........................................243
Table 4.4: Longitudinal Score Differential by Age................................................247
Table 4.5: Between Age Group Effects Test Results.............................................248
Table 4.6: Longitudinal and Control Univariate Analysis of Variance....................248
Table 4.7: Longitudinal and Control Parameter Estimates.....................................248
Table 4.8: Program and Control Score Differentials..............................................249
Table 4.9: Score Differentials Between Treatment and Control Groups...............249
Table 4.10: Score Differentials and Location........................................................250
Table 4.11: Score Differential Significance by Location........................................251
LIST OF FIGURES

Figure 1.1: Learning Continuum.................................................................15

Figure 3.1 Interview Participants...............................................................96

Figure 3.2 Scout Participants.................................................................96

Figure 3.3 Geology Merit Badge Participants........................................109

Figure 3.4: Geology Diagram.................................................................127

Figure 4.1 Total Merit Badge Requirements mapped onto the National Science
  Education Standards, 5-8 and 9-12.......................................................144

Figure 4.2: Favorite Thing About Scouting............................................169

Figure 4.3: Scouts Science Locations....................................................244

Figure 4.4: Control Group Frequency by Age........................................245

Figure 4.5: Treatment Group Frequency by Age....................................245

Figure 5.1: Boy Scout Locations and Activities......................................264
1. INTRODUCTION

“The basic skills and values that are taught in Scouting are values and skills that I use every day.”

Dr. Lonnie G. Thompson, Ph.D.
Winner of the National Medal of Science
Time Hero of the Environment, 2008
National Academy of Science Member

Scout Oath

“On my honor I will do my best
To do my duty to God and my country
   And to obey the Scout Law;
To help other people at all times;
To keep myself physically strong,
   Mentally awake,
   and morally straight.

Scout Law

“A Scout is trustworthy, loyal, helpful, friendly, courteous,
kind, obedient, cheerful, thrifty, brave, clean, and reverent.”

Outdoor Code

“As an American, I will do my best to
Be clean in my outdoor manners,
   Be careful with fire,
Be considerate in the outdoors, and
   Be conservation minded.”
(The Boy Scouts of America, 1998)
1.1 Background of the Problem

Lord Baden-Powell started the Boy Scouts because he believed that the young men of Great Britain were in trouble morally, physically, and militarily (Rosenthal, 1986). Young males today are also in trouble - educational trouble and moral trouble. Statistics kept by the U.S. Department of Education since 1981, show that boys lag behind girls according to almost every educational measure (Cole, 1997; Gurian & Stevens, 2004; Mortenson, 2006) (Appendix A). In many nations, especially those with post-industrial economies, including the United States, there is an increasing gap in school performance, college attendance, and college completion between girls and boys (Judith Kleinfeld & Reyes, 2007). In the most recent survey of American youth, cheating is rampant in schools and is on the rise; 64% of students cheated on a test during the past year, up from 60% in 2006. Both boys, 35%, and girls, 26%, admitted to stealing from a store during the past year ("The ethics of American youth - 2008 summary", 2008). The enrollment of males in higher education has been on a “downward spiral” since their peak percentage enrollment in 1949, with 69.7% of college enrollees being male. By 2002 the percentage of males enrolled in higher education had fallen to 43.1% of the total enrollment in institutions of higher education, with no evidence of a trend reversal. This trend of males abandoning the college track begins in middle school and high school, where boys study less, take fewer college-prep classes, make lower grades, and participate less in extra-curricular activities (R. Jones, 2005).

The Public Policy Institute of California, in study of California public schools, has found a higher rate of enrollment by high school girls in most math and science courses.
Except for computer science courses, girls enroll at higher rates in all subject area courses that fulfill college entrance requirements. Researcher Ann Danenberg found girls enrolled in physical science classes at a 7% higher rate and in life science classes at a 16% higher rate (Public Policy Institute of California, 2001). Indicators for the 2003/2004 school year showed girls made up a higher percentage of students enrolled in chemistry classes, while boys made up a slightly higher percentage of students taking high school physics classes. The skew towards females is higher in chemistry classes with the gender proportions being more nearly equal in physics classes ("State-level data on state science-math indicators from the 2003-04 school year", 2008). At the college level, a study comparing the gender of science majors at Swarthmore College in 2001, showed the following distribution of males to females:

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>9</td>
<td>25</td>
</tr>
<tr>
<td>Chemistry</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Computer science</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Engineering</td>
<td>18</td>
<td>7</td>
</tr>
</tbody>
</table>
| Physics/Astronomy | 8  | 3       (Paul, 2002)

The test scores and number of science and math courses taken by girls in high school have increased much more rapidly than those of boys during the past thirty years, contributing significantly to the discrepancy of male/female college enrollment and graduation rates (Cho, 2007).

College enrollment statistics show a skew towards females:
- Undergraduate enrollment in four year colleges – female 56%, male 44%
- Graduate enrollment – female 60%, male 40%
- First-professional degree – female 50%, male 50%.
(L. G. Knapp, Kelly-Reid, & Whitmore, 2007).
1.2 Statement of the Problem

Scouts are exposed to and experience science at many levels; boys indicate that participation in Scouting helps increase their interest in science ("Values of Americans: A study of ethics and character", 2005), yet a search of the literature reveals limited research on Scout science. According to Pat Wellen, Director of Research for the Boy Scouts of America, there is no research on science education in the Boy Scouts, even though most of the merit badges have a science basis (Wellen, 2008). If boys are exposed to science as Scouts, how much exposure do they receive? Where? How do boys learn science in Scouts? Are boys held accountable for the science they learn in Scouts? Is the Boy Scout experience effective in teaching boys science? Do the science experiences boys have as Scouts excite them about science and enable them to do better in school? Do Scouts believe that their Boy Scout experiences help them do better in school?

1.3 Purpose of the Study

The purposes of this study are: to determine the impacts of participation in the Boys Scouts of America (BSA); to determine what aspects of participation in the BSA influence science learning and interest; to determine if participation in the BSA merit badge program (specifically in the Geology merit badge) engenders science content in Boy Scouts; to identify the National Science Education Standards met by each merit badge; and to determine the learning styles preferences of Scouts.
1.4 Theoretical Framework

Boy Scouts have, underlying their educational material, a hands-on, activity based, free-choice philosophy. In 1907, when Lord Baden-Powell founded the Boy Scouts, educational theory was being influenced by John Dewey and Maria Montessori (Block, 2007) as well as Charlotte Mason (Smith, 2000). Pragmatism and free-choice learning, underpinned by Dewey’s, Montessori’s and Mason’s educational theories, permeate Boy Scout educational practices and materials even today.

Knowledge, according to the conventional philosophical definition, is a special type of belief, a true, justified belief (Meyers, 2005). Dewey’s theories suggest that the foundation of knowledge, mediated by language and tools, is constituted by the interaction between man and his environment (Miettinen, 2006). Dewey, a pragmatist and post-positivist, rejected the absolutist idea that knowledge existed independently of the mind, even while he observed the usefulness of having a concept called knowledge.

The pragmatist view of knowledge has consequences for society. The pragmatist view, because decisions must be made, acknowledges recognizing beliefs that are a reasonable justification for decision making rather than recognizing unjustified beliefs (Meyers, 2005). Pragmatism, by Dewey’s definition, was the philosophy that reality had a practical nature or character. When things of reality enter the sphere of the human by human-environment activity, they become known (Miettinen, 2006).

Activity Theory, an integrated conceptual system rather than a predictive theory, has, as its unit of analysis, an activity directed at an object that motivates the activity. Activities consist of conscious, goal-directed actions undertaken to fulfill an object.
While there are both internal and external activities, internal activities cannot be understood if analyzed separately from external activities as internal and external activities transform into one another. Because tool use influences external activities and behavior of individuals, it also influences their internal activities, their mental functioning (Kaptelinin, 1997). Dewey’s activity theory suggests that the foundation of knowledge is the interaction between man and his environment, mediated by tools and language (Miettinen, 2006). The categories of empiricism, naturalism, instrumentalism, and functionalism categorize the theory of activity proposed by Dewey. There is, according to Dewey, no distinction between self and the world of reality, as humans are practical beings engaged in exercise. Self and consciousness, special forms of action, are functions of life activity (Miettinen, 2006).

The environment is educative when an individual does his share in an activity, thus appropriating the “methods and subject matters,” of the activity and acquiring needed skills. As the young partake of the activities of the groups to which they belong, the group educates them, without conscious intent. In order for an environment to develop specific factors, which the young will absorb deeply but without intent, the environment must be manipulated in order to develop the desired factors in the young. Guidance, not control, is how the group should direct the activities of the young; the direction should be both simultaneous and successive. Education by guidance works because young are interested in taking part in cooperative activities; effort must be made to make the conditions as educative as possible (Dewey, 1916).
Free-choice learning, underpinned by Dewey’s educational theories, is also evident in the Boy Scout educational programs and practices; the experts, or merit badge counselors, as they are called in the Boy Scouts, are people who help the learner discover the things that are important to the learner. Dewey recognized informal learning as the “dominant influence in learners’ lives” (Meyers, 2005). Formal education, “deliberate educating of the young”, differs from informal education, the education one obtains through life and social interactions; in informal education, education is “incidental ... natural, and important” (Dewey, 1916).

Learning styles theory, the theory that each individual has a preferred style in which to learn, has documented that “gender is one of six characteristics that tends to differentiate among individuals’ learning styles” (Honigsfeld & Dunn, 2003).

“Post-structural feminism breaks with the theoretical frameworks in which gender and sexuality are understood as inevitable...”(Davies & Gannon, 2005). Through post-structural feminism, one can move beyond what is known, the accepted reality. Feminist discourse “rose to counteract the negative constructions of women and girls in masculinist discourse” (Davies & Gannon, 2005). The rise of feminism empowered women and led to better education for girls and women in and following a time when boys excelling over girls in school was taken to be “a stable/unquestionable truth.”

However, statistics kept by the U.S. Department of Education show that boys currently lag behind girls according to almost every educational measure. In the 2004-05 school year, females earned a majority of associate’s, bachelor’s and master’s degrees (Snyder, 2007). Feminist post-structural theory can help explain these new realities; realities in
which the “unquestionable” superiority of boys in school has been disrupted (Davies & Gannon, 2005).

Deconstruction, while it may not be a method of research as it is inextricably tangled with the object, is a means to look at the texts of both the merit badge pamphlets and the interview transcripts. Deconstruction reveals what may be hidden, can challenge what is taken for granted, and reveal blind spots (Burman & MacLure, 2005). Some of the binaries that may be investigated during the research study include the presence/absence of science or science terms, boys’ views of science in the Boy Scouts/adults’ views of science in the Boy Scouts, and the binary of written vs. experienced science in the Boy Scouts.

1.5 Research Questions

1. What impact(s) do(es) participation in the Boy Scouts of America (BSA) have on the learning of and interest in science?

2. What aspects of participation in the BSA influence science learning and interest?

3. Do the merit badge requirements align with the National Science Education Standards?

4. Does participation in the BSA merit badge program (specifically the Geology merit badge) engender science content knowledge as identified by National Science Education Standards?

5. What are the learning styles preferences of Scouts?
Science learning does not occur in a vacuum, from a single experience; science learning does not always occur in a school setting. Science educational experiences occur wherever people live, work, study, play, or visit. Science learning is cumulative, an amalgamation of the science experiences from zoos, museums, school classes, television shows, books, newspapers, Internet sites, out-of-school activities, community based organizations including Boy Scouts, Girl Scouts, 4H, and similar youth organizations (John H. Falk, 2001). “Museum-like settings,” including zoos, aquariums, museums, and nature centers, have been the sites of most of the research on science education outside of schools. This research has provided a baseline of understanding the educational potential of free-choice learning situations for science education. “Clearly lacking, though, are comparable studies of learning from film, radio, community-based organizations such as scouts, summer camps, home, friends, the workplace, the Internet, and a whole range of other real-world situations,” (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003).

This study may be significant in determining how informal science education programs expose boys to science, what informal science experiences are valued by Scouts, Scout leaders, and scientists who were Scouts. Boy Scouts may be one of the largest providers of long-term informal science education for American youth, as Scouts make up 14% of the population of boys between the ages of 11 and 18. Boy Scout programs, including Cub Scouts, Boy Scouts, and Venture Crew, involve 9.5% of the
available population between the ages of 7 and 18 (The Boy Scouts of America, 2008d; Wellen, 2008).

The Boy Scouts of America has limited research on how their programs meet the educational needs of boys. Research exists on how Scouts develop values and how the Boy Scouts promotes good character, but research for science education as addressed by the Boy Scouts is limited. More research is needed in this area to document that the Boy Scout Program fills a needed role in introducing boys to science and providing them with experiences with which to construct knowledge.

America’s educational infrastructure benefits from both the formal and informal educational providers (John H. Falk, 2001) as important educational roles are filled by each (Schugurensky, 2006). As the nation depends - for scientific and educational literacy - on its educational infrastructure, the infrastructure is vital to the well-being of the nation. Boy Scouts, as a free-choice/informal educational provider, is a part of the nation’s educational infrastructure. The educational role performed by the Boy Scouts, as part of the free-choice/informal portion of the educational infrastructure, is greatly underestimated, not well understood, and greatly underappreciated (John H. Falk, 2001).

This study, the first comprehensive study of science education in the Boy Scouts of America organization, is an attempt to fill a hole in the research on science education external to a school setting, and is designed to document the role of the Boy Scouts as an effective informal/free-choice science education provider.
1.7 Definition of Terms

(Terms of importance defined for utilization in this study are underlined). In order to avoid confusion, the terms Boy Scout and Boy Scouts will be reserved, except in direct quotations, for the Boy Scouts of America organization (BSA). The Boy Scouts of America is a national educational organization:

“The purpose of the Boy Scouts of America, incorporated on February 8, 1910, and chartered by Congress in 1916, is to provide an educational program for boys and young adults to build character, to train in the responsibilities of participating citizenship, and to develop personal fitness,” (The Boy Scouts of America, 2008d).

The basic organizational unit of the Boy Scouts is the local Boy Scout troop; troops are organized into districts and districts into councils. The National Boy Scout Headquarters is the overarching governing body of the Boy Scout organization.

Boys, between the ages of 11 and 18 (possibly age 10 if they have earned their Arrow of Light Award and “crossed over” from Cub Scouts to Boy Scouts) who are members of the Boy Scouts of America, are identified as Scouts. Younger members of the Boy Scouts are Cub Scouts; the youngest Cub Scouts are Tigers, age seven; the oldest Cub Scouts are Webelos. The coed branch of the Boy Scouts is the Venture program. A Scoutmaster is the designated adult leader of Boy Scout troop. A Scout leader or Scouter, as defined for this paper, is an adult volunteer registered to work with a Boy Scout troop who has passed a criminal background check (The Boy Scouts of America, 2008d). Scout leaders include Scoutmasters and merit badge counselors.

The Order of the Arrow, OA, is the Boy Scouts’ National Honor Society. Scouts who, “best exemplify the Scout Oath and Law in their daily lives,” are inducted into the society when the other members of their troop vote them in. Membership in the OA can
be for life; membership does not end when a boy turns 18. The OA provides leadership training and opportunities for its members to participate in service and activities (The Boy Scouts of America, 2008d).

A merit badge is a round patch embroidered with a symbol representative of the subject of the merit badge topic, given to a Scout upon completion of a series of requirements. Merit badges are sewn on a sash worn across the right shoulder and chest at formal functions. (If a Scout is a member of the OA, he wears his OA sash instead; the merit badge sash is then folded and worn suspended from the belt in order to display the Scout’s merit badge accomplishments.) The merit badge pamphlet contains the requirements and information that a Scout needs to know in order to pass the merit badge requirements; there is a merit badge pamphlet for each of the 121 different merit badges. To complete the requirements of a merit badge Scouts may work together or on their own; Scouts may work on merit badges individually, as a troop activity, at summer camp, or at a special event. To pass the requirements and earn the merit badge a Scout must work with a merit badge counselor.

A merit badge counselor in the Boy Scouts of America is the term used in this paper for a mentor or counselor, which, for this paper, are assumed synonymous. A mentor or counselor is a person, usually older and more experienced, who guides, fosters, advises, and supports the progress of another person, often advising on a special subject (Microsoft, 2006). In the Boy Scouts, merit badge counselors are people who are sincerely interested in boys, work with them, encourage them, listen to them, make a difference in their lives (The Boy Scouts of America, 2008g, 2008h). Merit badge
counselors may or may not be licensed/certified teachers, but they are involved with guiding Scouts in a non-formal out-of-school learning situations. Merit badge counselors are:

People who are knowledgeable about the various merit badge subjects are selected, approved, and trained by council and district advancement committees to serve as merit badge counselors. ... A counselor must not only possess the necessary technical knowledge but also have a solid understanding of the needs, interests, and abilities of Scouts. A counselor must also be a registered adult with the BSA (The Boy Scouts of America, 2008h).

There are six ranks in the Boy Scouts: Scout, Tenderfoot, Second Class, First Class, Star, Life, and Eagle. To progress through the lower ranks, a Scout must complete rank advancement requirements. To progress through the upper ranks, a Scout must earn merit badges, do community service, and hold leadership positions. Eagle Scout is the highest rank a Boy Scout can earn. A Scout must earn his Eagle before his 18th birthday. Requirements to become an Eagle Scout include earning 21 merit badges, including the 12 Eagle required merit badges, doing service hours, holding leadership positions, and designing and completing a special community service project. To finalize the rank advancement to Eagle Scout, the Scout, in addition to completing all the required paperwork, must go through an Eagle Board of Review in which he gives an oral defense of his project and his accomplishments during his time in the Boy Scouts. Usually three or four adults, often adult Eagle Scouts, and an advancement representative from the local district or council serve on the Scout’s Eagle Board. When a boy earns his Eagle, an Eagle Court of Honor is called to honor the Scout, during which the Scout will be presented with his Eagle, a silver eagle suspended on a red, white, and blue ribbon. An Eagle Scout can earn Eagle Palms before his 18th birthday. Each Palm, bronze, gold, and
silver, represents five additional merit badges and at least three months of additional Boy Scout membership (The Boy Scouts of America, 1998, 2008d).

A **Triple Crown** is earned by a Scout who attends all three of the Boy Scout **High Adventure programs**:

- Philmont, in New Mexico, where Scouts backpack in the wilderness;
- Boundary Waters, on the border of the United States and Canada, where Scouts canoe in the wilderness; and
- Sea Base, located in the Florida Keys, where Scouts can sail, scuba, snorkel, and explore an uninhabited island.

**Play** is participating in enjoyable activities for the sake of amusement, or fun; participation in an activity with no other goal than to have fun or pleasure by participating ("Microsoft Dictionary").

**Fun** is feeling enjoyment ("Microsoft Dictionary"). Fun may be included as a subset of play, but not all fun can be considered as play; fun does not necessarily mean play, but can be enjoyment at a task, associating with friends, engaging in an activity, participating in a sport, or learning (Jarrett & Burnley, 2007).

**Knowledge** is defined as a special type of belief, a true, justified belief (Meyers, 2005), constituted by the interaction between man and his environment (Miettinen, 2006). **Learning**, in this paper, will be defined as the acquisition of knowledge ("Microsoft Dictionary"). Learning may occur in a variety of settings, with or without instruction or instructors. **Formal learning, formal education, or school**, will refer, in this paper, to compulsory education occurring in a school setting with licensed/certified instructors.
The learning referred to by these terms will be considered to be classroom based, teacher led, planned, structured, and sequenced (Wellington, 1990).

There are many terms in the literature that may be used for learning that does not occur in a school setting, including, but not limited to, informal learning, non-formal learning, free-choice learning, self-directed learning, incidental learning, and outdoor education. There are ongoing debates about which is the best term to use (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003). The educational infrastructure of the United States can be seen as a continuum from formal education at one end to very informal and unstructured education at the other end. Free-choice learning providers and settings will occupy different places on this educational continuum, with some, as Scouts, tending to the more formal end and others, such as some activity-oriented museums, tending to the more unstructured end (Jarman, 2005). In this document, formal and unstructured learning/education will be defined to be on opposite ends of the learning spectrum, where informal/non-formal, and free-choice learning overlap on the continuum outside of the extreme formal end of school (Figure 1.1).

![Learning Continuum Diagram]

Figure 1.1: Learning Continuum
Learning experiences occurring towards the unstructured end of the continuum will be considered to be voluntary, un-sequenced, unstructured, open-ended, non-assessed, and unplanned (Wellington, 1990); most incidental learning will be considered to occur at the unstructured end of the continuum. **Incidental learning**, as used in this review, is unintentional, taking place even though the learner did not intend to learn. The learner is conscious of the unintended incidental learning, which happens while the learner is engaged in other pursuits, growing out of spontaneous situations (Jarman, 2005; Randler, Höllwarth, & Schaal, 2007; Schugurensky, 2006).

**Non-formal learning** is voluntary learning that occurs out of the school setting and characterized by task orientated group work. In non-formal learning, individuals are transformed into participants and community members. A leader organizes short activities in which members talk or play as they focus on practical experiences. Learning is shaped by the activity, rather than by the leader (Silberman-Keller, 2003). **Free-choice learning**, not usually found at the formal end of the learning continuum, takes into account the motivation and social context of the learner. **Free-choice learning** is self-paced, non-sequential learning voluntarily chosen by the learner, where the learner perceives himself or herself to have control and freedom of choice. Most free-choice learning is facilitated, even though the teacher and traditional notions of teaching appear to be excluded (John H. Falk, 2001).

Non-formal learning and free-choice learning may overlap in many or most aspects. For this paper, the term informal learning/education will include both free-choice learning/education and non-formal learning/education. The terms informal
learning, non-formal learning, and free-choice learning may be, at times and for this dissertation, used interchangeably when referring to informal learning, generally defined as learning which occurs in relaxed, casual, everyday situations outside of a school setting (Crockett, 1997; Microsoft, 2006; NSTA position statement: Informal science education, 1999).

Scouts often engage in self-directed learning. Self-directed learning, a type of informal/free-choice learning, refers to learning through doing projects, with or without the help of a mentor. Self-directed learning is self-regulated, a personal response to the situation and the demands of the environment, and is both conscious and intentional (Niemivirta, 1997; Schugurensky, 2006).

Outdoor education uses activities occurring in an outdoor, not manmade, environment to help students develop socially, personally, and educationally (Gair, 1997); it is learning in and for the outdoors. Outdoor education does not include field trips to museums, science centers, or other buildings, and it does not include sports or athletic activities. Outdoor education can be formal, that is, related to school, and directed by a teacher, or informal, away from a school setting and control. Outdoor education may be included in environmental education; environmental education is defined as all educational programs focusing on the environment and the interactions of humans with and on the environment (Passmore, 1972).

Single-sex education is education provided to only one of the two sexes, as it can be tailored to a) the learning styles, b) prior experiences, c) current interests, concerns, and needs of the gender being taught (Parker & Rennie, 2002).
Experience can refer to the knowledge or skill gained by participating in an activity or to the active participation in an activity or event which leads to an increase in skill or knowledge level ("Microsoft Dictionary").

Self-efficacy is a person’s judgment about how well he or she is able to reach a goal, or accomplish specific tasks. It is a person’s perception of and belief in his or her own abilities (Bandura, 1986).

Goals are defined “as internal representations of desired states, where states are broadly construed as outcomes, events, or processes” (Austin & Vancouver, 1996).

This paper will use the definition of learning style developed by Dr. Rita and Dr. Kenneth Dunn, “the way in which each person begins to concentrate on, process, internalize, and remember new and difficult academic content.” The Dun and Dunn learning style model targets 21 different elements that influence the way people learn. Most people are affected by between 6 and 14 of the elements, which, “are classified into environmental, emotional, sociological, physiological and psychological variables,” (Rita Dunn, Denig, & Lovelace, 2001).

1.8 Limitations

This study is limited to science education in the Boy Scouts. The findings of this study are limited to boys in the Midwest who are members of the Boy Scouts of America, and are statistically not generalizable to other populations; however, the findings may have implications for Scouts in other areas of the country and for boys who are not Scouts.
Limitations to the Geology merit badge portion of this study include the possibility that the participants may have been sensitized to the information as a reactive effect of testing, an unavoidable consequence of the pre-test posttest method of collecting data. External validity also may have been threatened because the participants knew they were participating in a study (Campbell & Stanley, 1963). Internal validity may be limited by the participation of several merit badge counselors and the disparity of locations in which the merit badges were earned as well as limitations due to the research design, including a pretest/posttest, practice effect. Internal validity may be limited due to selection-maturation interaction, as boys of several different ages, Scout ranks, and school grades were involved in the study (Campbell & Stanley, 1963).

1.9 Delimitations

This study is limited to boys between the ages of 11 and 18 that are members of the Boy Scouts of America, and does not include studies of Cub Scouts, Varsity Scouts, or Venture Crews (including Sea Scouts). This study does not focus on comparisons of boys of different Boy Scout ranks, boys that are Eagle Scouts, or boys who are not Scouts; it does not include a study of leadership training or character development, even though these are very important parts of the Boy Scout curriculum. Girls, the learning styles of adolescent girls, science education of girls, and science education in youth organizations other than the Boys Scouts of America, while important topics for science education research, are not included in this study. The study of knowledge acquisition using merit badge pamphlets is limited to geology content knowledge acquired using the
Geology merit badge pamphlet. The Geology merit badge study focused on content knowledge acquisition; it did not endeavor to measure the excitement for geology engendered in the Scouts who participated in the research.
2. REVIEW OF THE LITERATURE

Educational researchers agree that boys and girls have different educational needs and learning styles (Fennema, 2000; Gurian, Henley, & Trueman, 2001). This literature review explores how the Boy Scouts of America provides science education opportunities for boys that meet their needs and learning styles. The history and organization of Scouting, how the Boy Scouts integrates science, and the literature relating to leadership, mentoring, and peer tutoring as it relates to Boy Scouts are explored first, followed by literature relating to education, brain research, learning styles, gender studies, self-efficacy, and how these relate to Boy Scouts.

2.1 Boy Scouts

2.1.1 Boy Scout History

Origins

Lord Robert Baden-Powell started the Boy Scout movement in Great Britain in 1907. In 1910, an American businessman named William D. Boyce, because of an unknown Scout’s kindness, brought the Scouting movement to the United States (The Boy Scouts of America, 1998). The year 1911 saw the establishment of the National Council Office, the adoption of the Scout Oath and Law, the printing of 300,000 copies of the first edition of The Boy Scout Handbook, and the presentation of the first Heroism awards. Boy Scouts spread quickly, boys from every state in America were enrolled as Scouts by 1912. On June 15, 1916, Congress granted a federal charter to the Boy Scouts
of America, limiting membership to American citizens and giving protection to the Boy Scout name and insignia. By 1924, the Boy Scouts included physically disabled boys. Younger boys, too, wanted to be involved in Scouting; Cub Scouts was started in 1930 (The Boy Scouts of America, 2008d). Professor John Dewey, educator, Dr. L. M. Terman, author of graduated psychology tests for children, and Dr. E. L. Thorndike, the author of the army psychology tests, were members of the committee that worked on the activities and organizational details of the Cub Scout program. The Cub Scout program was designed to supplement rather than duplicate the Boy Scout program ("Plan to organize Boy Scout juniors", 1930).

Service

Boy Scouts have a long history of service to the country, starting with their efforts in World War I and the influenza epidemic, during which they planted gardens, sold bonds, and watched the coasts for enemy ships. The United States government, during World War II, called upon Scouts to complete 69 service projects. Scouts continue their tradition of service with the Good Turn for America, launched in 2004, fighting poor health, homelessness, and hunger (The Boy Scouts of America, 2008d).

2.1.2 Boy Scout Organization

There are four categories of Scouting: Cub Scouts, Boy Scouts, Varsity Scouts and Venture Crews, which includes Sea Scouts (Table 2.1).
Table 2.1: Comparisons between Scouting programs

<table>
<thead>
<tr>
<th></th>
<th>Cub Scouts</th>
<th>Boy Scouts</th>
<th>Varsity Scouts</th>
<th>Venture Crew</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Male</td>
<td>Male</td>
<td>Male &amp; Female</td>
</tr>
<tr>
<td>Age</td>
<td>7-10</td>
<td>11* to 18</td>
<td>14 to 18</td>
<td>14 to 21</td>
</tr>
<tr>
<td>Large group</td>
<td>Pack</td>
<td>Troop</td>
<td>Team</td>
<td></td>
</tr>
<tr>
<td>Small group</td>
<td>Den</td>
<td>Patrol</td>
<td>Squad</td>
<td>Crew</td>
</tr>
<tr>
<td>Rank</td>
<td>Tiger Cub</td>
<td>Scout</td>
<td>Scout</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wolf</td>
<td>Tenderfoot</td>
<td>Tenderfoot</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bear</td>
<td>Second Class</td>
<td>Second Class</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Webelos</td>
<td>First Class</td>
<td>First Class</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Star</td>
<td>Star</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Life</td>
<td>Life</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eagle</td>
<td>Eagle</td>
<td></td>
</tr>
<tr>
<td>Highest Award</td>
<td>Arrow of Light</td>
<td>Eagle</td>
<td>Eagle</td>
<td>Silver award</td>
</tr>
<tr>
<td>Membership**</td>
<td>1,687,986</td>
<td>913,588</td>
<td>254,259</td>
<td></td>
</tr>
</tbody>
</table>

*A boy may become a Boy Scout when he is 11, enters 6th grade, or earns his Arrow of Light Award.

**As of December 31, 2007 (The Boy Scouts of America, 1998, 2008d, 2008i)

2.1.3 Boy Scouts and Science Education

The Boy Scouts have always emphasized education, especially the natural sciences. The educational agenda has an active, outdoor nature emphasizing outdoor learning through camping, hiking, and outdoor activities (Nicholson, 1940; The Boy Scouts of America, 1998). Baden-Powell associated the study of nature – animate, inanimate, biology, plants, and animals with the pursuit of happiness. Baden-Powell’s list of things to study included: woodcraft, camping, observation – which included
tracking, mapping, and sign-reading – games, sanitation, first-aid, and the prevention of disease (R. S. S. Baden-Powell, 1920). As a boy moves up the ranks in Boy Scouts, certain scientific facts are required knowledge. Achieving Tenderfoot rank in the Boy Scouts requires knowledge of local poisonous plants and treatment for exposure to them. Advancement to Second Class rank includes being able to identify “at least ten kinds of wild animals” found in the local community. First Class rank cannot be obtained without the knowledge of ten or more local plants; Baden-Powell did not consider anyone to be a real Scout until they were a First Class Scout (The Boy Scouts of America, 1998). Rank advancement after First Class involves earning merit badges by studying and working with a merit badge counselor. Boy Scouts can earn several merit badges in various scientific fields, including an *Environmental Science* merit badge (which is required for Eagle Scout Rank) (The Boy Scouts of America, 1998).

**Scouts in Science**

Many scientists can credit their science experiences in Scouting as playing a role in their life experiences. Adm. Richard Byrd’s expedition to Antarctica in 1928, when he became the first man to fly over the South Pole, included Boy Scout Paul Siple, first Antarctic Scout. Paul Siple became an Antarctic researcher; the Siple Mountain range is one of the places that bears his name (Birley, 1969). There have been 12 Antarctic Scouts since Siple, the latest being Ben Pope in 2005-2006 (The Boy Scouts of America, 2008d). Scouts have gone into other fields; Eagle Scout William C. Devries, M.D. transplanted the first artificial heart (Worcester, 2006). Naturalist and conservationist E. O. Wilson credits the Boys Scouts with influencing his love of science (Wilson, 1994). Boy Scouts have had a strong influence in America’s space program:
The Boy Scouts of America teaches young people to be good citizens and trains them to become leaders. These qualities are also found in the U.S. astronaut program. Of the 312 pilots and scientists selected as astronauts since 1959, 179 were Scouts or have been active in Scouting: 39 Eagle Scouts, 25 Life Scouts, 14 Star Scouts, 26 First Class Scouts, 17 Second Class Scouts, 13 Tenderfoot Scouts, three Explorers, 27 Cub Scouts, 10 Webelos Scouts, and five with unknown ranks.

Of the 12 men to physically walk on the moon's surface, 11 were involved in Scouting.

The Boy Scouts of America is proud of America's astronauts.

(The Boy Scouts of America, 2008a).

Scout Science Activities

According to Nicholson, who analyzed the Boy Scout's educational system, Boy Scout educational material emphasizes things to do and skills to be acquired rather than merely on information to be learned, chosen from the perspective of what interests boys and the nature of boys. The educational techniques of game-playing, observing, experimenting, watching demonstrations, studying books, dramatization, talks, lectures, and examinations are all included in Boy Scout education (Nicholson, 1940), but boys are encouraged to learn by doing. The ideal science activities for scouts:

- involve active participation, particularly in making things;
- create expectation and excite wonder;
- are different from school science, with a minimum of reading and writing
- are short, to allow for variety, and self-contained;
- are easily resourced;
- are, above all, ‘fun’ (Jarman, 2005).

According to a survey done with 24 boys and 23 girls attending the sixth grade in a rural Midwestern US location, the activities that helped most in school were, ranked by order of helpfulness: doing an experiment, working with friends, building models, and going different places. According to the students the activities that were least helpful, in order from most to least helpful: playing an organized game, snacking while learning,
watching movies, and drawing (Freeman, 2002). The activities that ranked high for helping the sixth graders learn are also common activities in Scouting. Boy Scouts tries to provide activities that are meaningful to Scouts and to their personal lives. Boy Scout troops are to be boy run and boy led (The Boy Scouts of America, 2008d). When students see their work as meaningful and when they have greater participation in conducting a class or activity, students sustain more interest in the class or activity (Freeman, 2002).

Participation

If boys do not attend Boy Scout programs, they will not experience the positive benefits that are provided by the Boy Scouts; in youth programs, participation is a key issue. Long-term participation is required to obtain the desired outcomes of the program, but if the program is not meeting the perceived needs of the participants, they will cease to attend the program (Anderson-Butcher, Newsome, & Ferrari, 2003; Quinn, 1999). If boys are not attending Boy Scout meetings and programs, they cannot learn Boy Scout values (Harvey, 2008); youth club participation is linked with lower incidences of academic failure, delinquency, substance abuse, and other problem behaviors (Anderson-Butcher, 2000; Anderson-Butcher, Newsome, & Ferrari, 2003; Holland & Andre, 1987; Larson, 1994; Mahoney & Cairns, 1997; Posner & Vandell, 1994; Riley, Steinberg, Todd, Junge, & McClain, 1994; Schinke, Orlandi, & Cole, 1992).

Youth club participation, including Boy Scout participation, is typically voluntary, as these are free-choice venues. If young people are dissatisfied with the programming, they will cease to attend; attendance also decreases with the age of the participants (Anderson-Butcher, Newsome, & Ferrari, 2003; Gould, 1987; Harvey, 2008;
Quinn, 1999). Structured activities, in order to retain participants, must be linked to “play” (Anderson, Lucas, & Ginns, 2003); hooks such as recreation and sports initially attract youth to developmental programs (Lawson, Anderson-Butcher, Barkdull, & Byrnes, 2001). In order to keep boys involved, Boy Scout programs, including science, must be fun. “You’re talking about an age group that ... if it feels like work they’re going to put up a fight. So, you have to make it fun. You have to give them a hands-on. I mean, fun is hands-on” (Porchia, 2008).

There are many demands on youth’s time (Lundy, 2008a), boys are being pulled in many directions by many competing programs (Harvey, 2008), but what young people want from extracurricular programs are:

“constructive activities to engage their bodies, hearts, and minds...They want very much to prepare for their futures. They want safe places to go, grow, learn, work, and ‘just hang out.’ They want structure balanced with choice. They want a voice in determining programs, services, and opportunities. They want to learn and practice new skills. They want to spend more quality time with caring adults and with other young people. They want to contribute to the work of the larger society. And – yes – they want to have fun” (Quinn, 1999).

Based on Quinn’s findings, it appears that young people want what the Boy Scouts provides.

2.1.4 Boy Scout Leadership

Boy Scouts

Boy Scouts is boy-led, boy-driven, and boy-run (The Boy Scouts of America, 2008d). When young people are empowered to take responsibility for their own experiences, doing the planning and carrying out the related tasks, the “adventure” belongs to them (Gair, 1997). In the Boy Scouts, boys lead the meetings and teach their peers (Jarman, 2005; The Boy Scouts of America, 2006) which fits well with the peer-
orientated learning style of boys (Honigsfeld & Dunn, 2003). A patrol elects their own Patrol Leader, who is responsible for conducting patrol meetings, organizing the patrol for the monthly campout or activity, and preparing the patrol to lead troop meetings on a rotating basis with other patrols. The Senior Patrol Leader is in charge of supervising troop meetings and activities. Boys in leadership positions meet monthly with the Scoutmaster and other adult leaders to plan and schedule upcoming activities. Scoutmasters hold leadership-training sessions to help boy leaders develop their leadership skills. All boy leadership is under the control and supervision of the Scoutmaster (The Boy Scouts of America, 2008d).

Leadership by peers helps students support each other and diminishes educational stresses (Gurian, Henley, & Trueman, 2001). Boy Scouts, as an out-of-school program, is a good place for boys to assume a variety of roles and positions, older boys guiding younger boys, or boys with expertise in a given area serving as a mentor or guide for others, older or younger (Hull & Greeno, 2006).

Scoutmasters and Adult Leaders

Role

In Scouts, as it is boy-led and boy-driven, the upfront leaders are the boys, but the underpinning authority and overall leader is the Scoutmaster; the troop is characterized by his leadership (Shinkwin & Kleinfeld, 1983). Scoutmasters and the other adult leaders are one of the most important factors in the education of the boys under their guidance. According to Silberman-Keller, the direct and dominant educational figure in a group of learners is the leader. Because of the spontaneity and openness of the group, these leaders are not thought of as educators who direct and teach the group, even though this
is what they are doing, in all actuality (Silberman-Keller, 2003). Leaders must prepare the educational content in advance and fit it to their group. They use group discussions and activities, work with the group, organize the tasks, and prepare the agenda. In the Boy Scouts this agenda is put into place by the boy leaders (Silberman-Keller, 2003; The Boy Scouts of America, 2006).

Influence

Leaders who make their followers see their tasks as important, significant, and rewarding, inspire their followers to perform beyond all expectations. They have both a direct and an indirect influence on the attitudes, behaviors, and perceptions of their followers (Purvanova, 2006).

The use of positive role models is strongly encouraged for increasing boy learning (Gurian, Henley, & Trueman, 2001). As leaders and role models, Scoutmasters have a tremendous responsibility; Scoutmasters make a difference in the lives of the boys in the troop:

Boys learn a great deal by watching how adults conduct themselves. Scout leaders can be positive role models for the members of the troop. In many cases a Scoutmaster who is willing to listen to boys, encourage them, and take a sincere interest in them can make a profound difference in their lives (The Boy Scouts of America, 2008n).

A key variable that impacts the amount of learning that occurs in a Scout troop is the troop’s philosophy or ideology of the troop (Shinkwin & Kleinfeld, 1983). The ideology, the system of beliefs, values, and goals (Microsoft, 2006) that governs how members of the troop act and think, is defined by the Scoutmaster and the adults associated with the troop and is supported by the members of the troop. Scoutmasters who impose high standards on the boys in their charge and follow the official Scouting
program are more likely to engender a great deal of learning in the boys they lead: high expectations from the teacher or leader engender desirable and positive effects. Scouts are very aware of the expectations placed upon them (Rubie-Davies, Hattie, & Hamilton, 2006). Major differences between troops can be accounted for by the differing philosophies or ideologies of the Scoutmasters and associated adults. Educational experiences created by each troop differ as a result of the differing leadership of the Scoutmaster (Shinkwin & Kleinfeld, 1983).

The Scoutmaster and other adults associated with the troop model the behavior expected from the boys associated with the troop. The association of adults with the troop and their presence at troop activities, conversing with the boys about important events and activities in their lives, communicates to the boys the importance of Boy Scouts and creates an atmosphere conducive to fulfilling the educational expectations (Shinkwin & Kleinfeld, 1983). These leaders, who work with the boys on a voluntary level, are characterized by their commitment, seriousness, planning, and implementation (Silberman-Keller, 2003).

Mentors or Counselors

When Scouts earn a merit badge, they work with a qualified mentor, or counselor, who is knowledgeable in the field of the merit badge. The most influential teachers, mentors, and counselors are those who show interest and enjoyment in what they teach (Schiefele, 1991). Merit badge counselors, who must be registered with the Boy Scouts of America (The Boy Scouts of America, 1998), are often professionals in field of the merit badge, teachers of the subject, or are knowledgeable about the field due to their vocation or avocation (Stead, 1997; The Boy Scouts of America, 1998). A counselor builds bonds
with his protégé or group of students and acts as a role model, a pusher, prodder, and listener (Gurian, Henley, & Trueman, 2001). The counselor can provide positive reinforcement, structure, and attention formalized through the relationship (Gurian, Henley, & Trueman, 2001; Stead, 1997). Merit badge counselors act as mentors, teachers, and examiners (The Boy Scouts of America, 2008g).

Boy Scout merit badge counselors are told:

Here are some simple tips that every merit badge counselor should keep in mind.
- Make the Scout feel welcome and relaxed.
- Stimulate the Scout's interest by showing him something related to the merit badge subject, but don't overwhelm him; remember, he is probably a beginner.
- Carefully review each requirement, start with easy skills or questions, and encourage practice.
- Insist that the Scout do exactly what the requirements specify. Many of the requirements involve hands-on activities that call for a Scout to show or demonstrate; make; list; discuss; or collect, identify, and label—and he must do just that.
- Don't make the requirement more difficult—or any easier—than stated. A Scout may undertake more activities on his own initiative, but he cannot be pushed to do so.
- During testing, the Scout might need help in a particular area or with a certain skill, and may need to be retested later to ensure the requirement has been fulfilled.
- Encourage self-evaluation and self-reflection, and establish an atmosphere that encourages the Scout to ask for help.
- Take a genuine interest in the Scout's projects, and encourage completion. (The Boy Scouts of America, 2008e).

When boys are mentored, they have improvements in their academic achievement (Gurian & Stevens, 2004; Langhout, Rhodes, & Osborne, 2004); mentoring is perceived to be helpful for most people in a learning situation (Stead, 1997; The Boy Scouts of America, 2008g). The findings by Langhout, et.al., in their study of mentoring programs, indicate that there is a significant positive, if small, effect of enhanced social, academic, and psychological function when adolescents are mentored (Langhout, Rhodes, &
Mentoring/counseling can approach apprenticeship, where the learner observes the master’s model, tries, fails, and tries again with the social interaction of the mentor or master. This apprenticeship/mentoring interaction contributes to educational practice but learners feel that it is crucial for mentors to have expert knowledge of the field in which they are mentoring (Schugurensky, 2006; Stead, 1997). Formality in conducting a mentoring relationship leads to its success, regular meetings need to be conducted to make sure the learner’s program is progressing, as the objective of having a mentor/learner relationship is competence and progress (Stead, 1997).

The Boy Scouts reasons for using merit badge counselors:

One of the methods of Scouting is association with quality adults. Besides a Scout’s parents and relatives, his schoolteachers, his religious leaders, and possibly his sports coaches, most Scout-age youth do not have much contact with many other adults or professionals. Merit badge counselors provide an excellent means for a Scout to grow through his exposure to outstanding adults who serve as examples and mentors to them. The opportunity to deal with business leaders, trained specialists, and experienced hobbyists while in the pursuit of a merit badge offers the Scout a chance for personal growth and possibly a life-altering experience. The BSA recognizes that the merit badge counselor is the cornerstone to the merit badge program. By offering their time, experience, and knowledge to guide Scouts in one or more merit badge subjects, counselors help shape the future of our country. By assisting as the Scout plans projects and activities necessary to meet the merit badge requirements, and by coaching the Scout through interviews and demonstrations, the quality adult contact fostered by this working relationship can only enhance the Scout's self-confidence and growth (The Boy Scouts of America, 2008g).

2.2 Educational Theory

2.2.1 Scoutmaster Beliefs

Examples given by Scoutmasters about science education in Scouting relate primarily to the potential for Scouts acquiring knowledge about science principles instead of memorizing scientific facts (Jarman, 2005). Boys excel in tasks which focus on
knowledge of and understanding of scientific principles – the reasons why things work the way they do (Microsoft, 2006; Stark & Gray, 1999). Knowledge of general principles remains whereas factual knowledge may be lost (Bell, 2001); thus, what Scouts learn as general science principles will remain with them longer than if they memorized a list of scientific facts. According to Jarman, Scoutmasters have five beliefs about Scout science learning:

- children learn through experiences
- science participation will help in school
- children learn naturally when they are outdoors
- children learn through hands on activities, and
- children learn incidentally (Jarman, 2005).

Children learn through experiences - Experiential learning and Prior Knowledge

Charlotte Mason, a pioneer in educational theory and practice, taught that children were living organisms and in control of their own learning and proposed many teaching practices now being confirmed by current educational research. The work and theories of Charlotte Mason directly influenced Sir Robert Baden-Powell and the Boy Scout organization he founded (Smith, 2000). Mason believed that children should be outdoors every day; they should have time to explore and think things through for themselves, that there should be some times when guidance was provided. Mason taught that children should know the plants in their locale, that they should choose six trees to watch as they changed through the seasons. Mason believed that the outdoor time and experiences helped children to sharpen their powers of observation; she taught that children learn from real things in the real world. According to Mason’s science curriculum, children should learn from first-hand experiences, by being outdoors (Laurio, 2005).
Mason taught that children needed to be trained to govern their impulses, trained to do the right thing. Children, according to Mason, were to be trained to be clean, have physical exercise, good manners, and have control of their thoughts – mentally awake. The habit of thinking, drawing conclusions from what they see, remembering what they learned were important teachings of Mason, as were obedience, and truthfulness. Mason taught that children should have religious training, as well as short instructional discussions about the importance of being “candid, courteous, true, grateful, considerate” (Laurio, 2005). These educational principles are summarized in the Scout Oath and the Scout Law (The Boy Scouts of America, 1998).

Maria Montessori, an education innovator, also influenced Baden-Powell and the formation of the Boy Scouts (Block, 2007). Principles developed by Maria Montessori underlie many Boy Scout practices. These principles include that:

1. movement and cognition are closely entwined, and movement can enhance thinking and learning
2. learning and well-being are improved when people have a sense of control over their lives
3. people learn better when they are interested in what they are learning
4. collaborative arrangements can be very conducive to learning
5. learning situated in meaningful contexts is often deeper and richer than learning in abstract contexts
6. particular forms of adult interaction are associated with more optimal child outcomes
7. order in the environment is beneficial to children. (Lillard, 2005)

John Dewey stated that the experience that learners already possessed was the starting point for instruction (Dewey, 1938). Scout leaders believe that, because of the care in managing the learning environments, Scouts would almost inevitably learn through their experiences (Jarman, 2005). Non-formal education, of which Scouting is a
type, links experience with reality, as is shown in demonstrations and interactions with learning in the individual (Silberman-Keller, 2003).

Exposure to science must occur before there can be recall and long-term learning. An individual’s experiences, the more the better, engender successful construction of principles and knowledge (Bell, 2001). These knowledge-building experiences, from which students construct meaning, occur in a multitude of places – home, school, informal learning centers, and others (Anderson, Lucas, & Ginns, 2003). Students construct knowledge and meaning from their prior life experiences; prior knowledge and experience are thus significant factors in the construction of an individual’s knowledge (Anderson, Lucas, Ginns, & Dierking, 2000; Bell, 2001). Students maintain their interest in science when they anchor their construction of knowledge in their prior knowledge. While prior knowledge is indisputably effective in arousing student interest, prior knowledge experiences may lead to the construction of faulty and naïve concepts that are hard to eradicate with formal instruction, and thus work against the student (Dresel, 1998).

Children transfer learning from one context to another; instead of simply forming associations, children construct knowledge (Lillard, 2005). Construction of knowledge is most successful when it unites many of an individual’s experiences; sufficient prior exposure is necessary to develop theories of understanding. Different experiences will lead to construction of different knowledge structures and theories in order to understand the observations. Adding knowledge to these previously constructed knowledge structures is what constitutes learning. The depth of a student’s understanding depends on prior experience and attitude. Not all experiences necessarily lead to knowledge
construction; if a student is not interested, even repeated exposure will not lead to knowledge construction (Bell, 2001).

Science participation will help in school

Self-efficacy

Self-efficacy - the belief in one’s effectiveness in performing specific tasks (Bandura, 1986, 2006; Schunk & Meece, 2006). Self-efficacy addresses the question of how well a person can do a task, and is task and concept specific, focusing on one’s perceptions of one’s own capability (Bandura, 2006). Bandura proposed that an individual’s self-efficacy is the major determinant of choice of activity, willingness to work, persistence, and goal setting (Bandura, 1997). Self-efficacy has been found to be a strong predictor of academic achievement, even stronger than SAT scores (Zusho, Pintrich, & Coppola, 2005).

In science, students who have a strong belief that they can succeed in science tasks and activities will be more likely to select such tasks and activities, work hard to complete them successfully, persevere in the face of difficulty, and will be guided by physiological indexes that promote confidence as they meet obstacles. Students who do not believe that they can succeed in science-related activities will avoid them if they can and will put forth minimal effort if they cannot. When confronted with the typical challenges that science involves students who do not believe they can succeed are more likely to give up or experience stresses and anxieties that help ensure their failure (Briter & Pajares, 2006).

According to Bandura’s Four Factor Theory, students form their self-efficacy beliefs by interpreting information from mastery experiences, vicarious experiences, social
persuasion, and their physiological states. Mastery experiences are the most influential in forming self-efficacy beliefs. A student’s interpretation of successful experiences will raise his or her confidence, while an unsuccessful experience will lower confidence.

When one overcomes challenges, one develops a more resilient sense of self-efficacy. Frequent successes raise one’s self-efficacy, but individuals must cognitively process their experiences. Factors that influence the development of a person’s self-efficacy include their previously held self-beliefs, the perceived difficulty of the task, how much effort they expended in the task, and the help they received in the completion of the task.

The strongest and most consistent predictors of academic self-efficacy are mastery experiences. Mastery experiences necessary to the development of strong science self-efficacy beliefs may be provided by engaging students in authentic inquiry-oriented science investigations (Bandura, 2006; Briter & Pajares, 2006).

Vicarious experiences, including observing others perform tasks, are weaker than mastery experiences in helping create self-efficacy beliefs but allow students to evaluate their own likelihood of success at the same or similar tasks. A significant model can help instill self-beliefs that will influence the course and direction of a student’s life. Models that are most effective in creating self-efficacy beliefs are those models that are perceived to possess characteristics similar to the observer, characteristics such as age, sex, and perceived ability (Bandura, 2006; Briter & Pajares, 2006).

Social persuasion includes exposure to the verbal and nonverbal judgments that others provide. If these persuasions are positive, they will encourage and empower the student, causing them to believe in their capabilities and assure them that they can attain
the success they envision. If these social persuasions are negative, they will defeat and weaken self-efficacy beliefs, which is easier to do than to strengthen self-efficacy beliefs.

The emotional state of a student influences self-efficacy. Anxiety, stress, arousal, and mood contribute to a student’s sense of self-efficacy, as he or she engages in an activity (Bandura, 2006; Briter & Pajares, 2006). If students are not committed, they are bored, unmotivated, and cynical. Students have higher aspirations and accomplishments when they have stronger perceived efficacy to manage their own learning (Bandura, 2006).

Boys who are members of the Boy Scouts have many opportunities to increase their self-efficacy beliefs. When a boy chooses to do a merit badge pertaining to science, such as Geology, Astronomy, Mammal Study, Nuclear Science, or any of the 121 possible merit badges, he earns a merit badge to wear on his sash. The more merit badges a boy earns the more symbols he has to wear on his sash, which is worn at all formal Boy Scout activities. The merit badges on the sash are physical symbols to the boy and all those who see the badges, that this boy has had a mastery experience for each merit badge. As the strongest source of enhancing perceptions of personal efficacy are personal mastery experiences, which involve one’s accomplishments (Schunk & Meece, 2006), these physical symbols are important reinforcements to a boy’s self-efficacy conceptions. They are also social reinforcement symbols, symbols that earn him the respect of his peers and associates.

Every merit badge is designed to teach the Scout new skills while outwardly encouraging him to challenge himself and have fun in the process. Merit badges offer a range of difficulty over a breadth of subject matters, and a Scout is free to pursue any merit badge he wishes. The merit badge itself is a simple embroidered patch, but the intangible end result of earning it is that the Scout gains self-confidence from overcoming obstacles to achieve a goal (The Boy Scouts of America, 2008g).
To earn a merit badge, a boy must complete a set of requirements. Since these are requirements that a boy must do and master, the boy who completes the requirements develops a sense of self-efficacy by his efforts and accomplishment. The requirements that a boy must do to achieve the different badges often include inquiry experiences, which help to form strong self-efficacy beliefs in science (Bandura, 2006; Briter & Pajares, 2006). As rising in rank includes earning several merit badges, a boy has several opportunities to see himself as successful, and as, according to Bandura, frequent successes lead to higher self-efficacy (Bandura, 2006), which develops a higher self-efficacy. Mastery through completion of merit badge requirements increases positive self-efficacy.

Boy Scouting provides a series of surmountable obstacles and steps in overcoming them through the advancement method. The Boy Scout plans his advancement and progresses at his own pace as he meets each challenge. The Boy Scout is rewarded for each achievement, which helps him gain self-confidence. The steps in the advancement system help a Boy Scout grow in self-reliance and in the ability to help others (The Boy Scouts of America, 2008).

Many of the rank advancements that a boy must accomplish are science related, for example, list the warning signs of a heart attack; name, describe, and identify the poisonous plants in the local area; describe how different types of injuries are treated; make a pallet to carry an injured person safely (The Boy Scouts of America, 1998).

Boys, who are at least one rank higher than the boy who is attempting to earn the rank advancement, model, teach, and sign off that the skills or requirements have been mastered. Seeing that the instructor is a member of the same sex, not much older (or in some cases younger), and of similar ability levels, develops self-efficacy through vicarious experiences. The boy thinks that he, too, can do these things because the other
boy who has already accomplished them, is so similar to himself (Schunk & Meece, 2006). Sometimes, for example when demonstrating how to tie a knot, the model may make a mistake and have to redo the knot. Copying models who “display confidence and adaptation when confronting errors in learning are significantly more effective in sustaining students’ perceptions of self-efficacy than are mastery models who perform without errors” (Schunk & Meece, 2006; Zimmerman & Cleary, 2006). Boy Scouts uses role models very effectively to engender self-efficacy in boys.

Social persuasions influence self-efficacy. Boys are encouraged by older Scouts, Scoutmasters, patrol leaders, merit badge counselors, and parents. These people all tell the Scout that he is capable of doing the requirements and earning the merit badge or rank advancement. These positive reinforcements cause a Scout to believe that he, too, can achieve and accomplish his goals. When a Scout does not succeed at the first try, he is encouraged to try again, told that he will succeed, and helped to succeed. Wearing his merit badges on his sash also encourages a boy through positive social persuasion and positive reinforcement. These positive social persuasions seem to influence the development of a positive self-efficacy in the boy.

Motivation and Goals

Two types of rewards, extrinsic and intrinsic (Mortensen & Smart, 2007), may motivate learning in Scouts. These two types of motivation may be operating concurrently when a Scout is interested in the information he is learning in order to earn a merit badge. Extrinsic motivation, associated with performance goals (getting through and getting the credit), shows when a student strives to attain greater knowledge or skills, or to perform better than his peers do in order to demonstrate his ability and competence.
Intrinsic motivation is associated with mastery goals (desire to learn and understand) related to a student’s competence to master skills and tasks (Neiswandt & Shanahan, 2008), and is important for understanding out-of-school learning and can be used to predict school achievement. Evidence shows, that while boys whose only extracurricular activity is sports have depressed scores on standardized tests, boys who are involved in both service and athletic activities have higher standardized test scores (Bergin, 1992).

Motivation, an outcome of the motivational process, depends on whether a student expects success and also on his task-value beliefs (Katz & Assor, 2008; Pintrich & Schunk, 2002). Human behavior, according to motivation theory, is fundamentally goal directed, with goals being the reference point or standard against which current behavior is evaluated (Carver & Scheier, 1990). Bandura proposed that an individual’s self-efficacy is the major determinant of choice of activity, willingness to work, persistence, and goal setting (Bandura, 1997). Goals are shaped by many different things, including previous learning experiences, individual characteristics, and opportunities (Nurmi, 2004) and are guided by cultural norms (Nurmi, 1993). Peer support, as well as behavior and expectations, may foster greater academic goals in the educational sphere (Massey, Gebhardt, & Garnefski, 2008).

Boys working to achieve goals measure their success by emphasizing performance and outcomes. The most common out-of-school goals are affective (goals of having fun, feeling good, and entertainment), competition (self-assertiveness), and friendship (Bergin, 1992). Boys are much more inclined to performance goals as a measure of success than are girls (Niemivirta, 1997), and have a task-orientated learning style (Fritz, 1992). Boys are naturally competitive; they thrive on teamwork and
competition (Gurian & Stevens, 2005). When boys are engaged with topics they perceive to have personal everyday and future relevance, their motivation changes to a more intrinsic orientation (Nieswandt & Shanahan, 2008).

Goals for Scouts are hierarchical, a series of sub-goals with goals at many of the levels being endpoints or outcome events. These goals may provide general function and orientation for life (Austin & Vancouver, 1996). A boy may have hierarchical goals of completing a merit badge requirement, completing a merit badge, advancing in rank, and ultimately, earning his Eagle. A boy’s rate of advancement depends on his own interest, effort, and ability (The Boy Scouts of America, 1998).

The Boy Scouts uses the merit badge program to enable boys to set goals and to keep their enthusiasm high; the merit badge program allows boys to challenge themselves, compete against others, and move ahead at their own speed and in their own way. Scouts wear the symbols of their achievements on their uniform or sash, but are told that the achievement the badge represents is more important than the badge itself (The Boy Scouts of America, 1998). Merit badges symbolize mastery experiences associated with increased self-efficacy; a high self-efficacy is associated with higher academic goal endorsement (Vrugt, Oort & Zeeberg, 2002).

Children learn naturally when they are outdoors

Outdoor education

“Outdoor adventure is the promise made to boys when they join Scouting. Boys yearn for outdoor programs that stir their imagination and interest” (The Boy Scouts of America, 2008b). The major informal setting for Boy Scout science is the outdoors, which is so important to the Boy Scouts that Scouts repeat the “Outdoor Code”, including
a promise to “Be conservation minded,” at the end of each meeting. The Boy Scouts calls the outdoors the “laboratory”, where Scouts learn ecology and practice conservation (The Boy Scouts of America, 2008n), learning through camping, hiking, and outdoor activities (Nicholson, 1940; The Boy Scouts of America, 1998).

Boy Scouting is designed to take place outdoors. It is in the outdoor setting that Scouts share responsibilities and learn to live with one another. In the outdoors the skills and activities practiced at troop meetings come alive with purpose. Being close to nature helps Boy Scouts gain an appreciation for the beauty of the world around us. The outdoors is the laboratory in which Boy Scouts learn ecology and practice conservation of nature's resources (The Boy Scouts of America, 2008n).

Because of the space it affords, the outdoors is especially appropriate for boys, who have a natural need for space in order to develop their brains. Brain patterns, used throughout life, are built outdoors as a child inputs sensory information (Gurian, Henley, & Trueman, 2001); the outdoors is a medium for widening a person’s experiences (Gair, 1997).

“Every boy delights in the adventure of a hike into the woods. He loves to explore caves, to climb hills, to wander through and spy out unknown territory” (taken from Handbook for Scoutmasters, 2nd edition, 1920) (The Boy Scouts of America, 1998). Many people, especially teenagers, have a quest for excitement and adventure, personal challenges that are met through participation in outdoor activities. Our culture has eliminated risk, but boys still crave adventure (Iggulden, 2007); if young people do not get their excitement in socially acceptable ways, they will turn to socially unacceptable ways in order to get their thrills. Outdoor activities may include the possibility of danger, making them desirable to teenagers looking for excitement and adventure (Gair, 1997). Youth organizations, such as the Boy Scouts, which provide socially acceptable venues
for adventure (The Boy Scouts of America, 2008d), challenge and excite young people within a protecting, controlled framework (Gair, 1997). During 2007, there were 53,062 Boy Scout affiliates who adventured at one of the three Boy Scout High Adventure locations (The Boy Scouts of America, 2008f).

Outdoor education can:

- Develop an interest and concern for the outdoor environment;
- Provide challenge and adventure now missing in the lives of many young people;
- Enable them to discover the real satisfaction that comes from worthwhile work projects and voluntary service (Passmore, 1972).

Outdoor education can add relevance to what is taught about the world (Passmore, 1972), develop concepts of trust, ownership, leadership, determination, strategic planning, and motivation (Gair, 1997), and give learners real life experiences useful for constructing knowledge in variety of school science subjects (Gurian, Henley, & Trueman, 2001). “Learning by doing is a hallmark of outdoor education” (The Boy Scouts of America, 2008b). When students are engaged in topics that are relevant to their everyday lives and which they perceive as having future relevance, students are more motivated to learn. Students are more interested in relevant topics and are more desirous of developing competent knowledge in topics in which they perceive a strong utility value. Boys’ goal orientations change from performance goals to situational mastery goals when they feel topics are relevant to their personal lives (Nieswandt & Shanahan, 2008). Students more easily remember real-lived experiences; they better understand and remember when they learn by direct observation and problem solving teamwork in the outdoors, than when they simply hear or read information (Gair, 1997). Boys, whose
learning styles can be more activity oriented than those of girls, have a great potential of connecting with outdoor activities (Carrier, 2007).

Direct experience of the natural world develops environmental awareness (Gair, 1997). As early as 1962, researchers stated students did not have the outdoor experiences that students had enjoyed in the past; a study published by the Natural Academy of Sciences in February 2008, reported that since 1987 per capita visits to National Parks have declined, after 50 years of steady increase, (Pergams & Zaradic, 2008). Cultural changes, due to an increasingly industrialized and technically advanced society, were perceived as excluding the natural environment from the realm of children’s experience (Pike, 1962); “videophilia” was suggested as the root cause of the fundamental cultural shift away from nature-based recreation (Pergams & Zaradic, 2008). Outdoor education is seen as a way to stimulate children’s interest and curiosity, kindling interests that “might well lead to later specializations in any of the organized sciences,” but without the experiences in the natural environment, a child’s natural curiosity, a characteristic of successful scientists, might be stifled (Pike, 1962). Scouting gives boys many outdoor and out-of-school experiences without activities “such as playing video games and watching television” (The Boy Scouts of America, 2001). These extracurricular experiences engender interest in the sciences and provide a knowledge base for further education (Jarman, 2005; Uitto, Juuti, Lavonen, & Meisalo, 2006). Types of outdoor activities a Scout may participate in through the Boy Scout program include but are not limited to day hikes of 3-10 miles, daylong service projects, weekend overnights, summer camps and high adventure programs (The Boy Scouts of America, 2008b).
Environmental Education

Closely related to outdoor education is environmental education, as outdoor education transcends boundaries between subjects, developing an understanding, awareness, and a responsibility for the environment. Environmentally responsible behavior is the result of direct contact with the environment (Hungerford & Volk, 1990); if adults are to care for natural areas, they must be exposed to them as children (Duda, Bissell, & Young, 1998). The most responsible environmental behavior seems to result from extended periods spent in natural areas during childhood (Matthews & Riley, 1995; Vadala, Bixler, & James, 2007), however the majority of our children are growing up in urban and suburban environments, removed from the natural world (Tanner, 1980).

Maintaining the planet for future generations is the ultimate goal of environmental education; this can only be done by an informed citizenry working actively toward this goal (Tanner, 1980). Tanner’s suggestion for best practice to increase environmental awareness, which is remarkably similar to Boy Scout monthly campout experiences, is to

...release students, singly or in very small groups, to nearby wooded parks or vacant lots for two to three hours, frequently throughout their school careers. For reasons of safety and liability, they would have to be under adult supervision, or at least observation. The adults might be retired persons or other volunteers with an interest in children and nature. The children would not always have to be given prescribed learning activities...(Tanner, 1980).

Children discover, explore, and develop an understanding of the environment when permitted to play outdoors in a spontaneous, unregulated manner. By their explorations, children become aware of systems and patterns of life (Kola-Olusanya, 2005). When children participate in informal outdoor/environmental education activities such as field trips, hiking, adventure, and camping, they develop a relationship with
nature and develop more environmentally responsible actions and skills (Kola-Olusanya, 2005; Palmberg & Kuru, 2000). The Boy Scouts teaches “Leave No Trace principles”. These are principles by which people are encouraged to make a personal connection with the natural world and a commitment to protect the natural world (The Boy Scouts of America, 2008m).

**Summer Camp/Camping**

Most Americans associate Boy Scouts with camping and the outdoors (The Boy Scouts of America, 2001); there were 480,852 Boy Scouts who attended summer camp in 2007 (The Boy Scouts of America, 2008f).

Most Boy Scout troops have a monthly campout, “Troops that plan and carry out outings once a month attract and retain boys at a much higher level than those that have fewer outings during the year” (The Boy Scouts of America, 2008b). Boy Scouts promotes three major types of camping: weekend campouts, summer camps, and high adventure camping. Jamborees and camporees are Boy Scout group camping experiences planned and hosted by the district, council, or, in the case of a jamboree, the National Boy Scout organization. High adventure camping is designed for older boys (The Boy Scouts of America, 2008b).

Summer camp differs from camping, which is “living outdoors in a tent or trailer while on vacation or as a recreational activity,” (Microsoft, 2006). Summer camp is a residential camp. According to the American Camping Association, a residential camp is one in which campers spend a minimum of four nights in a setting where camp staff is responsible for the campers 24 hours per day. Summer camps/residential camps that focus on nature, rather than on computers, sports, or other agendas, have three
interrelated attributes that combine to create the camp experience: community, education, and the outdoors. Children who attend summer camp often return home with a wider appreciation and awareness of the natural world, having increased their learning about the outdoors and nature while at camp; camp has a significant impact on young campers, who develop life skills and experience nature in “a fun, hands-on setting.” Most importantly, the natural setting of most camps allows campers to enjoy learning about nature and the natural world (Arnold, Bourdeau, & Nagele, 2005). The total living situation provided by summer camps focusing on outdoor education provides opportunities for direct experiences with the outdoors and nature (Pike, 1962).

Summer camp directors feel that fostering connections of campers to the natural environment is important and requires purposeful programming; these directors feel that children are not as connected to the environment as they were 20 years ago. Camp directors gave several reasons for children’s disconnect from the environment including: (1) greater interest in electronics/media 85%, (2) decreased access to natural spaces, 78%, (3) lack of time (due to increased demands/expectations on children), 78%, (4) lack of knowledge or skill related to outdoor recreation activities, 70%, (5) parental fear of strangers, 66%, (6) parental fear of wilderness, 66%, (7) lack of environmental knowledge, 66%, and (8) discomfort endured outdoors not endured indoors (e.g., weather, bugs), 67% (James & Henderson, 2007). Children returning from camp self-reported an increased awareness of the environment after attending nature focused summer camps, this awareness remained after six months (Bialenschki, Henderson, & James, 2007). According to a survey of 10,034 Scouts attending Boy Scout Camps, 65% of Scouts attending summer camp learn about the environment and 49% learn/practice
first aid. “Summer camp is, in effect, an outdoor classroom for learning experiences” (The Boy Scouts of America, 2001).

The Boy Scouts promote summer camp for Scouts because:

At summer camp, the boys come closer to the natural world and to one another. They explore trails and sharpen skills together. Here, in the outdoors, Scouts learn to understand and respect the environment we all share, and develop an active concern for the health of the planet and a desire to help keep it healthy ... Boy Scout camp is Scouting and outdoor adventure at their best! (The Boy Scouts of America, 2009).

Children learn through hands on activities

Hands-on/Inquiry Based Learning

Science research, at least since Galileo’s experiments in the 17th century, has been based on inquiry, hands-on experimental investigations attempting to discover answers to questions concerning the natural world; science instruction, however, was often through rote learning, lectures, and demonstrations. In the late 19th and early 20th centuries, scientists, including Herbert Spencer and T. H. Huxley, and educators, especially John Dewey, urged science education through student experiences. Inquiry based education did not begin to become part of school curricula until after Sputnik in 1957. Demands on teacher time and the need for materials kept inquiry education to a minimum in schools through the 1980s, even though the data suggested that students taught with inquiry methods significantly outperformed other students. In 1996, the National Science Education Standards, produced with the support of the National Academy of Science, emphasized inquiry based learning and learning about inquiry (Pine et al., 2006).

Science, as well as other subjects, is taught by a hands-on approach in the Scouts (Jarman, 2005; Nicholson, 1940). This hands-on/inquiry based approach works well with
the tactual and kinesthetic needs of boys (Hlawaty, 2002; Honigsfeld & Dunn, 2003). Boys are very tactual and prone to tinkering, wishing to master and quantify their physical environment (Heard, 2000). Knowledge presented in school classrooms is often decontextualized and inert (Schugurensky, 2006). By tinkering with objects in the environment boys gain confidence, authority, and a willingness to explore further (Heard, 2000). When learning is acquired by doing, the knowledge is gained within the use context, thus it is active and vital (Schugurensky, 2006).

Students have higher recall of the information when science is taught with a hands-on (tactile/kinesthetic) method than when the same information is presented with traditional teaching methods of lecture, large group discussion, textbooks, and workbook activities (Searson & Dunn, 2001). Young people should be encouraged to explore with their minds and their senses (Gair, 1997); when learners physically do hands-on science they directly influence their cognitive development by constructing knowledge about events and circumstances. Cognitive development is influenced indirectly by hands-on science as memories are formed which can be recalled in later knowledge construction (Wellington, 1990).

Fun

Fun is a major criterion for a Boy Scout activity for two reasons: Boy Scouts is a free-choice educational medium, attracting and retaining members necessitates that its science activities be entrancing, active, and fun (Jarman, 2005); fun is needed for mental health (Nicholson, 1940). Fun is entertaining, interesting, and sometimes playful; spontaneous play is encouraged by the Boy Scouts as it provides opportunities for intellectual growth, physical development, and social adjustment (Nicholson, 1940).
Play, which represents content gained through experience, has a dominant role in non-formal education. Spontaneous games, games as part of an activity, games to lead into an activity, and guided play before an activity are all types of play. Play can promote accuracy, reliability, good workmanship, creativity, obedience, debating skills, punctuality, improved reading and critical reading, math skills, motor skills, self-awareness of bodily orientation, imagination, and conversational ability (Silberman-Keller, 2003). Physical play stimulates brain growth and is an organic method of learning academic skills of all kinds (Gurian, M.; Stevens, K. 2005). A high correlation exists between “fun, interest, and learning qualities of hands-on activities” (Jarrett, 1998); fun activities may promote interest, which, in turn, may promote learning (Bulunuz, 2008).

Many scientists had childhoods in which play was a very important part; playfulness marked their careers as scientists. Scientists whose curiosity was stimulated by play include Albert Einstein, Robert Burns Woodward, and Richard Feynman. Boy Scout experiences, “especially the ability to follow their own interests,” influenced biologist and conservationist E. O. Wilson (Wilson, 1994), cancer researcher George Klein (Jarrett & Burnley, 2007), and paleoclimatologist Lonnie G. Thompson (Thompson, 2008).

Scientists, who were polled for their opinion of what students should know and be able to do as a result of science education, repeatedly suggested that science should be fun and that more content and processes should be taught. The scientists did not make suggestions as to how this should be accomplished. Cultivating a love of science was, scientists thought, equal in importance to having students know science content and
knowing how science is applicable and relevant to their lives. Scientists thought science should “be more fun,” because the fun science, the “eureka moments,” stimulate students’ imagination and creativity, making them more interested, excited, and curious about science. Teachers are hampered in their attempts to encourage “authentic science”, where children are curious and engaged, because of the policies that focus on accountability; curiosity and motivation to become a scientist cannot be measured on a test (Taylor, Jones, Broadwell, & Oppewal, 2008). Many creative scientists including E. O. Wilson (Wilson, 1994) and Albert Einstein did not have a positive school experience; as schools do not encourage divergent, creative thinking (Jarrett & Burnley, 2007).

In a survey study of geoscientists conducted by Jarrett and Burnley about the role of fun, playfulness, and creativity in developing their interest in science, the “wow” experiences and the ability to explore were what made deep impressions, influencing their career choice. Males especially were interested in taking things apart and participating in “dangerous or inappropriate play” which included starting fires and building weapons. The geoscientists polled gave examples of fun activities as the reason they entered the geosciences. For many of these scientists, their interest in the outdoors, their tendencies collect things, and their experimentations were obviously connected to their current field and laboratory work (Jarrett & Burnley, 2007); paleoclimatologist Lonnie G. Thompson stated that his Scouting experiences “provided an experience of camping out, working in mountains. I still do that” (Thompson, 2008). Many geoscientists find their most fun in fieldwork; what may have brought them to the field originally was their love of the outdoors (Jarrett & Burnley, 2007).
The National Science Education Standards recommend that science should be taught using inquiry methods (National Science Education Standards, 1996). Development of productive scientific thinking appears to be strongly influence by play and fun in both formal and informal learning situations, but much of the fun of learning science has been removed because of the pressure to increase test scores (Jarrett & Burnley, 2007).

Children Learn Incidentally

Incidental learning is a subset of informal learning, both of which often occur in non-routine situations. While incidental learning and informal learning are similar in that both occur outside formal school education, they differ in that incidental learning is an unintentional byproduct of another activity, while informal learning can be planned - an intentional, often self-directed, activity.

Incidental learning includes learning by doing, learning from mistakes, and learning from testing limits. The content in incidental learning is buried in interaction and must be deciphered before learning occurs. Incidental learning experiences, living with and adapting to the environment, are not the same as formal learning experiences, rather, incidental learning experiences are the “way people make sense of situations they encounter in their daily lives,” and may be dependent upon the experiential context.

Incidental learning, inferred from actions, includes assumptions, values, and beliefs, and may include misconceptions due to misinterpretation (Marsick & Watkins, 1990).

Incidental learning that is spontaneous and non-intentional (Randler, Höllwarth, & Schaal, 2007), occurs in a variety of places and contexts including parks, zoos, museums, and other venues offering opportunities for education and recreation. Usually
all visitors learn something when visiting such places, whether or not they have specific
motivation to learn. Discussions and conversations may enhance incidental learning,
which often takes place in a social context (John H. Falk, 2005; Randler, Höllwarth, &
Schaal, 2007).

Visitors to parks often watch animals and observe their behavior, discussing with
their companions about the different species and the environment. Frequent park visitors
have a greater knowledge of animal species than people who do not often visit parks.
Knowledge of animal species increases with age, educational level, and frequency of park
visits, with frequent park visitors scoring significantly better in their knowledge of animal
species (Randler, Höllwarth, & Schaal, 2007). Many Boy Scout troops camp, on
average, once a month. Scouts are often frequent visitors to parks and other
educational/recreational areas, enhancing their opportunities to learn incidentally.

Incidental learning situations lead to more sustainable knowledge acquisition, as
incidental learning is mostly self-directed. Group visits to, and activities in, a place
offering recreational and educational opportunities may stimulate discussions involving
information about what is seen and experienced. (Randler, Höllwarth, & Schaal, 2007).
When these discussions involve survival skills, survival scenarios, or future use, the
information discussed is more likely to be remembered at a later time (Nairne &
Pandeirada, 2008). When Scouts are trekking through the woods or visiting a museum or
other type of educational/recreational area, they may discuss and practice survival skills
such as finding directions from a compass or the stars, locating edible plants, or studying
the local fauna (R. Baden-Powell, 1932), thus enhancing the possibility that the
information discussed will be remembered. “Learning is an important by-product of all

Interesting experiences in an informal learning environment may cause a visitor to pursue further information, either from books or from the Internet, about the plants and animals seen, (Randler, Höllwarth, & Schaal, 2007). School children, and others, with such experiences are invariably more knowledgeable, possessing an enhanced capacity to learn as well as having an increased motivation to learn more in the future (John H. Falk, 2005). The learning process involves more than just an exposure to an experience. Even though all learning is experiential, not all experiences are good for learning. Experiences which produce learning need to have opportunity for reflection at some point in time in order to give the experience relevancy and permanence (Dewey, 1938; Taniguchi, 2004). Meaningful experiences must incorporate reflection, whether in solitude or in a group (Taniguchi, 2004). This reflection may occur later, when the experience is remembered in conjunction with additional information (Bybee, 2000).

2.2.2 Characteristics

Biology

Assumptions

Feminist researchers have always worked from a basic assumption that, “there are basic differences between females and males that are more prevalent than the obvious biological ones and that result in males and females interpreting the world differently.” One’s entire life and world are influenced by these basic differences (Fennema, 2000).
Psychobiological research has turned up many differences in the brains of males and females to support the idea that males think differently than do females (Fennema, 2000; Restak, 1979). The differences between male and female thoughts and behaviors are based on biological differences and are not likely to be modified solely by cultural factors (Gurian, Henley, & Trueman, 2001; Restak, 1979). In general, men outperform women at spatial tasks while women are better at verbal tasks (Andreano & Cahill, 2009).

Sex-specific differences exist in healthy brains; the brains of males and females differ in several factors (Cosgrove, Mazure, & Staley, 2007). Brains of males and females have differences in every lobe, including the hippocampus, the amygdale, and the neocortex, which are recognized as the cognitive regions of the brain. Brain neurochemistry sex differences are pervasive; “there are sex influences at all levels of the nervous system, from genetic to systems to behavioral levels” (Cahill, 2006).

Males have a larger brain volume relative to total volume than to females (Cosgrove, Mazure, & Staley, 2007). Even though females have smaller skulls and smaller brain volumes, their brains are more convoluted than those of males, giving females more surface area in the cortex (Cahill, 2006; Luders, 2004). These gender differences in cortical complexity may be the biological reason that women tend to outperform men in certain cognitive skills (Luders, 2004).

Male and female brain differences occur in a wide array of neurotransmitter systems and in structural differences. The overall brain volume relative to total volume may not be as important as the size differences in brain structures. Men have a larger amygdale, a larger hypothalamus, a higher percentage of white matter, and a higher
percentage of cerebrospinal fluid than do women; women have a larger caudate, a larger hippocampus, a consistently higher global cerebral blood flow, and a higher percentage of gray matter than do men. These size differences in the brain structures are important, as “… these sex differences in brain morphology, function, and neurochemistry likely impact normal and abnormal behavior” (Cosgrove, Mazure, & Staley, 2007).

In females, the two halves of the brain appear similar, with more gray matter, while in males the two halves are dissimilar and have more white matter. When performing cognitive functions while undergoing MRIs, women’s brains light up in both hemispheres; men’s brains while performing the same cognitive function, light up in a localized area on one side (Cosgrove, Mazure, & Staley, 2007). There are many sex differences in neural activity without corresponding behavioral differences, for example, brain regions associated with retrieval of emotional, autobiographical memories differ in men and women, even though the memory performances and degree of emotion did not differ between the sexes (Cahill, 2006).

Sex hormones explain many, but not all observed differences between male and female brains. Some brain differences seem to result from different maturational rates in males and females. In many cases, the differences between the brains of males and females are not evident in overt anatomical structures, structural dimorphisms, but are functional dimorphisms as the differences are functional in nature.

Learning may be influenced by the sexual dimorphism of the human brain (Cahill, 2006), as normal functions are likely impacted by sex differences in human brains (Cosgrove, Mazure, & Staley, 2007). Memories, and thus learning based on memory, may be influenced by sex differences in the brain at the time of storage and at the time of
retrieval (Cahill, 2006). Auditory learning may be accelerated in females as female brains have an “accelerated maturation of the functional activation of auditory processing networks” (Nanova, Lyamova, Hadjigeorgieva, Kolev, & Yordanova, 2008). Males, more than females, tend to use visual imagery strategies when dealing with phonological and semantic processes (Gauthier, Duyme, Zanca, & Capron, 2009). The brain research data supports the data collected in this study.

Behavior

Baden-Powell on Boys

Boy Scouts is a very appropriate informal/non-formal free-choice vehicle for introducing boys to science, fitting their learning styles much better than traditional instruction. The founder of the Boy Scout, Lord Robert Baden-Powell, knew boys when he wrote in his book, Scoutmastership, that:

“A boy is not a desk animal. He is not a sitting-down animal…He is a boy – God bless him-full to the brim of fun and fight and hunger and daring and mischief and noise and observation and excitement. If he is not, he is abnormal” (R. S. S. Baden-Powell, 1920).

Learning Styles

Learning style “is the way in which each learner begins to concentrate on, process, absorb, and retain new and difficult information” ("International learning styles network", 2008; Searson & Dunn, 2001); a set of characteristics, biologically and developmentally determined, that make the same instruction ineffective for some students and effective for others (Searson & Dunn, 2001). The Dunn and Dunn Learning Styles Model identified at least 21 different variables that affect how a person learns. These
variables include processing preferences for environmental, emotional, sociological, physiological, and cognitive factors.

According to the Dunn and Dunn model, the immediate environment factors that influence learning include sound, light, temperature, and seating design. Some students prefer to study in quiet; others prefer sound or listening to music. Students vary on their lighting preferences, soft or bright. Students also vary on warm versus cool temperatures, and formal or informal seating preferences. Emotional factors that influence learning include motivation, persistence, responsibility/conformity and need for internal or external structure. Sociological learning factors include learning alone, with a partner, as part of a small group or team, with peers, with an authoritative or collegial adult, and/or in a combination of ways. Physiological learning factors are auditory, visual, tactile, and/or kinesthetic. The way information is presented to students often determines how well they learn. Auditory learners can learn by listening and can learn information presented in a lecture style format. Visual learners need to see pictures, charts, or modeling of the material. Perceptual preferences include food or liquid intake, time-of-day energy levels, mobility needs. Some students need to snack while concentrating; others need to move about. According to the Dunn and Dunn model, learners vary on their impulsive versus reflective inclinations and process information on a scale ranging from analytic cognitive to global.

Analytical learners focus on facts, fashioning understanding from a step-by-step process of assimilating facts. Global learners need to understand how the information presented relates to them, their lives, and/or their interests before they can focus on the facts. Global learners prefer illustrations and pictures; analytical learners respond to
printed words and numbers. Individuals differ in the way these learning style elements are combined and interact. Students statistically receive higher achievement scores when they assimilate information according to their preferred learning style ("International learning styles network", 2008; Searson & Dunn, 2001).

Males have different learning styles than females. Males appear to be more in need of tactual input in their learning styles (Hlawaty, 2002). Males use structuring, which operates independently of known facts, to organize their learning. Males are less verbal in their learning styles than are females; they are more active, have a higher analytical orientation, are more inner directed, have more experimental reasoning patterns than do females, and are task driven (Fritz, 1992). However, according to the newer research fewer males have an analytic orientation than females. Males are less self-motivated and persistent in their pursuit of learning and tend to be less responsible or conforming (Honigsfeld & Dunn, 2003); they learn to achieve a goal, emphasizing performance and outcomes to indicate their success (Niemivirta, 1997). Boys are more kinesthetic and peer-orientated than girls and tend to be visually, tactually, and kinesthetically stronger than girls; boys need kinesthetic input if they are to succeed (Honigsfeld & Dunn, 2003). Boys are less sensitive to sound from birth (Restak, 1979), and are not as auditory as girls; thus, they are much less likely to earn good grades related to listening to a lecture (Honigsfeld & Dunn, 2003).

The significantly higher kinesthetic and peer-orientated learning styles of boys is likely to impact their achievement. Boys learn by doing, rather than by being passive, thus they find it hard to sit still and concentrate on academic subject matter (Honigsfeld & Dunn, 2003). Boys learn by manipulating their environment, even though their fine
motor skills lag behind those of girls. Restak inferred a relationship between thinking and active participation through kinesthetic movement in how boys’ brains processed information. Boys think by doing; they suffer in traditional elementary schools, which are ideally suited to how girls think. The typical student is forced to sit for long periods in a traditional classroom, even though males learn by manipulating their environment. Males are forced to write at an early age, even though they do not have the fine motor coordination to excel at this task. Traditional schools do not generally give young males much opportunity to use their rapid muscular responses or their superior gross motor skills (Restak, 1979). The trend in boys’ brains toward spatial-mechanical functioning makes them want to move things through space – balls, paper airplanes, arms, and legs (Gurian & Stevens, 2004). Boys need space and movement in order to function and learn and are more inclined to use surface-level learning strategies such as rote-learning and memorization of detail than are girls. Boys learn to achieve a goal, emphasizing performance and outcomes to indicate their success (Niemivirta, 1997).

Hlawaty’s study comparing German males and females showed significant differences on five of twenty-two learning styles, practices that enhanced learning for the individual. German boys, compared to German girls, were not as sensitive to light, but needed more food, were not as motivated, responsible, or receptive to learning in several different ways, as shown on a Learning Style Inventory (Hlawaty, 2002). Studying learning styles of students in many countries, Honigsfeld found that boys are much more in need of kinesthetic input if they are to succeed (Honigsfeld & Dunn, 2003).

When males are taught with the appropriate learning-style responsive approaches, they have a significant increase in their achievement test scores (Honigsfeld & Dunn,
2003). Boys do better with active learning approaches; audiovisual, creative, and active teaching methods are much more effective than the traditional passive modes of instruction in teaching boys. In studying, especially science, both boys and girls would prefer more practical work and less note copying, but boys in particular would appreciate this method of teaching (Dawson, 2000).

The Boy Scouts recognizes that boys have different learning styles (The Boy Scouts of America, 2008k, 2008m). A publication to help Scout leaders teach the principles of Leave No Trace, an environmental protection program, informs Scout Leaders:

Each of us teaches and learns with our own unique style. Anyone who has worked with people knows that different people are inspired by different teaching and learning techniques. Most young people generally prefer active, hands-on, minds-on learning. These Leave No Trace activities have been written with the following styles in mind.

- Visual learner. The visual learner likes to learn through seeing—video, chart, picture, model.
- Auditory learner. The auditory learner likes to learn through listening—lecture, discussion, debate.
- Kinesthetic learner. The kinesthetic learner likes to learn by using his or her body—dance, drama, movement, hiking.
- Tactile learner. The tactile learner likes to learn through touching and feeling—hands-on activities and projects.
- Experiential learner. The experiential learner likes to learn by experiencing the activity first-hand (The Boy Scouts of America, 2008m).

2.2.3 Teaching and Learning Strategies

National Science Education Standards

One of the current needs of the United States is a scientifically literate population. People, both in the workplace and in their everyday lives need to be able to intelligently use scientific information to make wise choices, use advanced skills, reason, and problem solve (National Science Education Standards, 1996).
Responsibility for providing the support needed for all students to learn science falls on all parts and members of the science education system (*National Science Education Standards*, 1996). The Boy Scouts of America has a strong emphasis on science education in addition to its character building, personal fitness development, and citizenship instruction. The Boy Scouts is, and has been, influential in exciting and educating boys about science (Jarrett & Burnley, 2007; Lundy, 2008a; Porchia, 2008; Sonnenberg, 2008; Thompson, 2008). The requirements of the Boy Scout merit badges align with the National Science Education Standards (*Appendix C*) and can be used to promote a scientifically literate population.

The premise that science is an active process is the basis for the National Science Education Standards. “‘Hands-on activities, while essential, are not enough, students must have ‘minds-on’ experiences as well’” (*National Science Education Standards*, 1996).

The *Standards* call for more than "science as process," in which students learn such skills as observing, inferring, and experimenting. Inquiry is central to science learning. When engaging in inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. They identify their assumptions, use critical and logical thinking, and consider alternative explanations. In this way, students actively develop their understanding of science by combining scientific knowledge with reasoning and thinking skills (*National Science Education Standards*, 1996).

The Boy Scouts encourages “hands-on, minds-on” learning (The Boy Scouts of America, 2008m), Scouts are encouraged to ask questions and to develop critical thinking skills (The Boy Scouts of America, 2008j, 2008k); Scout leaders are told to, “Encourage participation and thought during the activity. Remember, building critical thinking skills
is more valuable than simply memorizing correct answers” (The Boy Scouts of America, 2008m).

Science in Scouting vs. Science in Traditional Schools

In the developed world schools, colleges, trade schools, religious institutions, and workplaces have historically been responsible for educating people, although they have never provided the majority of people with the most of their educational opportunities. It is increasingly apparent that these institutions are not meeting the learning needs of society. Currently most learning, including most environmental learning, is not acquired in a school setting, but rather in informal settings outside of school (John H. Falk, 2005).

Lord Baden-Powell was very emphatic when he wrote that “Boy Scouts is not a school having a definite curriculum and standards of examination” (R. S. S. Baden-Powell, 1920). Scouts do not want the science learned in Scouts to be like the science they must learn in school. Boys relate Scout science to interesting and fun and school science to boring (Jarman, 2005), as much of what goes on in school science classrooms is attractive neither to boys or girls (Stark & Gray, 1999). Traditional schools are not organized to maximize learning; students don’t have opportunities to develop the needed supporting relationships with their teachers and subject matters (Hull & Greeno, 2006). Boys enjoy discussing science in groups, not doing seat work and seat bound activities (Stark & Gray, 1999). School science is seen as involving too much writing and listening, with the teacher doing everything else (Jarman, 2005; Stark & Gray, 1999), whereas Scout science is perceived as fun, exciting, where the boys do the activities, with limited writing, and no written tests (Jarman, 2005). Achievement is assessed through
discussion(s) with the merit badge counselor. Table 2.2 provides a summary of science in the Boy Scouts versus science in traditional school settings.

### Science in Scouting vs. Science in Traditional Schools

<table>
<thead>
<tr>
<th></th>
<th>School</th>
<th>Scouting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curriculum</td>
<td>Formal</td>
<td>Informal educational agenda</td>
</tr>
<tr>
<td>Curriculum and Texts</td>
<td>Educators</td>
<td>Field professionals and educators</td>
</tr>
<tr>
<td>Motivation</td>
<td>Required attendance</td>
<td>Free-choice attendance</td>
</tr>
<tr>
<td>Location</td>
<td>School</td>
<td>Varies – often outdoors or in informal learning situations</td>
</tr>
<tr>
<td>Hours of engagement</td>
<td>180 days/year x # hours</td>
<td>Free-choice</td>
</tr>
<tr>
<td>Student characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Usually co-ed</td>
<td>Male</td>
</tr>
<tr>
<td>Age</td>
<td>5-18</td>
<td>11 to 18</td>
</tr>
<tr>
<td>Educational Group size</td>
<td>Limits vary 15 – 30</td>
<td>Often 1 to 1, usually small groups</td>
</tr>
<tr>
<td>Instructors</td>
<td>Certified teachers</td>
<td>May or may not be certified teachers</td>
</tr>
<tr>
<td></td>
<td>General knowledge</td>
<td>Expert knowledge</td>
</tr>
<tr>
<td></td>
<td>Background check</td>
<td>Background check</td>
</tr>
</tbody>
</table>

(R. S. S. Baden-Powell, 1920; Houston Independent School District, 2004; The Boy Scouts of America, 2008d)

Table 2.2: Science in Scouting vs. Science in Traditional Schools

In the view of many people, classroom education is disconnected from the real world (Bouillion, 2000). Different experiences made available to students in out-of-school settings may account for some performance differences in in-school settings. A student’s depth of processing information depends on his prior experience (Bell, 2001). Scout science is not a replacement for school but can be an effective additional opportunity where students are motivated in the study of science. Scouts, with their
wealth of out-of-school experiences, can and do call on these past experiences in subject matter, attitudes, and skills in order to build new knowledge (Nicholson, 1940). Because out-of-school science experiences transfer to school performance, current reforms are seeking to bring school, home, and workplace environments together in order to support children’s social and intellectual development (Bouillion, 2000). Teachers can, “orchestrate outside experiences for students and incorporate the expertise of community-based professionals like scientists,” to help students understand what science is like (Taylor, Jones, Broadwell, & Oppewal, 2008), which is what the Boy Scouts does through the merit badge program (The Boy Scouts of America, 2008h).

Scouting Curriculum

The Boy Scouts educational curriculum includes the Boy Scout Handbook and 121 merit badge pamphlets. There are also additional materials for Scoutmasters, Scout leaders, and merit badge counselors (The Boy Scouts of America, 2008d). Merit badges are an important source of science information for boys between the ages of 11 and 18. During 2007, a total of 4,595 Scouts completed the Nuclear Science merit badge, 10,034 Scouts completed the Electricity merit badge, 10,087 Scouts completed the Astronomy merit badge, 19,525 Scouts completed the Geology merit badge, and 72,279 Scouts completed the Eagle required Environmental Science merit badge. During 2007 Scouts earned a total of 1,879,476 merit badges (The Boy Scouts of America, 2008f).

Boy Scout Handbook

More than 37.8 million copies of the Boy Scout Handbook have been printed (The Boy Scouts of America, 2008n). The Boy Scout Handbook is the source of rank advancement requirements and the information to get a boy “started.” At the front of the
handbook is a tear-out section on the Boy Scout youth protection procedures, which a boy and his parent(s) must go through before a boy can achieve Scout Rank and become an official member of the Boy Scouts. The handbook is where a Scout keeps his written records, the initials and dates needed for advancement. The handbook contains, along with much other information, instructions and diagrams for tying various knots, diagrams and instructions of how to use different knots, how to use and care for a knife, flag etiquette, what to do if lost, and how a compass works as well as how it should be used with a map. Pictures and drawings are used liberally in the handbook. The Boy Scout Handbook also contains science information for Scouts including, but not limited to: pictures and descriptions of poisonous plants and how to treat oneself after contact with poisonous plants; first-aid instructions including how to prevent and treat frostbite, sunburn, and heat stroke; how to safely lift heavy objects; nutritional information about a balanced diet; wilderness waste disposal; and how to collect evidence of native plants and animals (The Boy Scouts of America, 1998).

Passing rank advancements, using the Boy Scout Handbook requirements, necessitates a Scout working with a higher-ranking Scout to have rank advancements signed and the signatures are recorded in the Boy Scout handbook. After a boy completes the requirements for a rank, he has a conference with his Scoutmaster, followed by a Board of Review. Adults, who will make certain the Scout has passed the requirements for the higher rank, conduct Boards of Review, at least for Star, Life, and Eagle Ranks. The board members discuss with the Scout the value Scouting has for the boy, the boy’s service to others, the way the Scout is acting as a leader in the patrol and
the troop, and what the boy has learned from his merit badges (The Boy Scouts of America, 1998).

Merit Badge Pamphlets

The Boy Scouts uses the merit badge program to enable boys to set goals and to keep their enthusiasm high (The Boy Scouts of America, 1998), because boys emphasize performance and outcomes to measure their success, (Niemivirta, 1997). The merit badge program allows boys to challenge themselves, compete against others, and move ahead at their own speed and in their own way. A boy’s rate of advancement depends on his own interest, effort, and ability (The Boy Scouts of America, 1998). The Boy Scout Fact Sheet about the merit badge program includes:

Background and Purposes
As chartered by the Congress of the United States, the Boy Scouts of America is a movement dedicated to supplementing and enlarging the education of youth. The merit badge program, which provides opportunities for youth to explore more than 120 fields of skill and knowledge, plays a key role in the fulfillment of this educational commitment.
A vital part of the BSA’s advancement plan, the merit badge program is one of Scouting’s basic character-building tools. Through participation in the program (which may begin immediately upon registration in a troop or team), a Scout acquires the kind of self-confidence that comes only from overcoming obstacles to achieve a goal. Instruction is offered in everything from animal science and public speaking to swimming and communications, providing a young man with invaluable career, physical, and interpersonal skills.

Merit Badge Pamphlets
Each merit badge subject is outlined and explained in a pamphlet that contains short introductory information written for Boy Scouts/Varsity Scouts by recognized authorities. More than a million pamphlets are sold yearly, and many are used as approved reference texts in libraries and school curricula.

Counselors
People who are knowledgeable about the various merit badge subjects are selected, approved, and trained by council and district advancement
committees to serve as merit badge counselors. For example, a dentist might be asked to serve as a counselor for the Dentistry merit badge. A counselor must not only possess the necessary technical knowledge but also have a solid understanding of the needs, interests, and abilities of Scouts. A counselor must also be a registered adult with the BSA.

Procedure
When a Scout has an interest in earning a particular merit badge, he obtains his Scoutmaster’s/Varsity Scout Coach’s approval and identifies another Scout with similar interests to become his partner. They are then directed to the appropriate merit badge counselor. The counselor reviews the badge requirements with the young men and decides with them what projects should be undertaken and when they should be completed. After the counselor has certified that the Scouts have qualified for the merit badge, it is presented to them at a troop/team meeting and can be applied toward rank advancement (The Boy Scouts of America, 2008h).

While some Boy Scout merit badges include a writing requirement, most assessments to pass merit badge requirements come from discussing the requirements with the merit badge counselor. The Boy Scout educational materials do not include worksheets. Worksheets may enhance the learning of students in free-choice environments by stimulating conversations about the topic of study, but in some cases have been found to impose classroom-like constraints upon the users and interfere with social interactions (Mortensen & Smart, 2007). Some Boy Scout leaders have constructed worksheets to use with the merit badge pamphlets. These worksheets usually list the requirements for the merit badge and have blank lines where the Scout may write what he wishes to discuss with the counselor. Worksheets downloaded from the Internet are not official Boy Scout educational material and not found on the Boys Scout website. Filling out a worksheet is not a requirement for completing a merit badge.
Strategies used in Scouting

The Boys Project, directed by Judith Kleinfeld, outlined five strategies to help boys succeed in school.

- Educate teachers on gender differences in development and learning
- Start school at a later age for slower developing boys
- Create “Focus Schools” which offer nurturing, personalized education
- Connect boys in groups with caring adults
- Respect boys (Judith Kleinfeld, 2006)

The Boy Scouts, an extracurricular organization for boys, incorporates most of these strategies in educating boys in an informal/free-choice learning environment. Education in the Boy Scouts appears to use learning styles of boys, including peer motivation, kinesthetic and tactile hands-on activities, learning with peers, structure, and informal design. Boy Scout education is nurturing and personalized; boys choose which merit badges they wish to work on, when and at what age they wish to work on a given merit badges; Scouts work on their chosen badges with counselors who directs their inquiries and studies. Boys connect in a group with caring adults; the two major group levels in Scouts are the troop and the patrol. Boys are respected in the Boy Scouts, as the Boy Scouts is a boy led, boy run program (The Boy Scouts of America, 2007). Following Dewey’s principles, adult personal authority is reduced to a minimum, the control of the group is social, done by members of the group (Dewey, 1965).

Informal/Non-formal/Free-choice Education/Learning

America depends on its educational infrastructure for scientific and educational literacy. America’s educational infrastructure, which is vital to the well-being of the nation, benefits from both the formal and informal/free-choice educational providers (John H. Falk, 2001) as important educational roles are filled by each (Schugurensky,
The goal of free-choice learning is to produce life-long learners (Korpan, Bisanz, Bisanz, & Boehme, 1997). Informal/free choice educational providers are an extremely important source of science knowledge for the American public as school based science learning likely has a limited contribution to the long-term public understanding of science. Public understanding of science may be assumed to be constructed from information gathered places and contexts not associated with a formal school environment (J. H. Falk, Storksdieck, & Dierking, 2007).

The National Science Teachers Association, NSTA, published a position statement (Appendix B) documenting importance of informal science education; NSTA recognized and encouraged the development of links between informal institutions and schools, including youth organizations. The NSTA position paper stated informal science education accommodated the differing learning styles of students as well as providing science education across the spectrum of learners. The importance of informal education in providing increased time for participation through field trips, field studies, overnight experiences, and special programs was recognized. The NSTA position paper also documented the importance of informal education in providing opportunities for mentors and professionals to share their time, expertise, and friendship with students. NSTA recognized the role played by informal science education experiences for sparking students’ curiosity about science and engaging their interest in the sciences ("NSTA position statement: Informal science education", 1999).

Informal learning experiences can lead to learning in two ways, directly and indirectly (Wellington, 1990). Learning, especially science learning, rarely develops from a single experience, but is cumulative, emerging over time, constructed from many
experiences (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003). Memories which may lead to knowledge are formed through participation in informal learning experiences (Wellington, 1990). Knapp and Benton proposed a model for learning through a “nonformal environmental education event.” In their proposed model, learners would participate in several personally relevant activities that repeat the concept. The learner could develop semantic memories with the attendant conceptual knowledge if the learner had vivid episodic memories of the experiences (D. Knapp & Benton, 2006). Informal science learning experiences are beneficial to students in formal learning situations, as what a person learns depends on what the person already knows and understands. A person learns by applying prior knowledge and experience to new experiences (John H. Falk & Dierking, 1997).

People acquire much personally meaningful and significant learning in informal settings. Much informal learning is self-directed learning, both intentional and conscious, often occurring where learners are involved in a community, and learning by doing. Providers of informal education, including the Boy Scouts, exist in a variety of places in the community and play important educational roles (“NSTA position statement: Informal science education”, 1999; Schugurensky, 2006).

There are many examples of free-choice learning settings that provide opportunities to acquire science content and/or skills: museums, 4H, Scouts, field trips, zoos, and educational television productions are examples. Much of the research done on free-choice learning has been done in museum or zoo settings. Museums provide information to the general public, many times this is content-only information. Some museums, especially museums geared toward children, offer hands-on activities, where knowledge
can be acquired experientially, for example using a stream of air to support a beach ball
to exemplify Bernoulli’s Principle, or primary colored light sources to show the additive
quality of light to form colors. Many times the experiences obtained in a museum setting
become bases on which learners build knowledge at some time in the future (Anderson,

Boy Scouts is an example of a free-choice learning educational institution which
uses hands-on activities and a curriculum with printed educational materials. In using the
educational materials published by the Boy Scouts, boys are free to choose what merit
badge(s) they wish to pursue, if any. If a boy is to earn a merit badge, he must complete
the requirements for that badge, but a boy is free to choose not to complete a merit badge.
As at least 85% of the 121 Boy Scout merit badges have at least one requirement from
the National Science Education Standards, there are many skills and much science
content presented through this printed venue. A large focus is on first aid and life saving
skills, recognizing the warning signs and symptoms of impending medical emergencies
or conditions (see Chapter 4 of this document). The Boy Scouts also engenders
experiential science knowledge that is not part of a written curriculum or merit badge
pamphlet but is developed through experiences (Jarman, 2005).

Direct measurement of much of the learning that occurs from informal science
education experiences in free-choice learning environments is not always possible.
Learning environments conducive to discovery and exploration make long-lasting
impacts that cannot be measured directly (Mortensen & Smart, 2007; Paris, 1997);
informal science experience often engender interest and excitement about science
Single Sex Grouping

Boy Scouts is for boys. Capturing a boy’s interest and getting him motivated to learn are the first tasks of anyone who wishes to teach him. Advantages to teaching boys in an all-boy learning environment are that the curriculum can be tailored to topics that are of interest to boys and those topics can be taught in ways that keep a boy’s attention and focus (“National association for single sex public education”, 2008). During the last decade many countries in the world have reported problems concerning the educational achievement of boys compared to that of girls (Mulholland, Hansen, & Kaminski, 2004; Robinson, 2004; Younger & Warrington, 2002).

History

Research into science education during the 1970s and 1980s showed that girls’ achievements were lagging behind those of boys. Girls had fewer extra-curricular experiences in science, took fewer science classes, and felt inadequate in science. Sex stereotyping appeared as early as kindergarten; the lack of encouragement and parental expectation discouraged girls from excelling in science. Girls who attended all girl schools, however, in contrast to girls who attended coeducational schools, had better attitudes toward science. The study done by Kahle and Lakes suggested that the underlying cause of the disparity between girls and boys could possibly be found in the science classrooms, where different experiences for the different sexes formulated different attitudes (Kahle & Lakes, 1983).

Kahle and Lakes used a survey from the National Assessment of Educational Progress, sponsored by the U.S. Office of Education, in order to ascertain progress in science by gender. Their findings showed that the experiences and expectations of girls
and boys in the field of science were significantly different. Girls reported fewer “hands on” experiences in all areas of science except the behavior of humans, plants, and sound. Girls participated at a much lower rate in extracurricular science activities, and were below the national mean on field trip items. Girls stated that their science classes were “boring”, that they did not like attending science classes, and were “often afraid to ask questions”. They stated that their science classes made them feel “stupid” and had negative attitudes about science as a career possibility (Kahle & Lakes, 1983).

Current Discussion

Following the findings about gender disparity in the 1970s and 1980s, enormous effort was put into improving the achievement of girls in school. Data suggests that girls have made great strides in their academic achievement, even in the area of science, and have overtaken boys in all areas of education (Mulholland, Hansen, & Kaminski, 2004; Robinson, 2004; Warrington & Younger, 2003; Younger & Warrington, 2002). Some of the possible reasons suggested for the differential between the achievements of boys and girls, especially in the traditionally masculine fields of science and math, include: socio-cultural expectations; external problems; internal problems; stereotypically masculine behavior; and poor student-teacher interaction (Mulholland, Hansen, & Kaminski, 2004). Girls tend to have more positive attitudes toward learning and school than do boys, are more willing to work hard, and are more willing to do extra work and homework. Girls are more attentive in class, working hard to compensate for their faulty perception of their ability. Boys, in contrast, over-estimate their ability and are over-confident (Robinson, 2004).
In many industrialized countries, particularly in Australia and England, a shift toward examining the education of boys began in the mid-1990s. Weaver-Hightower, in a literature review of the research on the education of boys, categorized the literature reviewed into four groups: popular-rhetorical; theoretically oriented; practice oriented; and feminist/pro-feminist. He compared the categories by giving a list of representative examples, characteristics, strengths, weaknesses, and gave reasons behind the push toward studying boy education. Weaver-Hightower also outlined the major findings of the two contributing research streams (masculinity and schooling), and suggested a future direction for educating boys. Weaver-Hightower found that, although the statistics show an increasing gap between girls and boys, little has been done to change the education of boys in a systematic way (Weaver-Hightower, 2003).

An approach to instructional strategies, known as “gender-inclusive” has developed based on the input from researchers and teachers around the world. This instructional approach values, extends, and incorporates the preferred assessment and learning styles, current needs, concerns, and interests, as well as prior experiences and knowledge. A gender-inclusive curriculum is equal for both sexes in terms of language, examples, and illustrations. This type of curriculum also emphasizes applications which are socially and environmentally meaningful (Parker & Rennie, 2002). Many different strategies have been employed in recognition of the sex-differentiated modes of learning, including: mentoring – mostly for boys, but sometimes for girls as well; sex differentiated teaching styles; literacy issue focus for boys; merit systems; motivational schemes; and single-sex (SS) groupings (Younger & Warrington, 2002).
Single-sex (SS) education, especially in science and math classes, was a strategy instigated during the 1980s to raise the achievement of girls. The current focus on SS education is for the benefit of both sexes, even though over half the schools studied by Warrington and Younger instigated SS classes because of the perceived underachievement of boys. The ideas behind the introduction of SS classes are that girls will feel less intimidated, boys will not feel the need to act out with masculine stereotypic behavior, and the achievement levels of both sexes will be raised (Warrington & Younger, 2003). The switch to SS classes is a commonly adopted form of intervention, although the adoption of SS classes, their relevance to achievement levels, and even which gender sex would most profit from these types of classes is still under debate (Robinson, 2004).

Research concerning the outcome of SS classrooms tends to show mixed results; much of the discussion about SS classrooms has been either in newspaper-type articles or unpublished conference reports. Much of the discussion refers to anecdotal reports, not scientifically based research, and the benefits of SS schooling are undecided (Mulholland, Hansen, & Kaminski, 2004; Parker & Rennie, 2002). There are no easy solutions to the problem of differential educational achievement by girls and boys; the causes are varied, complex, and inter-related (Mulholland, Hansen, & Kaminski, 2004).

The way SS programs are instigated, introduced, and implemented causes many of the difficulties in interpreting the research on the programs. Teacher preparation, motivation, perceptions, backing, and training are important factors in the success or failure of SS education initiatives (Parker & Rennie, 2002; Warrington & Younger, 2003; Younger & Warrington, 2002). If students are not involved with or prepared for the
decision to implement SS classes, their attitudes may preclude any benefit (Robinson, 2004; Warrington & Younger, 2003). Parental backing may also be a factor in whether or not SS education succeeds or fails (Robinson, 2004; Warrington & Younger, 2003).

Many times the experimental time periods may be too short to show any potential benefit (Robinson, 2004). SS initiatives may be scrapped by a school because the students think it is not fun, or is “boring”, even if the academic achievement goals are being met (Parker & Rennie, 2002; Robinson, 2004).

Current Research

Many places, especially in England and Australia, are now trying single-sex education as an antidote to the underachievement of boys as well as girls. A six month pilot study of 9th grade SS English and advanced mathematics classes researched a school-based program aimed at addressing the needs of underachieving boys in Australia. The researchers asked parents to discuss SS classes with their 9th grade children, and, if appropriate, request a place for their child in a SS classroom. Thirty-two girls and 35 boys requested SS English classes, while 29 girls requested a SS higher mathematics class. Boys were asked to volunteer to be in a SS mathematics class in order to keep the classes evenly balanced for the study. Data were obtained from pre- and post-test results of standardized tests in English and mathematics, grades in English and accelerated math from before and after the study, and semi-structured interviews with teachers and parents of students involved in the study. The results were inconclusive, due possibly to the relatively short period of the study. Girls in the SS mathematics class had a significant, though small, gain on the post-test even though grades were not significantly different. In the SS English classes both boys and girls had higher grade gains than did the students
in the co-educational groups, even though the boys did not have as high a gain as did the girls. Perhaps the gain was due to motivation – more students wished to be in the SS English classes than wanted to be in the SS mathematics classes. Teachers seemed to be aware of sex-specific strategies and learning tasks for the pupils, even though these sex-specific strategies were not completely developed due to the newness of the program (Mulholland, Hansen, & Kaminski, 2004).

Warrington and Younger have been involved in many studies concerning differential gender achievement in schools. In 2002, they published results of a study that combined analysis of the long-term record of SS teaching in a co-educational comprehensive school in England with results from quantitative and qualitative observations in classrooms. The school implemented SS classes in most subjects when the school was founded in the early 1970s, continuing to use them even when Her Majesty’s Inspectorate and the local education authority put pressure on the school to change to co-ed classes. (The socio-economic characteristics and the nature of the student intake did not change during the time period considered by the study, 1988 – 1999.) The girls and boys at this school had performance levels significantly above the national average; the trends of academic improvement showed similarities to those of other schools in that girls outperformed boys at every level and the gap between the achievement levels increased during the period. The school’s results differed from the national trends in that the percentage of both girls and boys achieving high level marks increased ≈ 70% relative to the baseline compared with a national increase of 43.9% for girls and a 38.2% increase for boys during the same time period. Relative achievement level improvement by both sexes was similar and higher than the national average,
although the boys started from a lower base. The pattern in the achievement was variable in the school, with boys twice outscoring girls – due to a dip in girls’ achievement levels while the boys’ levels remained stable, whereas the national pattern showed girls consistently outscoring boys. In the mixed-sex classes at the school, girls asked more questions, took a more prominent role, and participated more; in the SS classes the number of requests for help did not vary with gender. Teachers asked more questions in all boy classes than in all girl classes, but in mixed-sex classes, girls were asked twice as many questions as were boys. In SS classes boys were reprimanded more than praised, whereas girls were praised more than reprimanded; in mixed-sex classes, more praise than reprimands were given to both boys and girls.

Warrington and Younger found some evidence that, in mixed-sex classes, teachers had lower expectations for boys; their expectations were often focused on the confident and articulate girls. In the mixed classes boys were often relegated to the sidelines academically and physically. The boys were cooperative, often passive and working quietly, but not really participating in the lessons. In this school, there was little evidence that the school had provided different curriculums for girls and boys; many teachers informed the researchers that, although the management and classroom discipline may change, the content and methods of teaching were the same for both sexes in their separate classes. Younger and Warrington concluded their study by stating that SS classes are not a guaranteed solution to the disparity between boys and girls. The researchers stated that the potential of SS classes will only be achieved when different approaches for teaching girls and boys are planned systematically, implemented, monitored, and evaluated (Younger & Warrington, 2002).
In another study by Warrington and Younger, concerning SS teaching in English comprehensive schools, published in 2003, the authors found that the reasons for implementation, how the process was initiated, what subjects, what school grades, and how long the SS class form of teaching continued were all factors in the success of the students. Questionnaires were mailed to 90 schools that had used SS teaching within the past three years. From the 31 schools that responded to the questionnaires, the authors made follow-up phone calls to 23 of them, and made in-depth interview visits in 2 of them. The 31 schools had little consistency as to what subjects, what age groups, what levels, and what length of time SS teaching was used. The level of preparation of teachers, parents, students, and departments before SS instruction began also varied widely. Some schools reported using different teaching strategies for the different genders, one had a different strategy only for boys. Sometimes the strategies were pre-planned, usually the staff was unaware that different strategies were appropriate and would be needed; strategies emerged as teachers became aware of the differing needs of each sex. The authors found that schools where SS education was done only for a short time, where the teachers lacked commitment, and where little planning and thought had gone into teaching and management strategies, tended to have little difference in results and often ended up abandoning the SS teaching strategy. Schools where the teachers were involved, enthusiastic, and prepared, where students and parents were involved in the decision making, and where the senior management was committed to SS teaching, reported improved results (Warrington & Younger, 2003).

Parker and Rennie, in their study of gender-inclusive strategies in single and mixed-sex science classrooms in Australia, published in 2002, researched whether
gender-inclusive science instructional strategies were more easily implemented in single or mixed-sex classrooms. The study was conducted in ten government coeducational high schools over a period of two years. Teachers were given nine days of in-service training focused on science/mathematics gender-inclusive instructional strategies at a centralized location and 18 planning and recording days at their schools free of instructional responsibility. The major data collected by the researchers consisted of qualitative data obtained from teacher perceptions, supplemented by quantitative and qualitative data obtained from students as well as data from visits to two schools. Teachers often did not realize that boys and girls had different needs until they taught SS classes. Boys’ classes tended to be rowdier, more competitive, and harder to manage; SS girls’ classes were quieter and more co-operative. Teachers, due to their training, were more able to effectively and readily implement gender-inclusive science instruction strategies in SS classes, and were able to deal with shortcomings resulting from the students’ previous education. Success in boys’ classes depended on whether or not classroom management was dealt with effectively, either before or during the introduction of the gender-inclusive strategies. The authors suggested that SS education may be one strategy that improves outcomes for both sexes (Parker & Rennie, 2002).

The results of a study done in England to investigate the efficacy of a full year of SS science education in the 9th year of a Church of England urban secondary school were used to determine if the SS project would be implemented in the 10th and 11th years and were analyzed for the reasons for the results. The move to SS science classes was believed to be in the best educational interest of all the students and was thus explained to the students and their parents. Students were already tracked as LS (low sets) or HS
(high sets) for science; they were divided fairly evenly into: a class of HS girls; a class of HS boys; three classes of LS boys; and two classes of LS girls. Data included school exam reports in science and mathematics for Years 8 and 9, four themed papers for Year 9, Key Stage 3 SAT scores in science and mathematics, scores for the two previous year groups on the identical tests, SAT scores for the previous year group, and answers by teachers and students to questionnaires. The HS students, especially the HS girls who benefited most from the SS science classes were enthusiastic about continuing in SS science classes. Both HS girls and HS boys made progress and increased their scores; however, HS boys did not do particularly well in biology. LS students did not appear to benefit from the SS science classes. Contributing factors for the LS results could have been the high incidence of low ability levels in the LS boys’ classes, including the need for SEN support staff, as well as the tendency for the LS girls to talk even more than when they were in the mixed-sex classes. The LS students were not motivated to learn and did not appreciate the removal of the opposite sex from the classroom as it disrupted their social interactions (Robinson, 2004).

Benefits

Science instructional strategies targeted to a specific gender are more effective and are more easily implemented in single-sex learning environments (Parker & Rennie, 2002). For boys, gender specific instructional techniques may include the teacher (or Scoutmaster) roaming the area, speaking with a loud voice, and involving all the boys, as the best way to get boys energized is to keep the learning area loud and lively (National Association for Single Sex Public Education, 2005). While some studies on single-sex classrooms report mixed results (Robinson, 2004), many other recent studies show that
both boys and girls learn better in single-sex learning situations, with boys benefiting the most. The two major reasons boys benefit from single-sex education are: that teachers can tailor their teaching to the needs and learning styles of boys, and that the educational experience in an all-boy learning environment is more diverse and well rounded, as boys do not fear being seen as “non-macho.” Mixed educational environments have a subtle gender stereotyping, which is not present in an all-boy learning environment. Boys see co-ed educational environments as being run by “women’s rules” – sit still, don’t talk, and don’t cause trouble (National Association for Single Sex Public Education, 2005). Students feel there are fewer distracters in the single-sex learning environment; boys feel more self-confident (Robinson, 2004).

Students, both male and female, have better educational outcomes when taught by teachers of the same gender. These findings are particularly important, as 58 - 91% of teachers teaching 6th grade core subjects are female. Although the gender discrepancy in teacher percentages declines in the later grades, 83% of 8th grade English teachers are female, as are more than 50% of math and science teachers. The average positive impact on student achievement, when student-teacher gender was the same, was 4% of a standard deviation (Dee, 2006).

Single-sex programs, such as the Boy Scouts of America, may be part of the educational answer for American boys, as Scouting programs provide single-sex educational input in many areas, including science, to boys in ways that meet needs and learning styles of young males. The Boy Scouts of America has promoted male adult leadership since its inception (The Boy Scouts of America, 2008d), without the benefit of statistical research showing that boys have much better academic performance when
paired with a male instructor (Dee, 2006) or that boys do better with hands-on learning styles (Gurian, Henley, & Trueman, 2001; Restak, 1979).

2.3 Summary

In 2010, the Boy Scouts of America celebrate their 100th anniversary, a celebration of 100 years of success in teaching boys science in addition to leadership training and character development. The strategies and techniques employed by the Boy Scouts include, but are not limited to, single-sex education, hands-on experiences, field trips, relevancy through career orientation, peer-teaching, free-choice activities in informal settings, outdoor education, and self-efficacy in the form of rank advancements and merit badges. The Boy Scouts, for the past 100 years, have successfully employed these techniques and strategies that are now, in the current literature, recognized as effective means for teaching students. The science topics covered by the Boy Scout merit badges fit the National Education Standards. The Boy Scout organization states that involvement in Scouting:

1. Incorporates small group interaction with hands-on learning approaches.
2. Encourages creativity and critical thinking.
3. Provides many exciting introductions to curriculum that can match the youth’s abilities and learning styles.
4. Promotes real-world experience.
5. Enriches the family.
6. Provides a fun learning atmosphere.
7. Provides service learning opportunities.
8. Provides socialization opportunities with people of varied age groups.
9. Scouting experiences are welcomed at colleges and universities (The Boy Scouts of America, 2008k).
3. RESEARCH METHODS

3.1 Overall Approach to the Study

This study combined both qualitative and quantitative methods. The areas probed during this investigation, aligned with the research questions, include:

- Personal experiences with science education in Boy Scouting from scientists who were Scouts, Scout leaders, and current Scouts (1. What impact(s) do(es) participation in the Boy Scouts of America (BSA) have on the learning of and interest in science?),

- Scouts’ beliefs in the efficacy of working on merit badges to help in school and Scouts’ favorite things about Boy Scouting (2. What aspects of participation in the BSA influence science learning and interest?),

- Merit badge requirements in relation to the National Science Education Standards (3. Do the merit badge requirements align with the National Science Education Standards?),

- The efficacy of a representative merit badge (Geology) in transmitting science content knowledge, (4. Does participation in the BSA merit badge program (specifically the Geology merit badge) engender science content knowledge as identified by National Science Education Standards?), and
The learning styles of Scouts in relation to BSA presentation of science knowledge (5. What are the learning styles preferences of Scouts?)

Scouts, Scout leaders, and Scout scientists were interviewed to determine their science experiences in the Boy Scouts and whether these experiences were influential in the acquisition of an interest in and knowledge of science. Scouts were asked open-ended questions to determine their favorite Scouting activity to determine if the favorite activities had any science components such as outdoor education or environmental education. The requirements from the Boy Scout merit badge pamphlets and the Boy Scout Handbook were mapped onto the National Science Education Standards to determine if Boy Scout educational material provides science information according to the National Science Education Standards. Scouts were asked if they believed doing merit badges helped them do better in school to determine if participation in the Boy Scout program is perceived to influence school relevant learning. Scouts were tested for science knowledge acquisition and retention for a representative merit badge, Geology to determine the merit badge program effectiveness in transmitting science content knowledge. The learning styles of Scouts were identified to determine if Boy Scout educational material matches the learning style preferences of Scouts.

3.2 Theory

The purpose of the research is to generate theory grounded in the responses of the participants, a grounded theory, constructed from the data, not imposed on the data. A constructionist view of theory development was used in this study, as it was assumed that a theory, possibly one of many lying embedded in the data, would be discovered by the researcher (Corbin & Holt, 2005). The use of grounded theory, with its post-positivistic
roots, seemed appropriate when investigating an educational organization whose
development was influenced by post-positivist educational philosophers including Dewey
and Montessori (Block, 2007; Corbin & Holt, 2005; Meyers, 2005). Analytic tools,
including asking questions and using diagrams and concept maps, were used to tease out
a theory (Corbin & Holt, 2005).

Boy Scouts educational practices grew out of pragmatic theory (Block, 2007); this
American pragmatism fit well with the pragmatic stance of using mixed methods
(Greene, Kreider, & Mayer, 2005). The variety of data sources were used to verify the
research findings through triangulation, member checks, and transferability (Corbin &
Holt, 2005; Talburt, 2004). Quantitative methods were used to: quantify the merit badge
requirements fitting the National Science Education Standards; determine the amount of
geology content knowledge engendered in the Scouts completing the Geology merit
badge through the use of pre- and posttests; interpret the answers to the open-ended
survey questions concerning whether merit badges help in school and favorite things
about Scouting; and interpret the learning styles of Scouts. The quantitative pieces of the
research helped triangulate the data, testing if the Boy Scouts is effective in transmitting
science content knowledge through the merit badge program and attempting to provide
realism and objectivity along with a causal explanation of science knowledge acquisition
in the Scouts. The qualitative portion of the research attempted to explain the contextual
and socially obtained science knowledge construction (Greene, Kreider, & Mayer, 2005;
Lewin, 2005).

The text of the merit badge pamphlets was mapped onto the science standards, which
were then used to provide information concerning the amount and kind of science content
available to Scouts through the use of the pamphlets (Gillen & Petersen, 2005). Determining which merit badge requirements aligned with the National Science Education Standards involved the use of elements of discourse analysis. Determining which elements of the texts of the merit badge pamphlets met which of the National Science Education Standards involved elements of hermeneutical analysis (Brown & Heggs, 2005).

Geology content knowledge acquisition was determined by using pre and posttests to test the amount of content knowledge acquired while doing the Geology merit badge. Open-ended questions were used to ascertain Scouts’ beliefs in the efficacy of working on merit badges to help in school and Scouts’ favorite things about Boy Scouting.

Learning styles were identified by the use of the Learning Style Inventory for middle school students (Hawk & Shah, 2007), the test used was the LSCY assessment based on the Dunn and Dunn learning styles model (R. Dunn, Griggs, Olson, Beasley, & Gorman, 1995) and purchased from http://www.learningstyles.net/index.php?option=com_content&task=view&id=15&Itemid=197.

3.3 Sampling

Settings

Data collection locations were in the Midwest for all parts of this study. The interviewees chose the location for their interview; the settings for the interviews varied and included homes and offices of interviewees, neutral areas at a local university, a restaurant, a neighborhood pool where one of the interviewees worked, and the researcher’s home.
Data collection sites for the *Geology* merit badge/survey data included three Boy Scout summer camps, a landmark site, a community college and quarry, a science museum, and meeting sites for two Boy Scout troops. The Boy Scout camp areas were all located in roofed shelters with no walls. The landmark site and the science museum had educational areas in which to collect the data. The pretest at the community college was administered in a classroom; the posttest was completed at a quarry. The two Boy Scout meeting sites were in church activity rooms.

**Enrollment and Ethnicity**

The Boy Scouts of America does not track enrollment by socioeconomic status either on the local or national level. During 2008, in the Central Division of the BSA where the study was conducted, 14.1% of the available population of boys was enrolled in Boy Scouts, slightly higher than the national enrollment rate of 13.96%. The Northeast Division of the BSA enrolled 12.3% of the available population, the Southern Division enrolled 11.6% of the available population, and the Western Division of the BSA enrolled 18.2% of the available population of boys. In 2008, the number of boys enrolled in the Boy Scout program was 913,588.

In 2008, the year the data were collected for the study, the local council enrolled 19,549 participants in the traditional Boy Scout programs of Cub Scouts, Boy Scouts, and Venture Crew. Of the 19,549 members, there were 938 enrolled in Venture Crew, 5,214 boys were enrolled as Scouts in the Boy Scout program, and 13,397 boys were enrolled in the Cub Scout program. In the local council area during 2007, there were 45,550 boys between the ages of 11 and 13. Of this population, 5,252 (11.5%.) were enrolled in the Boy Scouts (The Boy Scouts of America, 2008i).
Many boys drop out of Scouting between 6th and 7th grade; crossover from the Cub Scout program to the Boy Scout program occurs during the later part of 6th grade. According to the local council records, enrollment in Boy Scouts in the 7th grade was 79.4% of the 6th grade enrollment. Many boys evidently stayed in the Boy Scout program for only one year, as 8th grade enrollment in the Boy Scout program was 59.2% of the 7th grade enrollment, 47.1% of the 6th grade enrollment. Boy Scout enrollment was similar for grades 8, 9, and 10, with a slight dip in grade 11. Enrollment in the Boy Scouts for grade 12 was similar to the enrollment for grade 11. The enrollment in 12th grade was 43.4% of the 7th grade enrollment, 73.3% of the 8th grade enrollment (The Boy Scouts of America, 2008i).

According to a spokesperson from the local council, the council is comparable to other councils in the Midwest where much of the population is European American (categorized as Caucasian in the Boy Scout statistics). The Boy Scout recruitment activities are similar in all parts of the country; however, there are two Boy Scout recruitment programs that target ethnic minorities, Scoutreach and the Soccer in Scouting program. The Scoutreach division “gives special leadership and emphasis to urban and rural Scouting programs,” to make sure that “all young people have an opportunity to join Scouting, regardless of their circumstances, neighborhood, or ethnic background” (The Boy Scouts of America, 2008i). The local council is working with Scoutreach in the capital city area where the minority population is 33.4% of the population (U.S. Census Bureau, 2008). The local council is not as involved in the Soccer and Scouting program, a program targeting Hispanic youth, as are councils with larger Hispanic populations.
The council representative stated that the local council was a 400 level council, meaning that it was a medium to large council. The council was similar to other councils of similar size, but would not be similar ethnically to councils located in very large cities like Los Angeles.

Enrollment in the local council by ethnicity of the 25,400 youth enrolled in all the traditional Boy Scout programs included:

- African American - 5.3%
- Alaska Native - <0.01%
- Asian - 1.0%
- Caucasian - 79.2%
- Hispanic - 1.6%
- Native American - 0.3%
- Other - 1.4%
- Pacific Islander - 0.1%
- Unknown - 11.0% (The Boy Scouts of America, 2008i).

The diversity of boys enrolled in the Boy Scout program was similar to the diversity of the regional inhabitants. The council where most of the research was conducted did not include the two cities in the state with the highest population of African Americans. The local council included large rural sections where the population had a higher percentage of European Americans than did the cities. The state demographics included:

- African American – 12.0%
- Alaska Native and Native American – 0.2%
- Asian – 1.5%
- Caucasian – 82.9%
- Hispanic – 2.3%
- Two or more races – 1.3%
- Pacific Islander – Z (U.S. Census Bureau, 2008).

The demographics of the second Midwestern state where data were collected were:
African American – 6.0%
Alaska Native and Native American – 0.9%
Asian – 2.0%
Caucasian – 85.7%
Hispanic – 4.7%
Two or more races – 1.1%
Pacific Islander – Z (U.S. Census Bureau, 2008).

The demographics in the third Midwestern state where data were collected were:

African American – 2.5%
Alaska Native and Native American – 0.4%
Asian – 1.6%
Caucasian – 91.0%
Hispanic – 3.8%
Two or more races – 1.0%
Pacific Islander – Z (U.S. Census Bureau, 2008).

One hundred and ninety boys answered one or both of the open-ended questions attached to the pretest for the Geology merit badge; 185 boys answered the question concerning whether doing merit badges helped them do better in school and 182 boys answered the question concerning their favorite thing in Scouting. Of the 190 boys who answered a question from the open-ended questionnaire, 97.3% were European American, 1.0% were African American, 1.0% were Asian, and 0.5% were Native American.

Sampling Information

Theoretical sampling, pursued during the formation of a grounded theory, allowed the researcher to pursue persons that enable comparisons of data, “thus extending knowledge about the properties, dimensions, and relationships between concepts,” (Corbin & Holt, 2005). In order to pursue the relationships between science as experienced by Scouts, perceived and provided by Scout leaders, and recognized and practiced by scientists, the samples investigated in this study included Scouts, Scout
leaders, and scientists who were Scouts. The selections of the interviewees was purposeful, the interviewees were selected to increase the available information (Lewin, 2005).

Interviews were coded and used as a source for concept development and the development of grounded theory (Corbin & Holt, 2005). The interviewer adopted the pose of the listener in order to not impose on the interviewee, rather to listen and see from the interviewee’s perspective the answers to the interviewer’s open-ended questions (Barbour & Schostak, 2005). The sample size was complete at saturation, “the point in the research process when no new concepts or further properties” emerge from the data (Corbin & Holt, 2005).

The size of the sample needed for evaluating the effectiveness of the Geology merit badge pamphlet in engendering content knowledge acquisition and the sample size for the learning styles portion of the research needed to be greater than 30 so that the effect size was not large by chance alone (Ary, Jacobs, & Sorensen, 2006).

3.4 The Researcher’s Role

The researcher’s role in the quantitative merit badge assessment portion of the study was to enroll participants and to administer the pre and posttests. In the role of primary data-gathering instrument to collect data for discovering and/or building a grounded theory, the researcher asked questions about the interviewees’ experiences with and observations of science education in the Boy Scouts (Ary, Jacobs, & Sorensen, 2006). The “symbolic interactionist assumption” concerning data construction by means of interaction between the interviewer and the interviewee necessitated collection of as full a record as possible of all the words and behaviors from the data collection
experience. These records of structured observations were collected by means of audiotape and field notes, both of which were scrutinized for patterns. The researcher personally transcribed the interview tapes (L. Jones & Somekh, 2005). This personal connection of the researcher with the data collection, transcription, and analysis gave the researcher access to contextual information not available on the recording (Erickson, 1985).

The researcher, because she was female and older than 18, was not a participant observer. However, as the mother of a son who had been a Scout for several years, the researcher existed at the fringes of the Boy Scout group, participating in some of the Boy Scout activities and absorbed into the culture of Scout parents. As a scientist, the researcher was able to connect with the subpopulation of scientists in the research population; as a merit badge counselor for several science related merit badges, the researcher was able to connect with the subpopulation of Scout leaders (L. Jones & Somekh, 2005).

The researcher analyzed the data, looking constantly during the data collection for similarities and differences in the participants’ responses in order to formulate a grounded theory. The researcher did the primary textual analysis of the merit badge requirements, mapping the science content information onto the National Science Education Standards (Ary, Jacobs, & Sorensen, 2006).

3.5 Data Sources

The research participants consisted of two groups, Scouts and adults affiliated with the Boy Scouts. The adults (n=8) participated in the interview section of the data collection, along with four Scouts, three of whom also participated in other sections of
the research. Scouts (n=197) participated in the interviews, the Geology merit badge assessment, the learning styles research, and answered the open-ended survey questions.

![Figure 3.1 Interview Participants](image1)

![Figure 3.2 Scout Participants](image2)

96
3.5.1 Participants

The Boy Scouts of America has protection policies in place to protect boys (The Boy Scouts of America, 2008d). The researcher passed the requisite background checks necessary to work with Boy Scouts. Scouts signed assent forms and their parents signed permission forms in order for the boys to participate in any research. Adults who participate in the research signed consent forms; scientists signed consent forms giving permission to use their names in the study. Boy Scout councils in data collection areas provided letters of support. Boy Scout camps, the landmark, and Boy Scout troops, whose members participated in the study, approved participation of their locale or Scouts in the study. The Internal Review Board of The Ohio State University reviewed and approved the study.

Interviewees

The interviewees (n = 12) consisted of four Scout leaders, four Scout scientists, and four Scouts. The group of scientists interviewed included a geologist, a paleoclimatologist, an actinide chemist, and a biochemist. Two older scientists were interviewed, men who have achieved recognition in their chosen fields. Two younger Scout scientists were interviewed, as they were Scouts more recently and would be the products of Scouting from the late 20th century rather than the middle of the 20th century. The scientists interviewed were from different parts of the Midwest; two were affiliated with a research I institution in a capital city, one was a geologist involved in private industry, and one was affiliated with a research I institution in a different Midwestern state.
The Scout leaders interviewed included a science teacher, a motivational instructor, a college student, and a law professor. The purposeful selection of these interviewees expanded the information from Scout leaders of different gender, age, occupation, and length of time involved with the Boy Scouts. The high school chemistry teacher and trained Boy Scout merit badge counselor was a female who worked mostly with the Venture Crew. The college student and motivational instructor were lifetime Scouts who came into leadership after they finished their Eagles. The science teacher and the law professor became involved in Scouting through the participation of their sons. One of the science teacher’s sons was an Eagle Scout who was out of the troop; her younger son was a current Scout. The law professor, who had been a Cub Scout but not a Boy Scout, gave his time and leadership to the organization because of his belief in the Scouting program, even though his Eagle Scout son was now an adult. The Scout leaders were from various troops and locations within the same state. Two were from different suburban towns near a capital city in the Midwest, one from a large city, and one from a midsized town.

The Scouts interviewed were all older Scouts, three Juniors and a Senior. Three of the Scouts were 16; one was 17. All the Scouts were Life Scouts, working towards their Eagles. The oldest Scout was preparing for his Eagle Board of Review; the younger Scouts were finishing their last required merit badges. Older Scouts were selected for this project as they had more experience with Scouting and science in the Boy Scouts. The Scouts were all from different troops and locations in the metro area of a capital city and appeared to be from varying socio-economic backgrounds.
In addition to the people interviewed for the project, the researcher also interviewed a Scout leader who was the Geology merit badge counselor for one of the troops participating in the merit badge research. The scout leader/merit badge instructor worked with a troop in a small, economically depressed town in a Midwestern state.

The high school science teacher, Ms. C., was the first Scout leader interviewed. During the interview, Ms. C. revealed that she had been a Girl Scout for 12 years, becoming a Senior Girl Scout and making her four challenges. Ms. C. stated that she was encouraged to enter the sciences because of the experiences, good leadership, and role models she had in the Girl Scouts. She credited her Girl Scout experience with developing her sense of confidence and teaching her to be a “little more assertive.” Ms. C. has been a Scout leader for six or seven years, mostly as a merit badge counselor for science merit badges, but recently as a Venture Crew co-leader with her husband, an Eagle Scout. She became involved in Boy Scout leadership because she has two sons, one of whom was a third generation Eagle Scout, the other was working toward his Eagle. Ms. C. said Boy Scouts provides youth with opportunities to “experience things, see things, try things, appreciate things. The BIG pieces I teach - I teach Scouts to teach what they know. Share it. That’s the biggest piece of it.”

Scout leader, Mr. A. entered the Boy Scouts as a Tiger, the Cub Scout rank for seven-year-old boys. At the time of the interview Mr. A. was 21 years old and still active in the Boy Scouts; he was interviewed while serving as Nature Director and merit badge counselor for a Midwestern Boy Scout Camp. The highest rank Mr. A. achieved was Eagle Scout with two Palms. Mr. A. was, at the time of the interview, the Assistant Scoutmaster for the troop in which he grew up: he became involved in a leadership role
when he turned 18. Mr. A was majoring in wildlife biology at the local community college, the location of which made it easier for him to join the troop on their camping weekends. Mr. A said that Boy Scouts had a 100% influence on his life, career choices, and hobbies. Mr. A stated,

I ... came up to camp every summer...From a young age I was exposed to nature and how beautiful it can be. I didn’t know what I wanted to do with my life. I started working up here at summer camp, and I realized that biology is where I really want to be ...I would say, 100%, Boy Scouts is the reason that I love nature as much as I do.

Scout leader, Mr. F., a university professor, was a Cub Scout for four years, but did not do Crossover or become a Scout; his Boy Scout experience was not a major influence in his career or interests. Mr. F. perceived the need for Scout leaders when his son reached Cub Scout age and wished to join Boy Scouts. He became a Scout leader at that time and had been involved in the Boy Scouts for the past 21 years, continuing even when his son became too old to be a Scout. Mr. F. was, at the time of the interview, the director of a Boy Scout camp in the Midwest, where he made sure Scouts had fun science activities in addition to their merit badge work. Mr. F., speaking about Boy Scouts stated:

I think it is a wonderful venue for people to learn, to appreciate the natural world. You can’t sit in a classroom, under fluorescent lights, with no access to the natural world and learn about it. You really need to experience it. ... I think very important that it be outdoors.

Scout leader, Mr. R, who works in human resources and adult education, started his Boy Scout career when he was eight years old, and was, at the time of the interview, in his 49th consecutive year of Boy Scouts. “Got in at eight years old and never been out.” Mr. R. got his Arrow of Light, became a member of the Order of the Arrow, earned
his Eagle and one Palm; he joined a Boy Scout camp staff as an instructor at age 15. Soon after Mr. R. got his Eagle, his Scoutmaster came down with a medical condition that left him unable to work with the troop for two years. Mr. R., with the troop committee’s guidance, took over the running of the Scout troop, becoming Acting Scoutmaster. When asked if Boy Scouts influenced his life or career choices, Mr. R. stated:

Well, absolutely it did. Once I graduated from college, my ... inclination, was to become a professional Scout, which I did for five years, both in the District ... and then as Program Director for the Council. That took me ... a natural movement into human resources at that point, so, yes. Absolutely.

Scout scientists gave permission for their names to be used in this and other papers leading from this research, upon condition that they be allowed to look at what was written before publication. Of the four Scout scientists who participated in the research, two had been in their careers for several years; two were just starting their careers. One of the four Scout scientists one was a Life Scout and three were Eagle Scouts.

Dr. Lonnie G. Thompson, paleoclimatologist and distinguished university professor, winner of the Vega Medal, member of the National Academy of Science, winner of the National Medal of Science, winner of numerous other awards, and named a Hero of the Environment by Time in 2008, started his Boy Scout career in 6th grade. Dr. Thompson earned his Life Rank, but not his Eagle; his troop dissolved before he could finish the requirements. His Boy Scout leaders were very involved, taking time away from their work to volunteer and camp with the boys. Dr. Thompson’s reasons for joining Boy Scouts included, “having structured activities,” his love of the “outdoors,” the
ability, “to go out camping in remote parts of West Virginia,” and the fact that, “a lot of my best friends were in Scouts.” Dr. Thompson counted his time in the Boy Scouts as a, “very important learning experience over those years.” Dr. Thompson, whose research involves traveling to remote tropical mountains to drill ice cores in order to study climate change, stated his Boy Scout experiences of camping in the mountains probably played a role in his life and career choices. He also credited his experiences of working on merit badges with developing his interest in the outdoors and the environment, “much more than it would have without them”. When asked if he would be doing his current research if it had not been for his Boy Scout experiences, Dr. Thompson answered:

It’s always a good question. ... I’m not sure about the answer to that. Because, in a way, you’re attracted to certain things because of your interests in nature, and certainly Boy Scouts were very important in developing and allowing those interests to develop in a structured environment ... that probably was very, very important in that regard.

Dr. Thompson stated that field experiences are very important, that the older geologists think that field camp is the most important thing for their students as field camp gives the students the experiences of being part of a system, exposure to the real world. The problem is that fewer and fewer students are signing up to attend field camp. Dr. Thompson wondered if people who were not Scouts, people who did not learn in the real world as Scouts, were different in how they view the world and deal with the world than were Scouts. Dr. Thompson seemed to think that scientists who were Scouts may be different from scientists who were not Scouts or who did not have the “real world” experiences. He stated, “I think Scouting is very important in that it gets young people out into the real world and experiencing the real world” (Thompson, 2008).
Mr. Sherman Lundy, Scouter, geologist, winner of the Silver Beaver award and co-author of the *Geology* merit badge pamphlet, joined the Boy Scouts during the 40th anniversary of Scouting when he was 11; he became an Assistant Scoutmaster at the age of 18. Mr. Lundy was influenced to become a Scout by reading old books about adventures in Boy Scouting and by his father, who had been a Lone Scout around the time of WWI and a Scoutmaster near the time WWII started. One of Mr. Lundy’s highest treasures is his Eagle, which he earned with three Palms. Mr. Lundy felt that Boy Scouts influenced his life a great deal, because...

...great deal, because ... the program of Scouting teaches you to learn how to work with others. It teaches you to make choices, to be dependable, and to seek answers and solutions to achieve a means to an end. It teaches you about leadership. It teaches you how to be a good follower, as well as a good leader, which I think are important in life.

Mr. Lundy earned all the Boy Scout science merit badges that were available when he was a Scout; science had always interested him. Merit badges got him:

...in to the subject matter ... the sciences, the *Geology* merit badge, the *Conservation* merit badge, the *Astronomy* merit badge - all of those piqued my curiosity, and I think helped lead me into this career program.

My favorite topics in science, terms in science are hands-on-mind-on. That’s my favorite litany. I like that approach because that’s what Scouting merit badges are – they’re hands-on-minds-on. If you look at them, they’re focused, and they’re direct...you get a chance to get out and do something. You don’t beat it into the ground. You get enough to stimulate your interest and curiosity over here, and when you walk away from it, you’ve got some neat experiences. That’s what I like about it (Lundy, 2008a).

Dr. Jason Sonnenberg, an actinide chemist, studies the elements on the bottom line of the periodic table. He joined the Cub Scouts on the invitation of family friend, who was running a Cub Scout den for Jason’s friends, over the initial objections of his grandmother, who, believing the misconception that “Scouting was just a training ground
for the military,” thought the Boy Scouts would turn Jason into a “militaristic little kid.”

Dr. Sonnenberg stated that Boy Scouts, with its reward system and leadership training, definitely influenced his life and career choices. Dr. Sonnenberg was in Boy Scout leadership for a time, moving from Eagle Scout to Jr. Assistant Scoutmaster and eventually Assistant Scoutmaster between the ages of 17 and 21 before his research and Ph.D. work interfered. During this time, he was also a merit badge counselor. Dr. Sonnenberg considers his Eagle Scout his highest accomplishment to date, even more than his Ph.D. The Board of Review for the Eagle was, in his mind, definitely harder than his Ph.D. oral exam – by the time he got to the Ph.D. oral, he had already done three oral exams, including his Eagle Board of Review, thus felt more prepared than he had for his Eagle Board of Review. Dr. Sonnenberg’s opinion of the Boy Scouts, “I think it’s the best program going for young men.” Dr. Sonnenberg would like to see more collaboration between universities and the Boy Scouts, with the university departments hosting merit badge programs and reviewing the merit badge pamphlets to make sure the books are up to date and have the newest, most updated information (Sonnenberg, 2008).

Dr. Leo Porchia is a biochemist studying the reaction kinetics of Hepatitis C virus propagation in order to develop an inhibitor for the virus. Dr. Porchia joined the Boy Scouts as a Tiger, because his friends were joining. He became a member of the Order of the Arrow and earned his Eagle a month before his eighteenth birthday. When asked if the Boy Scouts influenced his life or career choices in any way, Dr. Porchia responded:

Well, that’s ... a very good question. Scouting - we did camping, we shot weapons ... worked for goals. I joined the Army after high school, so, you could say, yes, it did, because I was predisposed to know all those things that you do in the Army, with essentially just real guns, camping in different places, ... So, I would say, yes, it did. It affected me in the long run...from my Army and my...
Scouting experiences - I did very well in college. ...made me want to be more... science driven... my exposure to science was definitely through Scouting. Not through school, definitely...in school, you read. Scouting we got hands-on, which was more interesting (Porchia, 2008).

The Scouts interviewed were all older Scouts, as they had more experience with the Boy Scouts. All were from the metropolitan area of a Midwestern capital city, their socio-economic backgrounds varied. Three were European American, one was Native American/European American. One boy attended a private preparatory school for boys, one boy attended a suburban high school, and two boys attended a small magnet school in the city school district. All the boys were Life Scouts, working on their Eagle rank; some were closer to finishing than others.

J., at the time of the interview, was 17, a senior in high School, finishing his Eagle, and finalizing the paperwork. J. joined the Boy Scouts as a Webelo and earned his Arrow of Light. His favorite subjects in school were, “math and probably history.” His favorite thing to do in the Boy Scouts: “camping,” because, “it’s a chance to get away from society and be out in the middle of nowhere pretty much for us. And, kind of be on our own for a week to cook and sleep by ourselves.” While camping, his favorite thing to do is, “…play with fires. I know a lot of guys like doing that … It’s fun to see how many different ways you can start a fire. In a safe way, though.”

J.’s Boy Scout High Adventure trips included Sea Base and Northern Tier; he planned to attend Philmont as an adult during the year following the interview in order to earn his “Triple Crown.” J. thought that the Boy Scouts gave him an advantage in school because he was more interested due to his experiences; he had a background and questions for which he wanted to find answers. J. wanted to major in engineering in
college. When J. was asked how his Boy Scout experience prepared him for his college major, he responded, “it’s taught me how to have a lot of fun with things - Scouts, and that a job doesn’t always have to be just completely boring and something that you do. It can actually be fun and something that you enjoy to do.” According to J., Boy Scouts had some influence in his choice of major, because, by giving him, “a broader knowledge of science fields, I know exactly what that entails, so I’m actually leaning more towards that because I like that kind of stuff.”

D., at the time of the interview, was 16 and a junior in high school. D. started Boy Scouts as a Tiger, earned his Arrow of Light, and became a member of the Order of the Arrow. D., at the time of the interview, was a Life Scout finishing his last Eagle required merit badge, Communication, and organizing his Eagle service project. His favorite Boy Scout activity, “Definitely have to say that camping, just the fun of being able to go out... just do... something fun - Going camping.” D. has been on two Boy Scout High Adventure trips, Sea Base and Northern Tier. He planed to go to Philmont the first chance he got, probably the summer of 2009. D.’s favorite subjects in school were anything that had to do with science; he preferred biology and chemistry to physics, “Just interested in life, how it works basically, chemicals, atoms.” D. had been working on where to attend college, he wanted to major in microbiology; his test scores and GPA qualified him for a full ride scholarship in many schools. When asked if he would have been as interested in science if it had not been for the Boy Scouts, D. answered that he had always had a lot of fun in the Boy Scouts with science. D. stated:

I think there’s definitely some part of me that really always liked science and really always wanted to spend my life in it, but I really think Scouts kind of brought science into my life a little bit more and got me more of a hands-on grasp
on it that I might not have gotten in school alone...Cub Scouts and Boy Scouts, they had science-based activities and they always linked it with enjoyment, something that you do with your friends. Hey, science is something cool. Whereas in school, it’s just another subject that you study and you might not always look at it with enthusiasm if it’s keeping you from playing video games or anything while you’re doing it as homework at home.

D. wanted to:

...just emphasize the fact that Boy Scouts and Cub Scouts, if nothing else, really just introduces science in a fun, kind of casual way. Maybe not that hard or challenging of concepts at first, but they basically introduce you to science and get you excited about learning it, which, as you develop and grow, you apply that open-mindedness and willingness to learn to other aspects of your life, which can really help you learn in the end.

B., at the time of the interview, was 16 and a junior in high school. B. became a Scout when his uncle invited him to a Boy Scout event at a local church. B. decided to join the Boy Scouts because of the camping and as something that would get him out of the house. Things about the Boy Scouts that B. enjoyed included the meetings, playing games, working on advancements, and having a good time with his friends. B. had one more Eagle required merit badge, *Personal Management*, and was thinking about what to do for his Eagle service project. B.’s troop, established in 2002, had not done much travel; B. had gone to several summers to a local Boy Scout camp. The troop had visited a couple local businesses while Scouts were working on merit badges associated with those fields. B.’s favorite school subjects were social studies related - history and government. B. was not sure of his college major; he thought he might possibly get a Master’s degree in library science and become a librarian. He was also considering being a writer for a newspaper, as he would like to include “political stuff” in his writing. B. felt that his experiences in the Boy Scouts helped, “me do well in class.” B. stated:
Scouts, ...we...focus more on...building...a family together... Building a team, building how to get along with each other...we’ve got to be careful of how treat each other, how we should work together...It’s still life skills that they can use in their careers. It’s necessary.

Scout K. at the time of the interview, was 16 and a junior in high school. He was working on his Eagle Scout rank, planning to do his Eagle service project at a local park during the winter or spring. K. and his twin brother were planning to get their Eagles; they would be fourth generation Eagles, following their father, grandfather, and great-grandfather. K. felt his parents had him involved in the Boy Scouts since he was born; adventure and the ability to get out of the house were what attracted K. to the Boy Scouts. Adventures, “Like rock climbing, backpacking, swimming” were K.’s favorite things about the Boy Scouts; he was a self-proclaimed “fire-bug.” K.’s troop had done quite a bit of travel; Tennessee, Kentucky, Indiana, Maine, Washington, D.C., and Gettysburg were some of the places the troop visited. Canoeing in Canada (Tinnerman), hiking part of the Appalachian Trail, and biking in Southern Ohio were some of the activities K. had done with his troop. K. thought the Boy Scouts was important because:

...we actually get out in the field...when other troops go to really far away places, they get to see other parts of the United States...other parts of the world...actually learning other features around the world. While other kids are stuck at home or, when they go on a family trip, they have an itinerary, they stay in the city or something, they don’t actually get to get out in the wilderness and learn different things... Going to all the different places we go...you find different historical places that you learned about, or you find different biological things that the biology teacher talked about, like adaptations. You see animals adapting to different areas, or the destruction, like the Ash Borer down south. We actually got to see that.

K.’s favorite subject in school was biology, “Biology and chemistry, all sciences, basically”; he planed to get his Ph.D. in Veterinary Medicine and open his own hospital, specializing in surgery on large and/or exotic animals.
**Geology Merit Badge Participants**

The three self-selecting populations in the *Geology* merit badge portion of the study included: boys who were members of the control group, who took a pre and a posttest, but did not work on earning the *Geology* merit badge; boys who were members of the longitudinal study, who had, at some time since becoming a Scout, earned the *Geology* merit badge and participated in the study by taking a posttest; and boys who earned their *Geology* merit badge, taking a pretest and a posttest so their content knowledge acquisition could be measured.

![Bar chart showing Geology Merit Badge Participants](image)

Figure 3.3 *Geology* Merit Badge Participants

**Learning Styles Participants**

Learning style participants self selected to participate in the study. Scout leaders were informed of the study at a “round-table” meeting, a monthly meeting for district Scout leaders. Boys who attended the weekend event at the science museum, boys from...
the troop activities, and boys from camps were invited to participate in the learning styles research project. Participation in the project was limited, possibly due to self-selection of boys to participate in the study, possible loss of instructions, and non-interest in assessments – too much like school. The researcher did not have contact information for individual Scouts, so could not contact the Scouts invited to be in the study.

3.5.2 Merit Badge Pamphlets

The requirements for the Boy Scout merit badges were taken from the book *Boy Scout Requirements 2008* (The Boy Scouts of America, 2008c). The researcher mapped the merit badge requirements onto the all National Science Education Standards for grades 5-8 and grades 9-12, except for the UNIFYING CONCEPTS AND PROCESSES standard (*National Science Education Standards*, 1996).

3.6 Data Collection

The three primary methods of data collection for this study included testing, interviews, and text analysis. Pre- and posttest data were collected from Scouts earning a Geology merit badge (*Appendix G*). The content validity of the instrument constructed for this investigation was determined by a panel of expert judges in the fields of geology and science education. The quantitative design for testing the efficacy of the Geology merit badge pamphlet in engendering science content knowledge was a combination of designs put forth by Campbell and Stanley. As random sampling was not feasible, the designs were quasi-experimental in nature. A non-equivalent control group design was used for the Scouts taking the Geology merit badge; the control information was collected at summer camps. Scouts in the control group and Scouts who participated by taking the Geology merit badge during summer camp took their pre and posttests at the same time.
at the start and end of the summer camp week. Scouts who had already taken the
Geology merit badge were given the posttest to determine if there were any long-term
effects on science content knowledge (Campbell & Stanley, 1963). Scouts who did the
Geology merit badge at weekend events, at summer camps, and Scouts taking the merit
badge with their troops were given pre- and posttests. The results from each type of
location were compared to see if there was a significant difference in science content
knowledge acquisition by type of location. (The weekend event at the local science
museum, although set up for the boys to do the Rocks and Minerals option of the
Geology merit badge, in fact did the Surface Processes option instead. The data from this
location were not included in the analysis of the Geology merit badge.)

<table>
<thead>
<tr>
<th>Location</th>
<th>Pre-test</th>
<th>Merit Badge</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No badge (Control Group)</td>
<td>O</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>Previous badge (Longitudinal Group)</td>
<td>Average of all pretest scores across control and treatment groups</td>
<td>X (earned badge previously)</td>
<td>O</td>
</tr>
<tr>
<td>Current badge</td>
<td>O</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>Weekend event</td>
<td>O</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>Troop event</td>
<td>O</td>
<td>X</td>
<td>O</td>
</tr>
</tbody>
</table>

Table 3.1: Research Design

Using the nonequivalent control group for the Scouts taking the Geology merit badge
at summer camp was designed to control for internal sources of invalidity of history,
maturation, testing, instrumentation, selection, and mortality but not for interaction of

111
selection and maturation. As neither the control nor the experimental/treatment groups were chosen for extreme scores, regression to the mean may not have been an issue. Using self-selected groups for the control and experimental groups, in which the experimental group deliberately sought exposure to X with no control group available from this group of seekers, increased the probability of selection interactions. Using the nonequivalent control group did not control for external sources of invalidity such as the interaction of testing and intervention, but, as the Scouts were not randomly pulled out of a program to participate in an intervention, these threats were less than they would have been in a true experimental design with random assignment to intervention and control groups (Campbell & Stanley, 1963). Separate control groups for Scouts taking the merit badge on a weekend event or a troop event was not possible; the control group from summer camp was used as the control for all treatment locations/groups.

Locations

Camps

The researcher collected data at three Boy Scout summer camps in a Midwestern state. The researcher located the camps offering the Geology merit badge by searching the Internet and talking to Boy Scout leaders. After obtaining a letter of support from the local Boy Scout council, the researcher contacted the Boy Scout camps to obtain permission from the camp directors to collect data on the Geology merit badge. One camp, of the four camps contacted by the researcher, was not able to participate in the study. After obtaining support from the council and permission from the camps, the researcher had to collect parental permission forms and personal assent forms from the
Scouts. Boys could not participate in the study unless the researcher had both parental permission forms and personal assent forms from the Scout.

Two camps had participants in the control sample, longitudinal sample, and treatment sample; one camp had participants only in the treatment sample. At the camp where only treatment data were collected, the researcher sent packets to the camp containing permission forms, assent forms, information about the research program, and a self-addressed stamped envelope in which to return the permission and assent forms to the researcher. The camp staff, during pre-camp meetings, distributed a packet of information for each Scout registered to take the Geology merit badge to the Scout leaders bringing boys to camp. The researcher collected permission forms, director of the natural science area of the camp collected the pre and posttest data for the researcher. Nine boys, during two separate weeks of camp, participated in the Geology merit badge study from this location. At this camp, the Scouts met daily with the merit badge counselor at a designated time to complete the merit badge requirements.

The researcher collected control group information, longitudinal study information, and treatment study information at the other two Boy Scout summer camps. The names and e-mail addresses of the Scout leaders bringing boys to the camp were given to the researcher. The researcher contacted the Scout leaders and sent each Scout leader a packet for each boy attending camp and a description of the study. The packets contained information about the research program, permission forms, assent forms, and a self-addressed stamped envelope in which to return the permission and assent forms to the researcher. The researcher was unable to contact one of the Scout leaders bringing Scouts to camp, another Scout leader did not want his boys to participate in the study.
The researcher distributed 269 packets to the Scout leaders bringing the boys to the three camps; 70 Scouts participated in the study as a member of one of the three sample groups. The researcher was present when the Scouts registered for the camps; boys were allowed to participate in the study if they mailed their permission and assent forms in to the researcher, brought the forms to camp, or if they and their parents signed forms when the boys signed in at camp registration.

The researcher was not present for all the interactions of the camp Geology merit badge instructor with the treatment sample at any of the camp locations. Two camps had set times for the boys to meet with the merit badge counselor on a daily basis; one camp had open hours for merit badge work. At the camp with open hours for merit badge work, the boys were free to choose when and where they would work on the merit badge. At camps with set hours, the boys met in a group at a set time with the merit badge counselor. To finish the requirements, each boy, at each camp location, had to have a one-on-one discussion with the merit badge counselor before he received his merit badge.

A Landmark Site

The researcher located a Midwest landmark site (L) by reading, on the Internet, information concerning their program for Scouts to earn the Geology merit badge. The researcher contacted the landmark and the local Scout council, obtaining a letter of support from the local Boy Scout council to collect information from Scouts attending the event. The letter of support from the local Boy Scout council contained the caveat:

I must require that you have a signed parental permission slip for each boy that is participating in this research and that you follow our guide to safe Scouting standards while conducting your research. At no time should you or any other adult be alone with a Scout and all activities must take place with two deep leadership.
The landmark administrators had to obtain permission from their authorities to enable the researcher to collect data at the site. The landmark site could not release the names of the boys registered to participate in the program, but gave the researcher the troop numbers as well as the city and state where the troop was located. The researcher contacted the Boy Scout district offices to obtain contact information for the troops, then contacted the Scout leaders of the troops, explained the research program, and sent the Scout leaders the information packets, the assent forms, and the parental permission forms to distribute to the Scouts and their parents. There was a very high rate of Scout participation at the landmark site; of 43 Scouts enrolled in the event, 36 Scouts brought their permission and assent forms to the researcher. Only seven Scouts who participated in the event were not in the study, six of these because they were not present for the pretest due to foggy weather conditions and one because a parent had not signed the permission form.

The program at the landmark concurrently offered a Geology merit badge for Boy Scouts and a Geology pin for Cub Scouts. The groups were commingled for the presentation, with the same material and activities being offered to both. The Scouts and Cub Scouts were divided into four groups for the program, with both Scouts and Cub Scouts in all of the groups – the boys were not separated by age, grade, or group affiliation. Most groups had about 40 people, which included Scouts, Cub Scouts, parents, and Scout leaders. Each group was divided into half (~20 people) for the cave tour. There was no lunch or snack break, the event went from 10AM until 1PM.
This program was not a Boy Scout program, but seemed to be a program put on for many different groups by the landmark staff and targeted to Scouts for this event. Scouts had no discussion with a merit badge counselor for any of the requirements; the requirements were assumed to be met when the activity was complete. The presenters, female except for one cave guide, were excited about teaching the boys but did not focus on the discussion parts of the requirements, possibly because of not having been Scouts. There was no geologist present, but the staff members were all very knowledgeable about the geology specific to this site. The requirements for the badge were touched on very briefly. The program was three hours total in length, including a tour of a cave which took almost one hour of the allotted time. Most of the requirements were “met” during a 45 minute power point presentation, which seemed to be a “show and tell” type of event.

The presenter, to meet Requirement 1, Define geology. Discuss how geologists learn about rock formations. In geology, explain why the study of the present is important to understanding the past, defined geology and geologist, using interactivity Q&A with the boys; there was no review after the terms had been defined. Origin, structure, and history were touched on briefly. John Hutton and his Uniformitarianism Theory of the present as the key to the past were presented briefly. The boys said the word, “uniformitarianism” as a group twice. There was very little discussion of rock cycle, a picture of the rock cycle was in the power point. The presenter talked about weathering - physical as by a waterfall, biological as by tree roots, and chemical as in cave formation by carbonic acid. She talked about erosion, eliciting comments from the boys about wind and water erosion. She told how glacial movement leaves glacial drift and till.

Requirement 2:
Pick three resources that can be extracted or mined from Earth for commercial use. Discuss with your counselor how each product is discovered and processed, was not covered, other than the local area had been a limestone quarry for road building materials when the cave was discovered.

A slide of a topographic map of the state, showing where the glaciers descended from Canada and how the land features were shaped by this event were to fulfill Requirement 3:

Review a geologic map of your area with your counselor and discuss the different rock types and estimated ages of rocks represented. Determine whether the rocks are horizontal, folded, or faulted, and explain how you arrived at your conclusion.

Much of the power point presentation time dealt with requirement 4b:

Learn about the career opportunities available in geology. Pick one that interests you and explain how to prepare for such a career. Discuss what courses might be useful for such a career. You may use resources found on the Internet (with your parent’s permission), at the library, in books and articles from periodicals, from television programs, and at school.

To introduce career opportunities in geology the presenter had a box of objects relating to the different careers. Boys were allowed to pick an object from a box, then were asked to determine which career it represented.

1. lava rock – vulcanologist
2. chisel – mining engineer
3. chert with crystals – geologist
4. speleothem – speleologist
5. fossil bone – paleontologist
6. onyx bowl fragment – archeologist
7. fool’s gold – mineralogist
8. picture of sharp blades – lapidarist
9. picture of shaking house – seismologist

There was no time for the Scouts to discuss how to prepare for any of these careers, nor what courses would be useful in any of the careers, so, even though the careers were
identified, Scouts did not complete the requirement as stated in the *Geology* merit badge pamphlet. The career of a speleologist was discussed in a little more detail; the presenter indicated that biology, paleontology, and hydrology were all involved in a career as a speleologist.

The *Geology* merit badge event at the landmark used the Rocks and Minerals option for Requirement 5. The first part of the first requirement in this option: *Define rock. Discuss the three classes of rocks including their origin and characteristics*, was met when the presenter had the boys define rock by answering a series of questions posed to the group. The answers were not written down.

To meet the second part of the first requirement,

*Define mineral. Discuss the origin of minerals and their chemical composition and identification properties, including hardness, specific gravity, color, streak, cleavage, luster, and crystal form.*

minerals were defined as being inorganic with a definite crystal shape. The presenter did not define inorganic. Gems were defined as being relatively uncommon hard minerals. Diamond, talc, and quartz were given their Moh’s scale number, but the scale itself and the reason for using it were not presented. The tests for identification were not presented. The “streak test” was used when the boys rubbed wet red granite on their arms and left a streak while they were doing their collection. No mention was made of a streak plate, but streaks of different colors were mentioned. Also mentioned, but not defined, were shininess, luster, cleavage, and light. These terms were defined orally, not written or discussed.
During the second activity, boys sluiced a bag of sand containing mineral samples, and then sorted the samples by color. The presenter told them the identity of the samples.

The sand kit bags could contain:

1. amethyst
2. fluorite
3. red granite
4. calcite
5. sodalite (The presenter mentioned this could be remembered as it was so delightfully blue.)
6. citrine
7. rose quartz
8. obsidian
9. jasper
10. limestone
11. tiger eye
12. variable quartzite

No mention was made of the point of origin of these specimens. These stones were to be the collection needed to satisfy Option 5, Requirement 3a.

*Collect 10 different rocks or minerals. Record in a notebook where you obtained (found, bought, traded) each one. Label each specimen, identify its class and origin, determine its chemical composition, and list its physical properties. Share your collection with your counselor.*

Boys did not identify the stones themselves; they were told (auditorily) what was in their sample. The Scouts did not label the stones, determine their chemical compositions, or give the class and origin of the stones. There was very little discussion of the samples with the instructors.

*Option 5, Requirement 4:*

*List three of the most common road-building materials used in your area. Explain how each material is produced and how each is used in road building,*

was not covered except by reference to the location’s previous use as a limestone quarry which provided road building material.
To complete the fifth requirement of the Rocks and Minerals option, the boys were to select one of:

a) With your parent's and counselor's approval, visit an active mining site, quarry, or sand and gravel pit. Tell your counselor what you learned about the resources extracted from this location and how these resources are used by society.

b) With your counselor, choose two examples of rocks and two examples of minerals. Discuss the mining of these materials and describe how each is used by society.

c) With your parent's and counselor's approval, visit the office of a civil engineer and learn how geology is used in construction. Discuss what you learned with your counselor (The Boy Scouts of America, 2008c).

This option supposedly was covered by a visit to a cave discovered when the area was quarried. The boys hiked through the woods, looked at a sinkhole, ran through another sinkhole, and toured the cave. The boys received quite a bit of information about the cave. As the boys walked through the cave, the presenter pointed out joints, the lifeline, erosion, and the effects of glacial waters. The presenter told the boys that the colors of the speleothems derived from the minerals in the solution; red and orange were from iron inclusion, black was from the inclusion of manganese. The boys experienced total darkness and the phospholuminescence of a calcium and manganese compound deposited on the cave wall. The Scouts appeared to be very excited, interested, and attentive while doing all activities, their interest was not quite as apparent during the slide show presentation as it was during the hands-on and kinesthetic activities.

A Merit Badge College

A Midwest Boy Scout council put on the Merit Badge College; the council also gave the researcher a letter of support to collect data from the Scouts in the council. One of the authors of the Geology merit badge pamphlet conducted the Geology merit badge
workshop at the Merit Badge College. Badge workshops were in two-hour increments; some badges took two hours, some four. The Geology merit badge took six hours. Most of the boys, except for the Geology merit badge students, met at 8:30 for an orientation after their registration – the Geology students went straight to their room to start the pre-test.

The forms and information concerning the study were provided to the Scouts and their parents; the researcher contacted most of the participant’s parents on the phone and e-mailed them the information and forms. Permission forms and assent forms were collected from the Scouts attending the workshop. Two boys did not participate as their Scoutmaster told them not to, even though one of the boy’s parents had informed the researcher that the boy could participate. The researcher had been given the Scoutmaster’s contact information, as the contact information for the second boy was faulty; the Scoutmaster decided he did not want his boys to participate, even when the presenter discussed with him the importance of the study. One boy came in too late to do the pretest, even though he had parental permission to participate. All the other boys participated, One boy was ADHD and not on his medication. He was not in the best of moods early in the morning, as he had had to get up at 5:00 or 5:30 AM to make the drive to the Merit Badge College. He did not fill out the first test; he said he didn’t know anything. He did better on the second test, but did not complete the whole test. Of the 17 boys who did the Geology merit badge at the Merit Badge College, 14 participated in the research.
As a prerequisite for the college, boys had to make a rock collection according to the directions in the *Geology* merit badge pamphlet. Some of the boys also worked on the merit badge worksheet before they came.

The boys were given handouts: two worksheets prepared by the presenter, including one with a topographic map; a rock identification sheet using the rock cycle from USGS; a map of the landform regions of the state – 2000, from the state’s Department of Natural Resources Bedrock Geologic Map of the state, and a stratigraphic column of the state.

The Scouts’ first task was to use the *Geology* merit badge pamphlet to look up and write definitions for geology, rock, and mineral. The boys were then asked to look at the acknowledgments, to see the presenter’s name. The presenter said that the boys should know that the people who wrote these pamphlets were regular people.

After the boys wrote their definitions, they discussed the definition for geology, then the definition of mineral. Boys were asked: Why be interested in minerals, why use minerals? The presenter and the boys discussed gypsum, it’s uses, where it is mined. The presenter related gypsum to gypsum board and construction.

The presenter had several samples that he showed the boys and passed around. He showed the boys a nail, then passed around an iron ore specimen. He talked about how to refine and make steel.

The boys passed around an aluminum foil specimen. The presenter asked the boys questions; they discussed that processed aluminum comes from bauxite. The presenter told the boys that Jamaica has the world’s largest bauxite mines. One of the boys brought up the electrical process used to separate aluminum from its ore. The
presenter expanded a little on this electrolytic process, discovered by Hall. He told the boys about the aluminum plant run by Alcoa.

Talc, a specimen from Texas, was the next sample the boys saw. The boys, upon questioning, stated that talc is used in talcum powder, women’s face powder, and lipstick. One boy said talc was flammable, but the presenter corrected him, the presenter and the boys discussed that talc is noncombustible.

For mineral identification, the boys were to use their worksheet. In order to do the chemical composition the boys were given small samples of a whitish crystal, which they identified as salt. They discussed that salt was a generic term for a compound produced by a reaction between an acid and a base and that the most common salt is NaCl, table salt. Chemical composition uses the chemical symbols from the periodic table of elements (term elicited from the boys). They discussed Na is sodium and very reactive and that Cl is a poisonous gas. The presenter talked about the possible overuse of NaCl in the body, sometimes an effect of drinking seawater, where Na replaces K and extracts water from the blood. The presenter emphasized that all minerals have a chemical composition.

To discuss specific gravity, the presenter passed sample minerals around – a heavy, shiny, metallic mineral with a crystalline shape, which some of the boys identified as galena. The presenter asked the boys what they noticed most about this sample – it’s heavy. He then asked the question, which weighs more, a pound of feathers or a pound of lead? – both weigh a pound, but the feathers take up more space. The presenter then elicited the terms mass, volume, and density from the boys. He told them that geologists used the term specific gravity instead of density. They talked about the chemical formula
for galena, PbS; they discussed the Latin term plumbum, lead, and that lead was used for plumbing and sealing pipes until after WWII.

The presenter and the boys discussed luster, that galena looks like a metal, that luster is the way something reflects light, and that the two types of luster are metallic and non-metallic.

The presenter and the boys also discussed shape, break, and cleavage. In discussing the various shapes, they discussed that galena breaks into cubes and that calcite looks like parallelograms. The presenter gave each of the boys a small sample of calcite to observe. He took a rock hammer and split a piece of calcite to show cleavage, and discussed that both galena and calcite have three distinctive edges. The presenter had the boys fill out the blanks dealing with cleavage on their worksheets.

The presenter told the Scouts that there are three directional cleavages, two directions means there are two distinct faces, one face – an example is mica. He peeled off a sheet of mica to show one directional cleavage. The presenter told the boys that one of the uses of mica is as a fire retardant; in WWI, muscovite mica was used in oven windows as the glass of the time would break with the heat of the oven.

The boys and the presenter discussed crystallography, where characteristic crystals are used to identify minerals and the sides of the crystals are counted.

The presenter asked the boys to identify what Fredrick Moh developed, then discussed with them the hardness test (scratch test) and the Moh’s scale, from 1-10. The presenter told the boys that a geologist usually uses three common tools to determine hardness: a fingernail, which has a hardness of 1-2; a penny, which has a hardness of about 3.5; and a pocketknife, which has a hardness of about 5.5. The presenter
demonstrated how he determines hardness in the field with a knife by scratching the galena sample, proving it has a hardness of less than 5. The presenter also discussed with the boys how one mineral could scratch another, thus determining hardness. The presenter and the boys also discussed color as the way something reflects light.

The presenter re-emphasized that identification needs to be with more than one method, the more ways used to identify a substance, the better. The presenter re-identified galena with the boys, using the various tests of specific gravity, hardness, luster, and cleavage. One boy asked him about the streak test. The presenter said he does not use that test very often, as many minerals have similar brown streaks. He told the boys they could rip out a tile from their bathroom and use the back of it to do their streak tests, as the back of a tile is unglazed porcelain.

The boys re-identified their salt sample using the tests:

- taste
- crystal form – cube shape – three directional cleavage
- non-metallic luster
- hardness

The boys, when they returned home, were to look at salt from the saltshaker, using a hand-lens in order to see cubes.

The presenter asked the boys how glass breaks; they discussed irregular breakage. They discussed that glass makes funny shapes when it breaks, having sharp and straight edge; they discussed that fracture means irregular. The presenter and the boys discussed arrowheads made by Native Americans; the presenter told the boys that most arrowheads were made from chert rather than flint. These minerals were used as they broke/fractured with concoidal shapes like broken glass.
The presenter demonstrated the use of dilute HCl, which reminded one boy of “soda pop.” The presenter told the boys that the word that geologists used was not fizzing, but effervescing. The boys then examined a rock sample with fossils. The presenter explained that one cannot always see minerals with the naked eye and then used HCl to show calcite as the foundation for limestone.

The presenter showed the boys a bluish colored sample, which the boys identified as being copper ore. They discussed that many colors meant different minerals. The presenter discussed that rocks have names, too. He had the boys go back to their written definition of a rock; boys identified a rock as having one or more minerals. The presenter, saying that colors were used to tell different minerals in a rock, passed around a sample. The presenter instructed the boys to look in the granite samples for minerals that make up granite; they could use cleavage, luster, hardness, and color. The boys looked at granite. Some of the possible minerals in granite were

- clear stuff – tested for hardness, quartz,
- pink – with hammer breaks in two directions – feldspar
- black – 2 directions – hornblend
- shiny – mica

An igneous rock sample with no observable minerals was passed around. The black rock from a volcano was identified as basalt. The presenter started to draw the rock cycle. He wrote the word “igneous” and had the boys participate in associating the word with ignite – fire.

The presenter drew a diagram on the board: (Figure 3.4)
Igneous

Basalt
- Starts underground
- Ends up on surface
- Cannot see crystals
- Both come from magma
  (magma means large)
  Magma is a large pool of melted rock
  If it oozes up on surface, it is basalt. If it blows up on top, it is lava or ash.

Granite
- forms deep underground
- can see crystals

Figure 3.4: Geology Diagram

The presenter talked about winter and its effects on rocks, stating, "If it is on the surface, weather forms cracks and starts the rock cycle." The presenter passed around a sample of crumbling granite, discussed the term "weathering," and how weathering produced sediments.

The presenter shifted the topic to sedimentary rocks, including limestone. He asked the Scouts, – What carries sediments? Answer – water. The presenter discussed two types of water, salt water in the ocean, and fresh water as in rivers. When sediments settle to the bottom, they form sedimentary rocks. The presenter had the boys look at the handout of how to identify rocks. The boys discussed life in water – bacteria, brachiopods, and fish. The presenter stated that sedimentary rocks might have fossils.

The boys and the presenter discussed plate tectonics with interjections from the boys about earthquakes. They discussed mountain formation and talked about the different types of collisions. They talked about heat, pressure, and the effects of these
processes have on igneous and sedimentary rocks, changing them into metamorphic rocks. A boy brought up limestone and asked if heat and pressure could change it to marble. The presenter said yes, and pointed limestone and marble out on the rock identification sheet. He stated that talc is metamorphic, and that metamorphic rocks often have lines or layers where minerals line up in a line. The presenter gave as examples gneiss from granite and quartzite from sand (which is mostly quartz).

The presenter gave the boys a break to work on their collections and fill in their worksheets. The presenter collected the blue cards (merit badge requirement cards) while the boys worked. The presenter said that the best way for the boys to learn is to look up the answer and fill in the sheet. During the break, the boys set out the rock collections they compiled prior to coming to the event. After the break, the presenter and the boys discussed unknown samples from the boys’ collections. As listed in the Geology merit badge requirements, the Scouts needed to have the names of their specimens, whether the specimen was igneous, metamorphic, or sedimentary and why they thought so, as well as a listing of the properties of the specimens.

The boys packed up and got ready to go to the quarry, keeping out their papers, which they needed at the quarry. Five cars transported the boys to the quarry located about five miles from the community college. At the quarry, the group met up with a geology student and two geology professors from a nearby university. One of the geology professors had been a Scout, the other had been in 4H while growing up.

The presenter explained the safety rules – from the mining safety rules and regulations.

1. Hard hats and safety glasses at all times.
2. Stockpiles are unconsolidated – stay off the stockpiles.
3. Wires are used to detonate and cause amphora to explode. On rare occasions, the detonators don’t go off, so leave the wires alone.
4. Don’t throw rocks. (The presenter made a joke – Don’t practice for the baseball recruiter here.)
5. Equipment is real, so stay off.
6. Fly ash from power plants is being used to fill the quarrying hole. Trucks carrying fly ash have the right of way.
7. Listen when adults talk.

The presenter gave the Scouts facts about the quarry - the piles of rock come from the face, 400,000 – 500,000 tons of rock per year are taken from the quarry. The rock, sold for construction, is used to make roads, sidewalks, pavement, buildings, foundations of houses, and parking lots.

The Scouts were issued hard hats and safety glasses before they got back into the cars and drove into the quarry; they were told the rules for using rock hammers. (Most of the boys had the use of a rock hammer; there were not quite enough hammers to go around, so the boys had to share.)

Arm’s length rule for using hammers.
Stay an arm’s length away from someone pounding on a rock.
Stay off the high face, as it could crumble.
Don’t go near the high face.

When the group reached the quarry bottom, the presenter explained that in their state the bedrock is limestone; the brown color of the till is due to oxidized iron. He explained that his company mined the limestone bedrock underneath the glacial till deposited by the glaciers that covered the state ½ million years ago. The presenter told the boys that glaciers had covered the state several times in its history; in the quarry location there were probably at least two different deposits of till covering the bedrock, but, in this area of the state, the limestone bedrock was fairly close to the surface.
The presenter pointed out the law of superposition – younger stuff is on top of older stuff, unless disturbed. The presenter discussed stratigraphy – strata are layers. The boys guessed the rocks in the quarry to be about 450 million years old. The presenter explained that the limestone was laid down in the Devonian; the area was a sea floor, covered by shallow water, producing a marine environment and forming limestone. According to the presenter, the state had been south of the equator during the Devonian.

The boys were allowed to collect samples while the presenter got the pizza for lunch. The adults walked and observed the boys, directing them to use the blunt end of the hammer instead of the sharp end while pounding on rocks. The boys were excited when they found calcite crystals or pyrite; there were few fossils, but a very thin layer of shale provided some brachiopods.

When the presenter came back, the group went to the building at the top of the quarry for a lunch of pizza and soda. After lunch, the boys worked on their collections and papers, discussing them with the geologists.

One of the geology professors worked with the boys after lunch to explain the geology of the state. The boys worked on the geology of the area requirement and filled in the section on their worksheets. The professor explained the map of the state, one of the handouts given to the boys; he explained that the map showed what the state would look like if all the loose material was scraped from the top.

The rock in the quarry was in horizontal layers; the boys, working on one of the requirements, were to work with their counselor on whether the rock is horizontal, folded, faulted, or changed. The presenter reminded the boys that the rock in the quarry was
limestone. He had the boys repeat the three types of rocks: igneous, sedimentary, and metamorphic. Limestone was identified as sedimentary; the layers were horizontal.

The presenter drew lines on the board to show the progression of rock ages across the state. The rocks showed a gradient, a down dip across the state; traveling NE in the state, the rocks were older.

Structural geology was defined. The boys found a circle on their maps; the circular formation/pattern, called the Mason Impact Structure, was the result of a meteor crashing into the state long ago. The meteor hit Cretaceous rock, forming a deep meteor crater, but the crater filled in with glacial till.

The boys turned to the last page of their worksheets, where the presenter had included a topographic map section. The boys discussed what the lines meant. The boys had to find a hilltop and estimate the elevation of the hill from the contour lines. They wrote “hill” on this area of their map. The boys discovered that hilltops could be recognized by circles on the topographic map. The presenter walked around and checked the boys’ labels. The boys were to find close contour lines to estimate the height of the hill. The map used 10’ contour lines; the relief between the lines was 10’. The boys were instructed to find a stream and it’s name. The presenter talked to the boys about the meaning of the word stream – any flowing body of water. The presenter then had the boys find a valley without a stream.

The presenter and the boys talked about the need for a scale and direction and discussed that, as they lived in the Northern Hemisphere, their maps were oriented with North on top. The presenter then had the boys look for structures on the topographic map. He said they could find barns, inhabited dwellings, and things of that nature. One
boy asked about finding a quarry on the map. The presenter stated depressions were marked with tick marks on the contour lines, indicating low spots; quarries could be marked with a symbol of a crossed hammer and pick. Elevations were marked at road intersections. The presenter explained that the boys were using copies of a topographic map; real topographic maps were in color. He told the boys that geologists used color quite a bit in their maps.

A Scout asked about the age of the rocks in the quarry – answer – in the local area, the rocks were about 385 million years old. The boys finished their worksheets and turned them in for the credit toward their Geology merit badge. The group then went back down into the quarry where the boys had about 15 minutes to collect their last samples. The posttest was administered in the quarry. After the posttest the boys had about 5 – 10 minutes to collect more samples, then the group went back to the community college and disbanded. The boys appeared to be very involved and interested in both the presentation and the quarry portions of the event.

A Science Museum

Data were collected when a local area science museum offered the Geology merit badge. The researcher discussed the event with the program director, but, as the program director had not been a Scout, there was some miscommunication. The science museum did the Geology badge, but instead of doing the Rocks and Minerals option studied by the researcher and discussed by the program director along with the researcher, the museum did the Surface Processes option. Most of the pre and posttest questions were geared toward the Rocks and Minerals option. The program director set up the merit badge
event at the museum; an Eagle Scout member of the museum staff presented the event. The researcher had no prior contact with the Eagle Scout who presented the event.

The *Geology* merit badge event was advertised through the museum’s Scout connections. The researcher also mentioned the event at a round table, a local Boy Scout planning meeting. When boys registered for the event with the museum, information, permission forms, and assent forms were included in the information e-mailed to them. Thirty-five boys registered for the event; 26 remembered to bring their permission and assent forms with them to give to the researcher. The boys paid $15 to participate in the event, which also covered their admission to the museum. The data for the *Geology* merit badge were not included in the study, as the boys received a different treatment. The answers to the open-ended questions were included in the results, as they were not part of the *Geology* merit badge pretest/posttest study.

**Local troop locations**

The researcher collected data when two troops offered the *Geology* merit badge. For both troops, boys were given information about the research project, the parental permission forms, and assent forms during regularly scheduled troop meetings. The boys turned in their permission and assent forms to the researcher at a regularly scheduled meeting before taking the pretest. According to the merit badge counselor for one of the troops in the study, “The idea of the merit badge in the classical sense is, you meet with your counselor, you both do some things, you do some discovery, you come back, you talk about it again, then you might have to go back and do some more. I’ve done that with several of the kids here.”
In one troop location, the troop merit badge counselor held an initial session, which lasted 1.5 - 2 hours, with the troop members taking the merit badge. During the initial session, the merit badge counselor covered the general description requirements with the Scouts. He talked to the Scouts about the definition of geology, what geologists do, and they discussed general information about geology. During the initial meeting, the merit badge counselor went over all the requirements of the badge with the Scouts, explaining the options. The merit badge counselor guided the boys into choosing options that fit their locale.

The merit badge counselor did not “pre-program anything”; a parent arranged a visit to a local quarry that several Scouts attended before their second meeting with the merit badge counselor. The quarry guide explained the stratification layers as well as what the quarry did during its separation process. Some Scouts were not able to attend the quarry visit, but instead visited the coke plant.

During the second session with the merit badge counselor, the Scouts individually showed the counselor their written definitions of what was discussed during the first session and discussed their definitions with the counselor. The group looked at the rock collections that were brought to the second meeting.

The counselor followed the merit badge requirements very strictly; Scouts had to discuss, demonstrate, and show according to the merit badge requirements. The counselor did not add to the requirements, but also did not allow the Scouts to shortcut the requirements. If Scouts came to the second session without completing the requirements to the best of their ability, the Scouts had to work on the requirements until the requirements were satisfactorily completed. The merit badge counselor worked
individually with the Scouts. Scouts met with the counselor for a third time to finish the requirements, discussions, and to get their blue merit badge cards signed. Including the initial two hours in which the boys met as a group, an hour for the second meeting, and an hour for the third meeting, the merit badge counselor spent about four hours with each boy working on the merit badge. The merit badge counselor also made sure, in talking to the boys, that the boys were aware of vocations and avocations in the field of geology, as:

The point of the merit badge program is to introduce them to possible vocations or avocations. It’s not to see that they’re geologists. So, they come away with, after talking with me, a better understanding of what they got off the internet or books, and mostly these days, it’s going to be the internet. So, I think they learn something from it.

At the second troop location, the merit badge counselor met with the boys six times for about 25 to 35 minutes each session after regularly scheduled troop meetings. With the merit badge counselor, the boys collected fossils and rocks for their rock collection requirement on one of the troop’s monthly campouts. The boys and the merit badge counselor visited a working sand pit and talked to the operator about the visible layering of the glacial deposits, the pit operations, and the ultimate source for the deposited materials. The counselor and the boys visited the geology museum of the local university and a research facility on the same campus. The boys looked at the geologic time scale as built into a local building from the native sandstones incorporated in the order of their geologic formation. The boys worked individually and as a group throughout the merit badge earning experience, then met individually with the counselor to discuss and finalize the requirements.

As the troop merit badge acquisition experiences took place over several weeks, there may have been several confounding variables which could not be controlled
including history, maturation, and statistical regression. History may have included some of the boys being exposed to geology or earth science in school, on the news, or on TV programs during the time of the merit badge acquisition (Campbell & Stanley, 1963). These confounding variables were not present at the weekend events or the week-long summer camp events.

Interview and Written Methods

Interviews about science education in the Boy Scouts were conducted with Scouts, Scout leaders, and scientists who were Scouts. Field notes were written and transcripts were made from the audiotapes of the interviews. (The quotes included do not contain the uhs, ahs, ands, likes, and double iterations of words.) According to Erickson, field notes, tapes, and interview transcripts are not data, but are documentary materials from which data must be constructed through analysis (Erickson, 1985).

Merit badge pamphlets, the source of printed text and the source of written science information, were deconstructed and analyzed as to their mediation of science content (Burman & MacLure, 2005).

Information on the learning styles of Boy Scouts was profiled by the use of the LSCY Learning Styles Instrument based on the Dunn and Dunn model of learning styles (R. Dunn, Griggs, Olson, Beasley, & Gorman, 1995; Hawk & Shah, 2007).

3.7 Data Analysis and Verification

Qualitative

The interview data were analyzed by constant comparative methodology in order to establish significant patterns in knowledge and knowledge acquisition through the merit badge intervention. As the interviews were collected and transcribed, the researcher
compared units of data to generate tentative categories in order to identify concepts. The transcripts were coded in constant comparison with all other transcripts and data. These categories or codes were eventually fused into conceptual categories which evolved into an overall framework of a grounded theory (Ary, Jacobs, & Sorensen, 2006; Corbin & Holt, 2005). As the data were collected, transcribed, and analyzed, the researcher generated assertions and established evidentiary warrants for the assertions, both confirming and disconfirming, by reviewing the data corpus to test the validity of the assertions (Erickson, 1985).

Concepts were derived from multiple sources, including the merit badge pamphlets. Gathering data on the same topic from multiple sources of data were a means of triangulation used to validate the research findings (Corbin & Holt, 2005).

The findings concerning the National Science Education Standards mapping project were checked by a panel of experts (n = 5) in science education.

**Quantitative**

The questions for the Geology merit badge assessment were reviewed by a panel of experts in geology (n= 4) and pilot study was conducted. The data from the Geology merit badge study and the Learning Styles study were analyzed with the help of a statistician from The Ohio State University Department of Statistics. Paired T-tests, one-way ANOVAs, CHI Squares, and Cluster Analysis statistical tests were employed to analyze the data.

**3.8 Ethical Considerations**

The ethical framework of the study, governing access to people and places and governing access to how the information gathered was represented and used, focused on
principles of anonymity, confidentiality, and rights of access. Using the IRB forms from The Ohio State University, each individual in the research study population had a personally negotiated privacy policy (Barbour & Schostak, 2005). Informed consent of all parties involved was the basis of the ethical framework. Minors were informed of what the study entailed; parents of the minors involved in the study were informed of what the study entailed and what involvement their sons would have in the study. As the researcher was the person responsible for collecting the permission and assent forms but was a person who had no authority over the minors in the study, the minors should not have felt coerced to become a part of the study. Adults were informed of what the study entailed and were assured of confidentiality, unless they waived their right to privacy. Scientists consented to let their names be revealed with their information, as the use of their names could benefit the study. Those interviewees who elected to be public with their information were allowed to review what was incorporated into the final document from their informational input; these participants were allowed to comment upon and add information to the document before the document was finalized (Barbour & Schostak, 2005; Piper & Simons, 2005).

3.9 Assumptions and Limitations of the Study

Assumptions

An assumption of the study was that the control group from the summer camps was similar to Boy Scout groups throughout the Midwest and that the boys in the control group were similar to boys who took the Geology merit badge in a location other than summer camp. The summer camp control group was used for the longitudinal study comparisons, weekend events, and troop activities.
Limitations

This study, a mixed methods study, was limited by the research design. Qualitative data of the “real” were “verified”, quantitative data must have validity; the validity of quantitative data is internal and external (Talburt, 2004). The external validity determines the extent to which the data can be generalized to the population at large; internal validity is the extent to which the results are occasioned by the independent variable, not a result of an uncontrolled variable or variables (Ary, Jacobs, & Sorensen, 2006). Verification of qualitative data, corresponding to internal validity, was done with member checks and triangulation with transferability corresponding to external validity. (To triangulate, the answers from Scouts, Scout scientists, and Scout leaders were compared to each other and to the answers given on the open-end questions.) Singular readings and answers, rather than opening the data to the multiple uses of naturalistic inquiry, were produced using the verification methods of member checks, triangulation, and transferability (Talburt, 2004). As this study is pragmatic in practice, a realist interpretation with a singular interpretation of the data was accepted.

The selection of Scouts from states in the Midwest, limited the generalizability of the results of the quantitative research to the Midwest. As randomization of the sample of Scouts taking the Geology merit badge was not possible, a quasi-experimental design had to be used in place of a true experimental design (Campbell & Stanley, 1963). As Scouts were of different ages and grades in school, equivalent groups in the samples were unlikely. Analysis of the data included analyzing by age and/or grade in school to see if these variables made a difference in the results.
A threat to external validity in this study was that the participants may have been sensitized to the information as a reactive effect of testing, an unavoidable consequence of the pre-test/posttest method of collecting data. External validity may also have been threatened because the participants knew they were participating in a study (Campbell & Stanley, 1963). This participant awareness effect may have been mitigated because this was a free-choice activity and the participants were pre-disposed to maximize their achievement in pursuit of obtaining a merit badge.

A variety of things may have threatened internal validity. Possible threats to the internal validity of the study included the participation of several merit badge counselors and the disparity of locations in which the merit badges were earned. As merit badges are overseen by many counselors in many settings throughout the US, it was informative to compare the results from different locations. Control for different merit badge counselors were not be possible, but results were analyzed by type of location to see if the type of location of the intervention is significant. An unavoidable threat to internal validity, due to the research design, was testing - a pretest/posttest, practice effect. A third threat to the internal validity was selection-maturation interaction, as Scouts of several different ages and school grades would be involved in the study (Campbell & Stanley, 1963). The researcher attempted to alleviate this effect by comparing the results by age and/or grade in at least one of the analyses. A one-way Anova was performed to factor out age/grade effects. The number of Scouts participating in the learning styles research may have skewed the learning style data, the effects of which were mitigated by the use of a cluster analysis.

Sample sizes of the interviewees were also limitations to the study when quantitative criteria of evaluation were used. The limited number and purposeful selection of Scouts,
Scout leaders, and scientists interviewed may have reduced the generalizability of the findings. The non-probability samples in the qualitative section of the research study limited the generalizability. Undoubtedly, biases will occur from these approaches (Lewin, 2005), however, the case study approach illuminates how individuals respond to science as conveyed through Boy Scout programs and activities.

3.10 Summary

Data to investigate science education in the Boy Scouts were collected and analyzed using a mixed method approach. The merit badge requirements were analyzed, mapped onto the National Science Education Standards, and quantified. Scouts responses to the open-ended questions were analyzed and quantified. Pretests and posttests were administered to Scouts; the results were analyzed and quantified. Scouts took an on-line assessment of their learning styles; the results were analyzed and quantified. Scouts, Scout leaders, and scientists who had been Scouts were interviewed. The interview transcripts were analyzed. The results from the data collections were used to develop a grounded theory of science education in the Boy Scouts.
4. RESEARCH FINDINGS

4.1 National Science Education Standards

I think actually, where Boy Scouts may have helped me more was planning. Seeing an outline, the requirements, seeing it followed through, dealing with troubleshooting... Designing a plan and following it (Porchia, 2008).

The Boy Scouts of America uses merit badge pamphlets and the Boy Scout Handbook as the curriculum for their educational outreach program. Most of the 121 merit badges offered by the Boy Scouts of America and Boy Scout rank advancements from Tenderfoot to Eagle have at least one requirement that fulfills a National Science Education Standard. The merit badge pamphlets and the Boy Scout Handbook, although not created to meet the National Science Education Standards, provide boys with many opportunities to learn science.

Scouts meet Tenderfoot, Second Class, and First Class requirements by completing the requirements listed in the Boy Scout Manual; rank advancements to Star, Life, and Eagle involve earning merit badges in addition to serving in leadership positions and completing service hours and service projects (The Boy Scouts of America, 1998). The requirements of each merit badge and each Scout rank were mapped onto Standards A-G of the National Science Education Standards for grades 5-9 and grades 9-12 (Figure 4.1 Total Merit Badge Requirements mapped onto the National Science Education Standards, 5-8 and 9-12) and (Appendix C). As merit badges often allow Scouts a choice in how they choose to fulfill a requirement, in the table a “1” indicates
that all the requirement options meet the standard, an “0” indicates if an option in the
merit badge meets the standard. The Geology merit badge has four options; the
requirements for each option meet different standards as indicated underneath the tables.
Hatch marks and colors indicate the Eagle required badges.

The three rank advancements that do not have merit badge requirements
(Tenderfoot, Second Class, and First Class) have science requirements, mainly Life,
Science and Technology, and Personal/Social requirements. Sixteen merit badges
(13.2%) do not have any requirements that fulfill National Science Education Standards;
American Business and Entrepreneurship (1.65%) each have one optional science
requirement that fulfills a National Science Education Standard. Of the 121 possible
merit badges a Scout may earn, 103 badges (85.12%) have at least one science
requirement as indicated by the National Science Education Standards. (Appendix D lists
the requirements for the Eagle required Environmental Science badge as a sample of
science requirements in merit badges.)

To earn his Eagle, a Scout must earn a minimum of 21 merit badges. Ten of these
merit badges – Camping, Citizenship in the Community, Citizenship in the Nation,
Citizenship in the World, Communications, Environmental Science, Family Life, First
Aid, Personal Fitness, and Personal Management, are on the “must do” list for Eagle. A
Scout must choose either Emergency Preparedness or Lifesaving and he must choose
Cycling or Hiking or Swimming. The Scout also chooses which additional merit badges
he will complete for his 21 or more merit badges. The list of additional merit badges to
make the 21 required may include the optional choices – for example, a Scout may do

143
### 5-8 Merit Badge Requirements

<table>
<thead>
<tr>
<th></th>
<th>Inquiry</th>
<th>Physical</th>
<th>Life</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abilities Necessary to Inquiry</td>
<td>A1, A2</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>C1</td>
<td>C2</td>
<td>C3</td>
</tr>
<tr>
<td>Understandings about Inquiry</td>
<td>70</td>
<td>70</td>
<td>20</td>
<td>22</td>
<td>27</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>All Badges</td>
<td>72</td>
<td>72</td>
<td>9</td>
<td>21</td>
<td>14</td>
<td>24</td>
<td>16</td>
</tr>
</tbody>
</table>

### 9-12 Merit Badge Requirements

<table>
<thead>
<tr>
<th></th>
<th>Inquiry</th>
<th>Physical Science</th>
<th>Life Science</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abilities Necessary to do Inquiry</td>
<td>A1, A2</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>B4</td>
<td>B5</td>
<td>B6</td>
</tr>
<tr>
<td>Understandings about Scientific</td>
<td>72</td>
<td>72</td>
<td>9</td>
<td>21</td>
<td>14</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>All Badges</td>
<td>1</td>
<td>1</td>
<td>A, C</td>
<td>B, C</td>
<td>B</td>
<td>D</td>
<td>D</td>
</tr>
</tbody>
</table>

### Geology

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Badges</td>
<td>11</td>
<td>15</td>
<td>18</td>
<td>21</td>
<td>24</td>
<td>16</td>
<td>19</td>
</tr>
</tbody>
</table>

A - Surface and Sedimentary Processes Option  B - Energy Resources Option  C - Mineral Resources Option  D - Earth History Option

---

**Figure 4.1** Total Merit Badge Requirements mapped onto the National Science Education Standards, 5-8 and 9-12
Cycling, Hiking, and Swimming, all three will count toward his minimum 21 merit badges, but only one will be counted as meeting the list of “requireds” (The Boy Scouts of America, 1998).

All of the merit badges on the “must do” or “must choose one” for earning Eagle Rank have science requirements except Citizenship in the Community, Citizenship in the Nation, and Personal Management. Citizenship in the World has one science requirement, Requirement 3:

Do the following:
A. Pick a current world event. In relation to this current event, discuss with your counselor how a country’s national interest and its relationship with other countries might affect areas such as its security, its economy, its values, and the health of its citizens.”
B. Select a foreign country and discuss with your counselor how its geography, natural resources, and climate influence its economy and its global partnerships with other countries (The Boy Scouts of America, 2008c).

This requirement meets a Science in Personal and Social Perspectives standard for grades 5-8 and grades 9-12 on the National Science Education Standards. On the 5-8 standards this requirement fits in the science and technology in society category; on the 9-12 science standards, this requirement fits in the science and technology in local, national, and global challenges (National Science Education Standards, 1996). The other “Eagle requireds” have more than one science requirement.

By the time a Scout has finished the 10 “must do” merit badges for Eagle, he will have completed four inquiry projects. Depending on the option the Scout chooses to fulfill his Environmental Science merit badge, he may have met Physical Science standards for B2, Structure and properties of matter; B3, Chemical reactions; B4,
Motions and forces; B5, Conservation of energy and increase in disorder in physical science. He will have met Life Science standard C4, Interdependence of organisms; had an option of meeting standard C5, Matter, energy, and organization in living systems while doing his Environmental Science merit badge; and met standard C6, Behavior of organisms. Meeting Earth and Space Science standard D1, Energy in the earth system, is an option with the Environmental Science merit badge.

Scouts meet Science and Technology standards in five of the required merit badges Camping, Communications, Environmental Science, Family Life, and First Aid. Four Eagle required badges, Camping, Family Life, First Aid, and Personal Fitness, cover standard F1, Personal and Community Health in the topic Science in Personal and Social Perspectives. Standard F2, Population growth, is covered by an Environmental Science merit badge requirement, while both Environmental Science and Camping merit badges cover standard F3, Natural resources. First Aid, Environmental Science, and Camping merit badges cover standard F4, Environmental quality, and standard F5, Natural and human-induced hazards, which is also covered in the Personal Fitness merit badge. The Boy Scout program emphasizes standard F6, Science and technology in local, national, and global challenges, which is covered by six of the ten mandatory Eagle required merit badges - Camping, Citizenship in the World, Environmental Science, Family Life, First Aid, and Personal Fitness.

In the category of History and Nature of Science, no Eagle required merit badges cover the standard G2, Nature of Scientific Knowledge. Environmental Science and
Personal Fitness cover standard G1, Science as a Human Endeavor; Environmental Science and First Aid cover standard G3, Historical Perspectives.

The Boy Scout merit badges, taken as a whole, cover all the standards as set forth in the National Science Education Standards, emphasizing inquiry, science, and technology. The Boy Scouts encourages Scouts to do inquiry; of the 121 merit badges, 58.6% have an inquiry-based requirement. Science and technology is a major thrust of Boy Scout science education through merit badges; 73.6% of merit badges have a science and technology requirement. Of the 10 “must do” Eagle required merit badges, 40% have an inquiry requirement, 50% have a science and technology requirement.

The least studied of the National Science Education Standards in the Boy Scouts for grades 9-12 are Cells, C1 in the Life Science topic, and Origin and Evolution of the Universe, D4 in the Earth and Space topic. The study of cells is a requirement in only two merit badges, Forestry and Plant Science. The study of the origin and evolution of the universe is a requirement for Astronomy, and Geology. The least studied National Science Education Standard for grades 5-8 is standard D3, Earth in the Solar System, in the Earth and Space topic. Earth in the Solar System is studied only in Astronomy and Space Exploration.

Other lightly represented standards for grades 9-12, each covered by four merit badges, are Molecular Basis of Heredity, C2, in the Life Science topic, and Geochemical Cycles, D2 in the Earth and Space Science topic. For grades 5-8, only four merit badges cover Earth’s History, D2, in the Earth and Space Science.
Boy Scout merit badges have a very strong emphasis on standard F1 in the topic Science in Personal & Social Perspectives. For grades 5-8, standard F1 is Personal Health, for grades 9-12 standard F1 is Personal & Community Health. First aid, safety, and personal health, topics that are requirements for many merit badges, are all components of standard F1. Personal Health/Personal & Community Health are National Science Education Standards covered by 70% of the Boy Scout merit badges.

Many merit badges require Scouts to meet with professionals in the field of study, discuss career options in the field, and/or discuss the education needed to become a professional in the field. This emphasis in the topic of History and Nature of Science is, for both grades 5-8 and grades 9-12, G1 - Science as a human endeavor; 36.4% of merit badges have a requirement that fits in category G1.

The Boy Scout merit badge program fills a need for science education outside of the school setting. The requirements of the merit badges meet the National Science Education Standards in a way that appeals to the interests of boys and which makes science relevant to their lives and future goals. During 2007, Scouts earned 1,879,476 merit badges, including 72,279 Environmental Science merit badges (The Boy Scouts of America, 2008f). If the number of earned merit badges having no science requirement or only an optional science requirement are removed from this number, in 2007 Scouts earned a total of 1,628,500 merit badges with at least one science requirement.
4.2 Open Ended Survey Questions

4.2.1 Self-reporting

Self-judgments of academic confidence are, in general, significantly and positively correlated with future achievement (Assor & Connell, 1992; Byrne, 1984), especially for children over the age of nine; a self-reported appraisal of academic confidence is a valid measure of a student’s performance (Assor & Connell, 1992). To increase the validity of the self-reports on the survey, a) the information being requested was clearly stated, b) the Scouts were clearly asked about their personal beliefs and ideas about themselves and their experiences and performances, c) all answers were acceptable, d) the researcher, in almost every instance, was unknown to the Scouts answering the questions, e) the Scouts were told the purpose of the study, and f) the questionnaires were given to well-monitored groups in order to offer more anonymity and privacy (Assor & Connell, 1992).

4.2.2. Survey Questions

Scouts who participated in the research for the Geology merit badge, the control group, the participants in the longitudinal study, and those who did the merit badge were asked two open ended questions on the demographics information sheet:

6. Have you done other merit badges? (Circle either No or Yes and answer the questions by your answer choice.)
   A. No.
   B. Yes. If yes, do you feel that doing merit badges helps you do better in school?
      a. No.
      b. Yes.
      Please explain your answer______________________________

What is your favorite thing about Scouts? ____________________________

149
Why do you like this best? _________________________________________
_______________________________________________________________
_______________________________________________________________

Merit Badges Survey Question

Of the 185 Scouts that answered the question about merit badges, 165 had taken at least one merit badge. Of these 165 Scouts, 75.2% (n = 124) reported that doing merit badges helped them do better in school. Scouts at higher ranks, who had completed more merit badges, tended to be more cognizant of how merit badges helped in school (Table 4.1).

<table>
<thead>
<tr>
<th>Scout Rank * Does it help you do better in School?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does it help you do better?</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>No Answer</td>
</tr>
<tr>
<td>Scout</td>
</tr>
<tr>
<td>Tenderfoot</td>
</tr>
<tr>
<td>2nd Class</td>
</tr>
<tr>
<td>1st Class</td>
</tr>
<tr>
<td>Star</td>
</tr>
<tr>
<td>Life</td>
</tr>
<tr>
<td>Eagle</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Table 4.1: Answers to open-ended question, “Does it help you do better in school?” by Scout Rank

Scouts’ explanations for positively answering the question, “do you feel that doing merit badges helps you do better in school?” fit into eight categories:

1. Prior knowledge/New facts
2. Understanding
3. Preparation
Boys felt that doing merit badges supplied them with new knowledge and facts. They felt that they had an edge or an advantage over other students because they already knew the basics of the subject covered in the classroom. The Scouts felt that they had a better understanding of the material, that they could answer more of the questions posed in the classroom, and that they did better on tests and quizzes because of the knowledge they possessed by doing merit badges. The boys felt as if they knew and understood more than other students, that they possessed knowledge not possessed by their peers.

Scouts who had done merit badges felt more prepared for classes. They felt that they knew what to expect in a class and what to do during class. The boys felt that by doing merit badges, they had background information for their next science classes and knew details about the subjects that they would not have known if they had not done merit badges. The Scouts felt that they had learned information that would help them in school, information that applied to what they learned and would learn in school. A 9th grader wrote, “They help me remember things in school.”

Scouts credited doing merit badges with helping them develop skills. The skills mentioned by the Scouts were mental/study habit skills and skills that helped them do better in school including reading, research, and writing skills. Scouts felt that merit badges were influential in developing their leadership skills, mental skills, and skills that were useful in and out of the classroom.
Geology, Reptiles and Amphibian Study, Mammal Study, Aviation, Personal Management, and Citizenship in the Community were some of the specific merit badges that Scouts mentioned helping them in school. Life Science, Language Arts, and Science were some of the school subjects where boys credited merit badges with help.

Some Scouts anticipated help in and out of school from the merit badges they had taken. Some of the anticipated help was a “heads-up” (6th), an early acquisition of knowledge, help in learning information before it was encountered in school. “When taking merit badges you learn about many different things you may learn in school now or in the future” (12th).

Several Scouts credited merit badge work with the development of organizational skills, crediting merit badge work with brain training, helping mental skills, and with development of better study habits. Scouts also believed that doing merit badges helped them focus on schoolwork, task completion, and paying attention.

Scouts who said merit badges helped them in school also credited personal growth to doing merit badges. Boys stated they realized “connections you wouldn’t have otherwise known” (12th), achieving “a wider view of everything.” (9th) Scouts who did merit badges found, “MB’s create a connection between learning pursuits and enjoyment put into completing them” (11th). Doing merit badges was credited with making one a better person, teaching things that are not taught in school, and teaching “... self respect and dignity” (11th).
Of the boys who had taken at least one merit badge, 24.8% (n = 41) did not believe that doing merit badges helped them in school. The reasons given for believing that doing merit badges did not help in school fit into five categories:

1. Don’t care, don’t pay attention
2. Not relevant
3. Cover different topics
4. Don’t affect the grades
5. Different

Boys in the category, Don’t care, don’t pay attention, did not feel that doing merit badges helped them in school because, “I haven’t really done any of those in school (sic)” (7th), “I don’t pay attention. (sic)” (7th), “Because they boring (sic)” (6th), and “Because I never think about them in school” (6th). Boys whose answers fell into this category (n=4) included two 6th graders and two 7th graders, young Scouts without much merit badge experience.

Non-relevance was the theme of many answers from the boys who did not believe doing merit badges was beneficial in school. Boys stated that merit badges had nothing to do with school, and that the things they learned while doing merit badges were not things that they learned in school because school did not cover the topics covered by merit badges. One 6th grade Scout stated that merit badges did not help his grades.

Some Scouts seemed to gain quite a bit of information by doing merit badges, but did not feel that their acquired knowledge was useful in a school setting. Boys were divided in their opinions as to whether school or Scouting provided better information - “It covers different and less information” (9th) versus, ”Badges cover important things. School does not. The subjects are not covered in both. Merit badges cover totally
different (and more useful) things than school‖ (11th). Most boys were of the opinion that merit badge information was useful, even if it was not helpful in school.

Some Scouts stated that schools did not cover subjects covered by merit badges, the two institutions taught different subjects and skills. An 11th grade Scout said school did not teach subjects “... related to merit badges,” while a 12th grade Scout stated, “While they do teach skills of self motivation and time management, they usually cover completely different topics than those taught in schools.” A complaint by boys was that they did not get to use in school the knowledge and skills they learned while doing a merit badge. A 10th grader stated, “During school I don’t think all the basic merit badges can help with my subjects. Now if someone needed first aid that’s different, but so far no.”

Three Scouts, one who did not think doing merit badges helped in school and those that did feel doing badges helped in school, talked about the information they learned by doing the Aviation merit badge.

Do not help: “I don’t learn about areodynamics in school. (sic)” (7th)
Do help: “I did aveation badge and we talked about wind in scienc. (sic)” (8th)
“After taking an aviation badge, I continued to write a report about planes in Language Arts and got an A+.” (6th).

Three Scouts made statements relating school and merit badges. “I think that if you are good in school you will do well in merit badges,” was the opinion of a 10th grader. The opinions of two 6th graders, “Merit badges are easy, school is hard,” and “Merit badges are fun and school isn’t,” may reveal a connection between fun and ease of learning for middle and high school boys. The connection of Scout science to interesting and fun and school science to boring was noted by Jarman (Jarman, 2005).
There were no Scouts, other than the four 6\textsuperscript{th} and 7\textsuperscript{th} grade Scouts who did not pay attention, did not think about them, were bored by them, or had not done them in school, who said they did not learn by doing merit badges. Only one Scout said that merit badges covered less information than school. Most of the boys who did not believe that doing merit badges helped in school thought that the skills and knowledge did not overlap between doing merit badges and school, thus doing merit badges did not help in school.

At least 21 Scouts made connections between merit badges and science in their statements as to whether or not doing merit badges helped them do better in school. Two Scouts did not see their science learning through merit badge work as being helpful in school, as they did not perceive the topics they studied as being covered in school or had not yet encountered them in school - “I don’t learn about aerodynamics in school. (sic)” (7th), “During school I don’t think all the basic merit badges can help with my subjects. Now if someone needed first aid that’s different, but so far no” (10th).

Scouts referring to science as the reason doing merit badges helped them in school either gave doing well in science or referred to a specific badge or knowledge from a specific badge as helping them in school. Scouts credited working on merit badges with preparing them for their science classes, “I have been prepared for things like science (sic)” (7th). Scouts also credited working on merit badges with helping them in science, “it helps me in math and science” (6th), “because some of the skills help you, like math, SS, S” (6th), “If you take science badges, it can help in science class by giving you the information long before you get to it in school.” (8th), “I have learned more in
fields such as science which helps in school.” (10th), and “It helped me and gave me background information for the next science I took” (11th).

Specific badges, either named or information from them given in Scout’s answers to the question of, “do you feel that doing merit badges helps you do better in school?”, included Aviation, “After taking an aviation badge, I continued to write a report about planes in Language Arts and got an A+.” (6th), “I did aviation badge and we talked about wind in science. (sic)” (8th); Geology, “We are studying minerals in school.” (6th), “Yes because it will help me in geology in science. (sic)” (6th), “Because the merit badges help you in a subject like geology helps you is since (sic)” (6th), “It will help me if we do a geology section in science class.” (7th); Reptile and Amphibian Study, and Mammal Study, “I learned what mammals, reptiles, and amphibians do” (6th). Other Scout answers may have referred to any number or combination of merit badges, “Some merit badges help explain life” (6th), “I learn a lot by doing merit badges and they really helped me in life science” (9th), and “It helps me do better in school and outside school because it teaches me safety and I learn a lot (sic)” (7th).

Doing merit badges seems to increase a boy’s self-efficacy as indicated by analyzing interviewee responses and Scout answers to the question concerning belief that doing merit badges helps in school. A boy who completes a merit badge enjoys what Bandura calls a “mastery experience” (Bandura, 2006) and receives a physical symbol of this mastery in the form of a patch to be worn with his Class A uniform at all formal Boy Scout meetings such as Courts of Honor. Because these boys believe that doing merit badges help them in school, they are more likely to work hard in the classes in school that
they perceive to be associated with the merit badges they have taken (Briter & Pajares, 2006). Positive experiences that may lead to better school performance are important when so many boys are in trouble scholastically.

Favorite Thing in Scouting

Answers from the boys (n = 182) who completed the question concerning their favorite thing about Boy Scouts were analyzed as to what was the “favorite thing about Scouts,” and “Why?” The 6th grader who stated “nothing, You do nothing,” was the only boy to express this opinion.

Camping Survey question and Interview Data

“Camping” was the “favorite thing about Scouts” for 54.4% (n=99) of the boys who completed the survey. When combined with “summer camp,” 8%, “outdoors,” 5%, “adventure,” 3%, and “hiking/swimming,” 2%, what 72.5% of the boys liked best about Boy Scouts involved outdoor activity. These outdoor activities and exposure to the environment tend to increase boys’ environmental awareness and attitudes (Carrier, 2007). Of the Scouts and Scout scientists interviewed, half of them also listed camping as their favorite Scouting activity.

Boys gave many and varied reasons for liking camping best of all their Scouting activities, reasons categorized:

1. Special Reasons
2. Fun
3. Friends
4. Outdoors
5. Activities
6. Food/Sleep
7. Escape
8. Adventure

Camping, “its the reason i joined. (sic)” (8th). Many boys join Boy Scouts for the camping experiences and the adventure. Often Boy Scouts is the only time when these young men have a chance to experience the outdoors for prolonged periods, “I never go camping otherwise.” (8th). Boys may not be able to articulate their reasons for liking camping, “I don’t really know” (6th), and “because I do” (6th) are reasons somewhat more eloquently expressed by, “Because it’s awsom (sic)” (7th).

Exploring, seeing the world, and adventure are reasons boys like Boy Scout camping experiences. The ability to move and learn without confinement to a school desk, “We can run around but learn” (7th), is an important factor in the boys’ enjoyment of camping.

Other special reasons for liking camping are because campouts are bonding times between the members of the troop, the frequent (usually monthly), “We do it so often” (8th) and “My troop camps a lot” (7th), times when boys are able to be with their friends. Friendship, being able to spend time with their friends - friends from the troop, friends from other schools - just hanging out and having fun were reasons cited by several Scouts as their primary reason for liking to go camping. Boys are often very peer oriented, liking to work in groups and do things as a group. Campouts give boys time to form these interpersonal bonds of friendship.

Sometimes campouts, in addition to being time with friends, are also times of escape and independence, “I’m with friends and can do stuff I can’t at home.” (7th). (Many mothers may not be comfortable with their 11 and 12 year old sons building and lighting
fires, cooking on propane stoves, using axes, saws, and pocket knives, things that young Scouts learn to do safely when they earn their Totin’ Chip and Firem’n Chit (The Boy Scouts of America, 1998).) Boys often enjoy being away from home and their siblings, “because you get to do almost everything on your one (sic)” (6th). One way boys express their independence is in cooking for themselves, “I get to cook and see friends” (6th), “Badmition in free time and cooking (sic)” (11th), “Because you can sleep in the great outdoors and home cooked meals” (6th). Scouts like leaving home to sleep, claiming, “I tend to sleep better than at home.” (10th), and, “I like to sleep under the stars” (7th).

Activities on campouts are important to Scouts, “I like this best because of the activitys (sic) my troop does” (8th). Scouts like camping, “Because you get to do fun activities.” (6th), “beacuh git to bo cool stuff (sic)” (6th), “exersize (sic)” (6th), and “...cause you get to go boating (sic)” (6th). Scouts like the diversity of activities that are done on campouts and being able to physically manipulate their environment, “I like the wide variety of things offered at the outings.” (8th), “I Do Becuse it’s hands on (sic).” (7th).

The interviews with the Scouts and Scout scientists indicated the love of camping with its underlying themes of getting away, cooking, sleeping, travel, activity, learning, friendship, and adventure were common to Scouts, past and present. The Scouts and Scout scientists also talked about liking fire, or campfires, an activity that was mentioned only twice on the open-ended survey, “building fires” “because you can be able to cook” (7th), except, perhaps as a hidden corollary in conjunction with cooking. Perhaps the
Scouts who filled out the survey were embarrassed about their enjoyment of fire or did not want to be perceived as having pyromaniacal tendencies.

Interview with J., age 17.

R: What’s your favorite thing to do in Scouts?
J: I’d say it’s camping.
R: I think every boy says that. Why?
J: Well, it’s a chance to get away from society and be out in the middle of nowhere pretty much for us. And, kind of be on our own for a week to cook and sleep by ourselves.
R: What’s your favorite thing to do when you are camping?
J: I like to play with fires. I know a lot of guys like doing that. It’s fun to see how many different ways you can start a fire. In a safe way, though.

Interview with D., age 16.

R: What’s your favorite thing to do in Scouts”
D: Definitely have to say that camping, you know, just the fun of being able to go out uh, guys, you know, just do out something fun. Going camping.
R: Do you do lots of exploring and look at life kind of things when you’re camping?
D: Well, when I’m camping I usually just try to enjoy myself. Gain an appreciation of surviving out there, not having your commodities that you have back at home.
R: So getting away is important?
D: Yeah.
R: What do you like to get away from?
D: You know, just being at home all the time just kind of sets a routine, just going out and doing something new and different just kind of breaks the routine, and provides that rush, that excitement that you get.
R: I talked to a Scout that likes to play with fire. Are you a firebug?
D: (Breathes out) HHH. I’m better now. I used to be really bad, but now, now I keep it in the limits, but I always like playing with fire.
R: Why is that?
D: It always seemed fun, I don’t know.
R: So, did you ever think about why fires started, or just, it was just fun to burn things, or?
D: Well, when I was younger and a Cub Scout, I just liked it because it was hot and it caught other things on fire. And, as I grew older, I understood the principles of combustion, never really looked at the fire that way when I’m still playing with it. But definitely I have an appreciation for how it works now. Interest in how it works.
Interview with K., Age 16.

R: What’s your favorite thing to do in Scouts?
K: The adventure. Like rock climbing, backpacking, swimming.
R: OK. Are you a firebug?
K: Yes. (laughed)
R: Do you think that’s common for Boy Scouts?
K: Honestly, yes. (Laughed) I have to say that.
R: Why?
K: I have, ‘cause you start at an early age, you learn how to build a fire, and then you kind of like, you now know how to build it, so you feel like, I don’t know, like you have control almost. Like you can start your own fire.
R: But it’s all under control.
K: Yes.
R: I mean, Boy Scouts don’t set forest fires, they just play with fire.
K: Yep.
R: I don’t know many Boy Scouts that aren’t
K: Pyros? (laughed)
R: I wonder why it is? If it’s just that boys that like activities are attracted to Scouting or what do you think?
K: If you’re attracted to adventure, actually getting out of the house, that kind of attracts me to Boy Scouts.
R: Getting out?
K: Getting out, not being cooped up in a house all day, doing nothing.
R: So you think the getting out is real important?
K: Yeah.
R: So, what kind of things do you like to get out to and from?
K: We went to Maine two years ago. We went up Mt. Katahdin, part of the Appalachian trail. We biked down in southern Ohio. We’ve been down to Tennessee, Kentucky, Indiana. We went to Washington, D.C. We planned a trip to New York, but that didn’t work through, but going, learning about all the United States, and all of the world, learning different features about it, it’s kind of interesting.

Interview with Mr. Sherman Lundy, Geologist.

R: What was your favorite thing as a Scout?
S: My favorite thing as a Scout. I think the outing portion of Scouting. ...the camping experiences that we had, and then being able to take these ideas out of there and go out and actually, physically do the out-of-doors activities. Everything from learning how to cook over a fire, and, I think, fire, the cooking over coals, learning how to work a compass. I mean, it isn’t just one thing, it’s all of those things wrapped together, that you can actually go out and get away from
being what today are called couch potatoes. You’re out becoming involved with all of this. Then all of these things begin to take on meaning. From the old idea of looking for moss on the North side of a tree - you find moss grows everywhere, it depends on the moisture conditions. Learning how to identify the trees. One of the Second Class requirements ... when I was a Scout, was identifying trees, plants, and whatever else. That was neat because you knew what you were looking at. You began to understand the relationships; you learned to respect that. You didn’t chop down the green trees to make your lean-to. To me it wasn’t just a single thing, it was all of these things put together, in my Scouting experience, so it was something you really looked forward to. Our meetings were on Monday nights and I, as a Scout myself, I think that was one of the things I looked forward to, is that we got to go to Scout meeting. We got to do all of these things, and to plan these things. (Lundy, 2008a).

Interview with Dr. Jason Sonnenberg, Actinide Chemist

R: What was your favorite thing as a Scout?
JS: Camping. Camping and hiking. I absolutely loved it. ... Campfires came close, actually. I liked that a lot. I guess I ... was more of the controlled firebug, but I was a firebug just as much all the rest of them, but I did like the camping, just the simplicity of it. It was always ... where you unplugged from society ... we were never allowed to bring electronic devices, things like that, so that meant you had to go out and play capture the flag or throw a frisbee or do other, more traditional sorts of entertainment. That really was nice. ... It was really nice to go back and do simple things, where you had to make conversation with people or you had to build the campfire, or you had to cook. Those were all really nice. There was also the benefit of getting away from home and my family. God bless ‘em all, but (laughed) picking up and disappearing for three days is, at that age ... not a bad thing. ... the get out and move. (Sonnenberg, 2008)

Many Scouts also like camping because of the connection with nature and the outdoors that they feel when they are camping. Some of the reasons boys listed for liking camping included liking the seasons, liking to collect firewood, being away from the city, being outside, loving the “outdoors and being and being out in God’s creation.” (9th), getting fresh air, “... being with wild life.” (8th), staying out in the open air, because it was calm, loving nature, hanging with friends, and having fun outside.
Some Scouts listed the outdoors and being outdoors as their favorite thing about Scouts, whether or not they were camping. The reasons for liking the outdoors were similar to the reasons giving for liking camping and having a love of the outdoors as the reason for their camping preference: “I like the outdoors because I’m away from everything and it just gives me a break.” (6th), “I like being outdoors and enjoy being outdoors.” (6th), “because it is calm (sic)” (6th), “What you experience in the wilderness is nothing like a town or busy city.” (9th), and, “Because it interests me” (11th). (Not all the reasons were listed for regarding the outdoors as the favorite thing in Scouts instead of camping with the outdoors, as the supporting reason overlapped.) Boys who listed the outdoors as their favorite thing gave the reasons such as: “Better than Being inside” (11th), “Better than indoors.” (10th), and, “It’s funner than playing video games” (11th). (Video games and electronic devices are banned from most Boy Scout campouts, necessitating more interaction between boys and between boys and the environment.)

Outdoor education has been used extensively to promote health and recreation since the late nineteenth century. Camping, a major component of outdoor education, has been a major means of educating people about the environment, promoted by, among others, people who also influenced the Boy Scout movement, including Ernest Thompson Seton and Lord Baden-Powell (Lund, 1997). The attitude of boys towards the environment is positively affected when they spend time in the outdoors (Carrier, 2007). As society has changed and climate changes have begun to occur, the importance of outdoor education and environmental awareness has increased. According to Dr. Thompson,
I think there is a nature deficit disorder developing where our young people spend far too much time with gadgets, electronics, and the new latest widget that comes out. Plugged in ... they don’t even go outside to do things because you can’t plug in your computer or your favorite game, or whatever. I think the real problem with that, of course, is that people don’t learn an appreciation for the world in which they live ... that they are part of an environment that, if we’re not careful, we are going to change in a way that life, as we know it, is going to be very difficult going forward. I think the initial step in every young person’s life is learning an appreciation that you are part of a whole. You have to be very concerned about what your actions might do; you’re impacting that whole and hence, your wellbeing going forth ... as people, as part of a system, we need to be aware of these changes that are taking place outside of our controlled environment. Scouting allows young people to experience that,” (Thompson, 2008).

The main reason given as to why boys like camping is, “fun.” The word fun was mentioned by 71 of the 181 boys polled (39.2%); the word fun was used in relation to camping by 23% of the boys polled. Fun, as the reason to like camping, was mentioned in conjunction with activities, being with friends, learning, and just fun. Fun is very important to boys, thus Boy Scouts was designed to be fun (Jarman, 2005; Nicholson, 1940). Baden-Powell described boys as “full to the brim of fun and fight and hunger and daring and mischief and noise and observation and excitement,” (R. S. S. Baden-Powell, 1920).

Camping, in and by itself, “It’s fun” (cited many times by Scouts of all grades), “It is the most enjoyable & fun” (9th), it’s “fun just playing around” (8th). Many boys need no other reason to like camping other than the fact that it is fun.

The activities undertaken when camping are fun: “The camping and activities, it is the most fun anyone can have.” (9th) “I like this best because it is an ativit is fun (sic)” (6th), “Because they have camp fires and so much more fun things.” (7th). Camping is an outlet, something fun to do, “I have nothing else to do on weekends and we do fun
stuff.” Friendship and fun intersect on campouts. Boys enjoy being with their friends, having, “fun, time with friends” (10th), because, “It’s a lot of fun hanging around friends.” (7th), You get to have fun and interact.” (8th).

Boys like camping because they have fun learning new things, “I have a lot of fun learning how to do new things (sic)” (10th), “It gives me ability to learn and grow in a fun environment” (11th). Boys may have a hard time learning if the activity is not fun for them. All of the Scout leaders, Scout scientists, and Scouts interviewed for the project emphasized the importance of fun for learning.

“Merit badges” and “Knowledge,” were the “favorite things” for 5% and 4% of Scouts respectively. As merit badges are for knowledge acquisition, learning was the favored activity for 9% of Scouts, not including the Scouts who liked camping because they could learn through the activities at campouts. Boys liked merit badges because merit badges are fun. “It is fun to do and learn different.” (6th). “Merit badges are fun and school isn’t.” (6th). Fun is an important factor in learning for boys in Scouting.

Boys like learning with their friends, one of the common learning styles of boys is that they learn with peers (Honigsfeld & Dunn, 2003). Boys liked merit badges because, “They can be fun” (8th), “becuse it is funner to learn with friends (sic)” (6th). Boys like, “Having fun learning. Because I think its better than sitting down bored (sic)” (7th). Although a Scout may do a merit badge on his own, merit badges are sometimes district or council-wide activities, summer camp choices, or troop activities. Some Scouts liked doing merit badges because “You meet new people.” (8th).
Scouts also liked doing merit badges, “because learning and working makes me strong and I love to learn” (7th). “They give you more to do in the BSA. You also learn a variety of stuff that would seem non-Boy Scout related (ex: Computers, Graphic Arts, Entreprenuership (sic)” (12th). Boys liked merit badges because they learned science, “Because there is two merit badges that are related to science” (7th), and because, competitively, “You know more things than anyone else” (12th).

Scouts valued merit badges, with the inclusion of career option study on many merit badges, because, “I’ll learn what I want to do when I’m older. I’ll help me with getting a good job. (sic)” (7th), “Because many Scouts LEARN their job” (7th) Survival skills taught in merit badges were also valued by Scouts. “It teaches you how to survive in life. Because, you should be prepared for what life gives you” (7th). “Learning to survive, its important to know if you get lost one day in the woods (sic)” (6th).

Summer camp is where many Scouts earn merit badges. Summer camps vary in how they organize the merit badge program. Some BSA summer camps have Scouts register for specific merit badges held a certain times during the day, every day for a week. Other BSA summer camps let the boys schedule their own activities and merit badge work. Counselors, often older Scouts, are available at certain locations; boys work on their chosen merit badges when and how long they wish, leading Scouts to say, “It’s fun. You can do whatever you want and the staff” (9th). Some BSA summer camps have special programs for Scouts who attend every year, in addition to the merit badge programs. These camp-specific programs may lead to extra patches or paraphernalia worn with the uniform, but are not merit badges or substitutes for merit badges.
Summer camp is the, “favorite thing about Scouts,” for 8% of the polled population, “because it Rocks,” (6th), and because, “It is fun” (8th). Fun is an important reason for Scouts liking to go to BSA summer camp. “We have cooler thing to do at camp. (sic)” (6th), “It is fun and active” (8th). Variety of activities and being with friends are important to Scouts, prompting Scouts to say, “They vary in what you do” (9th), and, when referring to BSA summer camp, “It is a fun way to be with your friends that are in Scouts” (8th). Fun and friendship were conjoined; talking, learning with friends in a fun way, and just “hanging out with my friends because it is fun” (9th), are important components of Scouting for boys.

Friendship is very important to Scouts. In addition to the Scouts who stated that they liked camping because it was a way for them to spend time with friends, 7% of the Scouts polled stated that what they liked most about Scouting were their friendships with other Scouts. Almost 17% of the Scouts polled mentioned friendship, in one context or another. Many of the reasons for listing friends, as the, “favorite thing about Scouts” were reasons listed for liking other things, such as camping or having fun. “Meeting friends, going to XXX summer camp. I feel these are the most fun things to do in Scouting” (10th). Scouts’ reasons for putting friends as their “favorite thing about Scouts,” included, “Because I am an extrovert” (9th), “So I can socialize” (6th), and “Fellowship, Scouts is the time I spend with friends the most” (11th). Scouts stated they liked, “Seeing friends because I don’t see them in school.” (8th), and “I like it because I have a lot of friends” (7th). Scouts also enjoy, “Getting to help people, (sic) Because it makes me feel good” (7th).
Scouts enjoy meeting new people. Some of the reasons Scouts like to meet new people include, “You have many friends to push you to eagle. (sic)” (10th), “I like meeting new people because you learn new things” (12th), and “Meeting new people exposes you to different ideas and cultures” (12th).

Of the Scouts polled, 5% listed activities as their favorite thing about Boy Scouts. Most liked the activities because they “were fun.” “We do fun things, learn, and camp. It is what I like to do” (8th) and “It is fun to work with other scouts” (7th). The “favorite thing about Scouts,” was given as, “Activities and camping, because without these I would not be in boy scouts (sic)” (6th). If it is not fun, boys will not stay. This is a basic tenet of Boy Scout education (Jarman, 2005).

Hiking is a reason for boys to like Boy Scouts, “Because I like hiking” (7th), “Backpacking, You get to see things like wildlife, and rock formations you can’t see car camping.” (10th). (The 2% of Scouts that liked hiking and swimming included only one who liked Boy Scouts because of the swimming.) Often hiking is associated with high adventure, such as Philmont. Several, mostly older boys like Scouting for the possibilities of adventure, liking the challenge and the rush, doing things that are out of the ordinary experience of most American boys - “Going places and doing dangerous or not-normal things.” (11th), “High adventure, because it gives you a greater rush” (12th), and “High Adventure, camping in extremes. I enjoy challenging myself” (12th).

Travel, as a favorite activity in Scouting, was often included as a subtopic in other favorite activities. Boy’s reasons for liking travel included fun and seeing the world - “The places you go becuis most of them are fun (sic).” (6th), “It is fun to go places and
camp.” (6th), and “I see the world (well, in North America). Most people don’t get to experience it.” (10th).

Three younger Scouts liked Scouting because of the rank system. Ranks were liked because, “They are fun” (5th) and “because its like the milatary (sic)” (6th). Military influence may also have been behind one Scout whose favorite thing was, “Uniform,” “I look cool.” (7th). (Geologist Mr. Lundy stated that the uniform was one reason he was interested in Scouting (Lundy, 2008a).)

Figure 4.2: Favorite Thing About Scouting
The reasons why boys like Scouting vary, but the themes of camping, outdoor adventure, friendship, and fun dominate the list, paralleling the reasons why scientist Dr. Lonnie Thompson joined the Boy Scouts, “... activities ... I always liked the outdoors ... camping ... friends ...” (Thompson, 2008). One reason Lord Baden-Powell invented Boy Scouts, “I knew that every true red-blooded boy is keen for adventure and open-air life...” (R. Baden-Powell, 1932).

4.3 Learning Style Research

There were no significant learning style differences by age or grade in the Scouts who participated in the learning styles research. A cluster analysis was done on the sample of Scouts who participated in the learning styles research; the three clusters did not differ significantly by age. Characteristics that were strong for all Scout clusters were a preference for learning visually, a preference to strong preference for learning tactually, and an intake style that varied from strongly preferred (Scout Type 1), to preferred (Scout Type 2), to it depends (Scout Type 3); no Scout cluster had a preference or strong preference for not eating while learning. All Scout clusters had a preference for learning globally, getting the big picture. Of the learning style participants, only one had a preference to learn analytically, no Scouts had a strong preference for learning analytically. Scouts of all ages learn by getting the big picture, they learn hands-on and by seeing, and they like to eat and snack while they are learning.

While not every Scout would exhibit all the traits of a cluster, Scouts clustered into three distinct types (Table 4.2). Scout Type 1, 42.8% of the sample, typified an always hungry Scout who was a visual/tactile learner. Scout Type 1 preferred to work
with his peers, was motivated by others, and did not always persist in finishing a task. Scout Type 1 learned best in the afternoon or evening, preferred to be free to move around and sit informally, and learned by getting the big picture - a global learner.

Scout Type 2, 17.1% of the sample, learned in all four modalities; Scout Type 2 was strongly tactile and could also learn through hearing, seeing, and moving. Scout Type 2 was peer oriented. Although self-motivated, Scout Type 2 did not always complete a task. This type of Scout did not prefer to be told what to do or how to do it; he preferred less authority. Scout Type 2 preferred more variety in learning situations; he also liked to be able to move around and liked to eat. Scout Type 2 had a preference for cool temperatures while learning, preferred to learn in the morning or late morning, not in the afternoon or evening. Scout Type 2 was more reflective than the other two Scout types, but like the other Scout types, he was a big picture or global learner.

Scout Type 3, 40% of the sample, had a learning style more typical of what is commonly seen as that of a studious person. Scout Type 3 preferred to learn alone instead of with his peers and preferred a formal seating arrangement in a quiet area while he studied; he learned best in the evening, not in the morning. Scout Type 3 was task persistent, usually finishing what he set out to accomplish. This Scout did not move around and did not necessarily need to eat while he studied; he did not prefer variety in how he learned. Scout Type 3 did not learn kinesthetically, by moving, or by hearing; he was a visual/tactile learner, learning hands-on. This Scout was also a big picture person, a global learner.
<table>
<thead>
<tr>
<th>Trait</th>
<th>Scout Type 1</th>
<th>Scout Type 2</th>
<th>Scout Type 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seating</td>
<td>Prefers informal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>Motivated by others</td>
<td>Self-motivated</td>
<td></td>
</tr>
<tr>
<td>Conformity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Persistence</td>
<td>Less task persistent</td>
<td>Less task persistent</td>
<td>More task persistent</td>
</tr>
<tr>
<td>Structure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alone/Peer</td>
<td>Peer oriented</td>
<td>Peer oriented</td>
<td>Works alone</td>
</tr>
<tr>
<td>Authority</td>
<td></td>
<td>Less authority</td>
<td></td>
</tr>
<tr>
<td>Variety</td>
<td></td>
<td>More variety</td>
<td>Less variety</td>
</tr>
<tr>
<td>Auditory</td>
<td>Auditory</td>
<td>Not auditory</td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td>Visual</td>
<td>Visual</td>
<td>Visual</td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>Kinesthetic</td>
<td>Not kinesthetic</td>
<td></td>
</tr>
<tr>
<td>Tactile</td>
<td>Tactile</td>
<td>Strong tactile</td>
<td>tactile</td>
</tr>
<tr>
<td>Intake</td>
<td>Strong intake</td>
<td>Intake</td>
<td></td>
</tr>
<tr>
<td>Morning/Evening</td>
<td>Strong evening</td>
<td>Morning</td>
<td>Evening</td>
</tr>
<tr>
<td>Late Morning</td>
<td>Not late morning</td>
<td>Late morning</td>
<td>Not late morning</td>
</tr>
<tr>
<td>Afternoon</td>
<td>Strong afternoon</td>
<td>Not afternoon</td>
<td></td>
</tr>
<tr>
<td>Mobility</td>
<td>Mobility</td>
<td>Mobility</td>
<td>Not mobility</td>
</tr>
<tr>
<td>Reflective/Impulsive</td>
<td>Mobility</td>
<td>Reflective</td>
<td></td>
</tr>
<tr>
<td>Analytic/Global</td>
<td>Global</td>
<td>Global</td>
<td>Global</td>
</tr>
</tbody>
</table>

Table 4.2: Scout Types in Three Clusters
A cluster analysis of the four learning modalities, Auditory, Visual, Kinesthetic, and Tactile, was performed in order to see if Scout learning modalities clustered in a target area, as this would be useful for teaching strategies that targeted the learning style modalities of Scouts (Appendix F). There were three clusters of Scout learning style modalities. Scouts in Scout Modality 1, 28.6% of the participants, were strong in all four learning modalities; they were exceptionally strong in the kinesthetic and tactile modalities. This type of Scout could learn with any type of teaching presentation. Scouts in Scout Modality 2, 42.9% of the participants, were strong in only the tactile modality. These Scouts did not learn well in a kinesthetic modality, their auditory and visual learning depended upon the circumstances. These Scouts need to be taught with teaching strategies which target hands-on activities. Scouts in Scout Modality 3, 28.6% of the participants, did not learn auditorily or kinesthetically. The Scouts in this modality were exceptionally strong learners in the visual modality; their tactile learning modality depended upon the circumstances.

To best reach the greatest number of Scouts according to their preferred learning modalities, Scout leaders should concentrate on tactile and visual activities. Tactile and visual modalities were strong in, or at least in certain circumstances, preferred by, members of all three modalities. Auditory and kinesthetic modalities were, at least in one of the modality clusters, not a preferred way to learn.

Boy Scout group management protocol uses Scouts learning styles to enable Scout leaders to manage group behavior. The researcher observed the use of Boy Scout management techniques at a data collection location where the presenter was an Eagle.
Scout familiar with Boy Scout management protocol. The presenter used his knowledge of Boy Scout protocol to control the group. Whenever he needed the boys to be quiet the presenter would announce, “Signs up.” He and all the boys would then hold up three fingers of their right hands and the room would become silent. The boys were used to this method; all the Scouts responded quickly and the room would quiet. The kinesthetic response to a visual and auditory request for silence seems to work well with the learning styles of boys; they are judged by their peer group on the quickness of their kinesthetic response to the visual and oral request.

4.4 Interview Data

4.4.1 Science

Definition of Science

The US Supreme Court, in the 1993 case *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, defined science as:

“Science is not an encyclopedic body of knowledge about the universe. Instead, it represents a process for proposing and refining theoretical explanations about the world that are subject to further testing and refinement (emphasis in original). But, in order to qualify as ‘scientific knowledge,’ an inference or assertion must be derived by the scientific method” (Shrake, Elfner, Hummon, Janson, & Free, 2006).

The Ohio Academy of Science, in 2002, defined science as:

“…science is a systematic method of continuing investigation, based on observation, scientific hypothesis testing, measurement, experimentation, and theory building, which leads to explanations of natural phenomena, processes, or objects, that are open to further testing, revision, and falsification, and while not ‘believed in’ through faith are accepted or rejected on the basis of scientific evidence” (Shrake, Elfner, Hummon, Janson, & Free, 2006)
Science is access to knowledge, the place where testable questions are asked. The scientific method, the core of science, is a procedure for determining the difference between knowledge and belief, a procedure for determining the evidence (Gerrold, 2003)

Scientists, Scout leaders, and Scouts gave definitions of science for this study, but they were not as precise as the definitions from the United State Supreme Court or the Ohio Academy of Science. The three groups seemed to have similar but different definitions of science; scientists focused on investigating and understanding, Scout leaders focused on methodically problem solving, and Scouts defined science as the study of everything.

Scientists defined science as learning, understanding, documenting, and transmitting information about the unknown and the processes of the world. Science, for the scientists, involved using logical thought processes to ask questions, learn about the unknown, and transfer that knowledge to others; scientists were concerned with processes. For Scout Scientists, science is about learning, asking questions, thinking, gaining understanding, and using reasoning to extrapolate the unknown. What is learned through asking questions and applying logic is to be documented and passed on to others. Questions were a major focus for scientists.

Scientists answered, “What is your definition of science?

Dr. Lonnie Thompson

I believe that it’s understanding and documenting the processes that make up our world; they come in all different levels. ...One of the reasons I was attracted to geology is because they deal with very big things. The climate system, the movement of continents, but systems and the whole ... understanding the earth and the universe in which we live at all levels. Big levels, but also you can go the other direction and down to the very, very small particles that make up atoms.
I’m always intrigued by the fact that you can go in both directions. There doesn’t seem to be a limit in either directions so far as we can tell. The greatness - the bigness to smallness (small chuckle) in the universe. I find that intriguing (Thompson, 2008).

Mr. Sherman Lundy

My definition of science. I think science is two-fold. Science is learning; science is investigating. You intertwine the two. If I had to define the science...Science is the capacity to learn how to learn, learn how to think, and learn how to question. To me, that is the key. If I learn how to learn, I know how to study. I learn how to think. I learn how to question. I learn how to go back and re-evaluate, and I’m not afraid to go back and re-evaluate. I’m not afraid to reassess. I don’t like the word afraid, but I learn to respect that capability because that way you’re always in a learning mode. It’s... not like you learn how to spell a word and you forget it. You learn how to LEARN, and that’s a process you keep doing all of your life. So to me, science is application, science is learning, science is learning how to learn, learning how to think, and repeating that process over and over again (Lundy, 2008a).

Dr. Leo Porchia

It is actually using reason to extrapolate the unknown and to add more to it. Science is essentially the fundamental understanding of how to better one’s environment through logic. ... Science is constantly changing, constantly being added to, and in some cases, constantly being taken back because somebody may have lied. But ... it’s always being added on to (Porchia, 2008).

Dr. Jason Sonnenberg

Asking questions. Asking questions and then thinking about it... All too often I think we as a culture, as a national community, and particularly my generation and younger, don’t think. We avoid it... there does seem to be a lack of thinking, across the board... I think that ... what drew me to science is the question asking, and then thinking about it. It really was the question asking...that I think I was allured by first... the question asking and “Why?” And “why” is a big question. ... asking and then finding your answer and then moving forward definitely...I think gets to the heart of what science is. ...But you’re mentoring and you’re teaching, and you’re passing knowledge...you’re passing knowledge, which is what teaching is. It’s also what science is, ‘cause if you’re at the forefront of human knowledge, the knowledge is just going to drop over dead if you don’t share it with somebody (Sonnenberg, 2008).
Scout leaders did not define science as asking questions and investigating the unknown, but were more concerned with methodically problem solving and studying the world and the things in the world. Scout leaders tended to agree with the scientists that science was about learning, but they did not emphasize the questioning aspect of science as much as did the scientists. Scout leaders focused more on studying things, parts of the natural world, and problem solving. Scientists defined science more as asking questions; Scout leaders concentrated more on the methodology and focus of the investigations and were concerned with things, problem solving, and methods. Scout leaders defined science:

For me science...is a big passion. Finding answers, trial and error, cause and effect, processes, who am I?, what am I?, why am I here?, you could go many different levels with that. But one of the biggest things, “how to investigate?”, “how does?”, “what is that?”, “how to organize them?” Problem solving a great deal. Discovery is huge. Just discovering. ...Sometimes it amazes me that the word science isn’t just the word life...I think really, science is an expression of life. Mrs. C.

My definition of science is definitely, I’d say 100%, everything that we do. It is, learning. In every way, there is a science to how we learn. It’s how we solve problems, it’s the scientific method in action. Even if you don’t think about it in a day, you are using scientific method in every decision you make. So, science is from when you wake up and you look out the window and go, “Oh, it’s kind of cloudy, I should probably take a little umbrella.” That’s science in action to me. So it’s everything. It’s everything that we deal with that isn’t, no, it’s probably everything. (chuckled). Mr. A.

Science is a methodology of studying things, and...using a procedure to test whether the things are real, what things are, and how they are. It’s a method of approaching - a rigorous, organized method. There’s science in languages. There’s science in literature. The broad sense ... the actual world and its components. Mr. F.

Science is the study of God’s creation and the interrelationship between the different rocks, and minerals, and animals, and plant life that’s out there. The natural cycle, I think you’d say. Mr. R.
Scouts defined science as the study of everything. When referring to science, scientists used the word question where Scouts used the word study. Scouts seemed to define what scientists do, study; scientists said what they did, said they ask questions. Scouts, like Scout leaders, included the topics of study - everything, the natural world, the physical world, life - in their definitions. Scientists were not as concerned as Scout leaders and Scouts with the topics of study.

Science is the study of everything around us, from human beings to very, very tiny molecular objects. Anything and everything in between, really, like, everything involves science in some way. Scout J.

Hey, science is something cool. ... Science is the observation of nature and the natural world around you. So, that’s a good way to put it. ... Science is always changing ... there’s always going to mysteries that the natural world has that we don’t know about, and that we can always find out about. It’s really a dynamic subject that never really grows old. Scout D.

From what I gathered from school and Boy Scouts, I guess I’ll say science is like the physical world, the biological components of the world, and, and the chemistry of the world. Basically studying the matter, the everything that we see. But anything, basically I think it’s also what we infer upon. What, how we see things, then we’ll make inferences from them. Then, hypothesize it, experiment it, see if we’re right, and then we know how to use that in our daily lives. How we can use that knowledge. Scout B.

I see science as a study of everything on the earth, environmentally, physically, not mentally, but physically, the structure that we live in and atoms and molecules and ... chemistry. Biology of life. Life, itself. ...Science is actually showing you how something is created, including yourself and others around you. How you’re different and how you’re the same, and how the earth was actually formed. The ellipse that you actually live on and how you have to keep it safe. Scout K.

Scientists, Scout leaders, and Scouts agreed that science was about everything, that there was not a limit to what could be studied in science. Incorporating the perspectives of scientists, Scout leaders, and Scouts, science is studying everything
through asking questions in a logical manner in order to find answers to problems and to find knowledge.

What Scientists Do

Scientists, Scout leaders, and Scouts were asked, “What are some things a scientist might routinely do as part of his or her job?” The interviewed scientists thought asking questions was a very important part of what they do. “...there are a lot important questions out there, but chances of you answering them in your lifetime are extremely limited. So, it’s very important to choose the right questions” (Thompson, 2008). Dr. Porchia was the only scientist interviewed that did not mention the word ‘question,” but it was implicit in his use of the word “experiment” and discussion of the “scientific method” (Porchia, 2008). Scientists rely upon their experiences in order to formulate their research questions.

“I often think that my best ideas come from, I guess you would call it from the gut, before you have any information, directly. If someone were to ask you, “Why do you think that’s so?” you'd be hard-pressed to put it into words. But, it comes from, I think, experience and being able to have a feel for what’s there before you even start the process of discovery and collection of the records” (Thompson, 2008).

The scientists interviewed used the scientific method – “All the time. Like torturously” (Porchia, 2008), “Yes, continually, always” (Lundy, 2008a). To describe their work, the scientists used terms and phrases including:

- define what the question is
- What’s the problem that we want to address?
- raising the resources
- get into those areas, bring the ice back, keep it frozen
- do the analysis in the labs and the clean rooms, the chemistry, the dust, the isotopes,
- pull all of those various parameters together for a history for that particular region
address that original problem that we had asked (Thompson, 2008)

exploratory work - auguring and coring
set up a procedure
reassess that procedure to give me the kind of information that we need to know
working and advancing our operation into these resource areas
examine what I am going to do ahead of time
develop a plan to follow through with that action
accumulate ... the cores or augur samples
do an analysis - what’s there
work with other agencies to make determinations about durability
reassess that information again (Lundy, 2008a)

Type all day in front of a computer
ask new questions
think about things that only maybe a handful other people are thinking about, or
think about things, possibly, no one else has ever thought about
think about stuff that is leading edge
contribute to the body of human knowledge
make connections and see things
think about things that maybe never have been thought about before
trying to get grant money
trying to understand existing theories
write papers to communicate what you do
going to conferences
play really on the frontier of human knowledge (Sonnenberg, 2008)

ordering, planning experiments
doing an experiment
analyzing the data
making a figure
writing a paper
writing for grants
read a lot
read before you do an experiment
look at the data
do the data analysis
decide if the experiment needs to be fine tuned
if the data is sufficient enough ...move on to the next item (Porchia, 2008).

Much of what the scientists said they do as part of their routine duties are tasks

that could be interpreted as using the scientific method. The terms scientists used about

180
their duties and order in which they listed their duties indicated that the scientists asked questions and followed the scientific method to answer those questions. The research scientists all included applying for grants or support as part of their job description – this was not mentioned by any of the Scout leaders or Scouts (and is not part of the scientific method).

Scout leaders did not mention most of what scientists listed as comprising their work as scientists. The youngest Scout leader, Mr. A., who was training to be a scientist, was most similar to the scientists in his description of what scientists do. Scout leaders said scientists:

- problem solve and logical problem solve (Mrs. C.)
- conduct a sort of research
- look at a problem and ... Find a way to fix it
- Answer questions
- look up information (Mr. A.)
- do oxidations
- do experiments
- do theoretical experiments, using calculations (Mr. F.)
- Confirm consistency (Mr. R.)

Scientists said they asked questions, determined problems, planned, thought, experimented, drew conclusions, and readdressed the original problem. Scout leaders said scientists solved problems, answered questions, did experiments and confirmed consistency. Scientists seemed to imply process; Scout leaders seemed to attribute completion.

The answers Scouts about what scientists do were more vague that those of scientists and Scout leaders, but Scout responses were actually closer to the responses of
the scientists than were the responses of the Scout leaders concerning routine activities of scientists. Scouts said scientists:

- update their knowledge
- work on research projects
- they’re always outside doing stuff, or in a lab working on discovering new things. Scout J.

- design and test the different kinds of experiments
- have an open mind and think in new ways
- discover new ways about thinking about things and then trying to apply those
- see if they work
- Come out with any favorable results and then use ‘em to kind of benefit society. Scout D.

- they always look out for change
- they’re looking at trends.
- always asking questions. Scout B.

- clean up an area before they start working
- find clues around the environment
- use microscopes and stuff like that to see into small things
- scientific method
- hypothesize
- almost all scientists use hypotheses, theory, independent variable, dependent variables, independent things that form their thesis or conclusion. Scout K.

Scouts seemed to realize that scientists ask questions, collect background information, design and test experiments, and think about new things. Scouts and scientists seemed to assign scientists more process duties than did Scout leaders.

Comparison of Merit Badge Work and Work of Scientists

Scientists were asked, “Think about experiences that you had as a Scout, both working on merit badges and doing activities. Would any of your experiences fit into your definition of science?” Scientists agreed that what they did as Scouts, both activities and merit badges was similar to their work as scientists. Mr. Lundy described how
(armed with information about what makes a good campsite) the decisions of setting up a campsite, arranging the operation, and assessing subsequent problems leads to Scouts developing a scientific approach to problem solving.

“So, yes, I think that you develop that capacity, call it scientific method, quote, unquote. And, then you apply this. I think that that’s one of the things that Scouting does” (Lundy, 2008a).

Dr. Lonnie Thompson was very definite that processes that Scouts go through to earn a merit badge are similar to what he does as a scientist,

“Experiences as a Scout. Yes, for sure. I ran experiments ... But when you start anything, you learn as you go and you find out well, there’s usually a world of knowledge around everything out there only you don’t know about it (small chuckle) till you start digging. I think that the whole idea of why, on any research project, that you initially do a literature search is to find out what do we know. You need to start with that knowledge, and you learn that by asking the question and going to check it. You start that in - when you are working on these various merit badges. It’s part of the process that I still use today. ... those processes, they start out small, but I think the basic process is the same. It gets more involved as the questions get bigger, but the process is the same.” (Thompson, 2008).

Scouts, according to Dr. Thompson, do literature reviews and run experiments when they do merit badges.

Team building, problem solving, and first aid, according to Dr. Jason Sonnenberg, are the three major groups of Scout skills that he uses as a scientist:

“...I had a stronger background in that stuff, so when it came to, in my case, laboratory science safety for our chemistry lab, it was, “Oh, I’ve been down this path before.” And, I think that holds for just about any sort of science that you do, that by far those three groups are the ones that are just part and parcel of Scouts and ... there’s no doubt that they are part and parcel of science.”

Dr. Sonnenberg said that when playing on the frontier of human knowledge, “the problem solving is used constantly” (Sonnenberg, 2008).

Dr. Leo Porchia was not as detailed in comparing Scout experiences with his
work as a scientist but he stated,

“...a lot of the merit badges definitely were science based. ... I do remember my Boy Scout troop doing a lot of things that were science based” (Porchia, 2008).

Scout leaders were asked, “Think about what Scouts must do to earn a merit badge dealing with science. How does working on the merit badge compare with your description of what science is?” They were asked how science is naturally embedded in Scouting. According to science teacher/Scout leader Mrs. C.:

“Oh, it’s perfect. They’re given a task. They have to gather data, explain the data, give the most popular theory or explanation for the data that they collected, develop the vocabulary to explain their data. Research, of course, is very big. They do experiments. They have to test. And they’re explaining it. They have to know the equipment. They have to know how to use the equipment. They need to know cycles. They need to know correlations.”

Scout leader Mr. F. said Scouts did not predict things in as “abstract or mathematical” a manner, but Scouts and scientists still worked on observational skills, testing concepts, observing results. Mr. F. stated that what Scout did while doing a merit badge was similar to what scientists do:

... merit badges cover the whole range of predicting, observing, doing, learning from results, testing results against a control. All can be present in merit badges. Certainly in many merit badges. All in protocols.

Mr. R. was asked if he thought Scouts working on science related merit badges were acting like scientists.

They would have to do their research in that way, they’ve got a pattern of research, it’s not a happenstance. There is a logical pattern of learning that has to take place at that point, so I would say there would be a pattern of progressive learning. As a boy prepares to take a merit badge he is going to have to crack the book open and start to look at materials, and then begin to relate the materials from the written page on to the actual life subject that he is taking a look at. So, it’s a hands-on process. It’s book learning. Its’ a blended learning from both the
reading of material, subject material, the interaction with the subject matter expert, and then the interaction with the plant, or the mineral, or the subject matter itself. So, a lot of visual learning, auditory learning, kinesthetic learning that takes place.

Scouts were asked if their experiences with science in the Boy Scouts were similar to what they thought scientists did. Scout J. thought that what boys did for some merit badges was similar to what scientists did:

Well, for merit badges you do have to do a lot of hands-on. For merit badges you have to do a lot of hands-on stuff. For Geology, I know we had to actually go out and find a lot of the rocks and the different types of soils. ...Scientists would too, if they’re doing like a research project or some sort of experiment that has to have a specific stuff. They have to be able to find that.

Scout D. also thought that some merit badge work involved working like a scientist,

Well, in the case of merit badges, you basically do the work, you try to learn something by doing the work. And then, by conferring with your counselor, you gain insight on what you did well, what you did wrong, how this helps you become better as a person. In a lot of ways, that’s really like the real world, ’cause you set out, you learn, you learn science, you learn what’s already there, and you try to learn, extrapolate on what you know could be, and then, speaking with the counselor is kind of parallel with speaking with your superiors or perhaps your colleagues. And, what could work and new ideas, what you can come up with.

Scout K. thought that Scouts work on a merit badge and scientists work was similar in that both Scouts and scientists had to ask and answer questions. Scout B. thought that what Scouts did was not like what scientists did, as scientists were looking for unknown information and merit badge pamphlets taught boys what was already known.

I think that merit badges are a great way to teach you the content of ... of what is already known. That’s the basics, then... to get to where scientists are...I think it requires more critical thinking and more questioning, and more inquiry.
One scientist and one Scout mentioned that what scientists do in their jobs was more involved than what Scouts do in working on a merit badge. What boys do while earning a merit badge or learning science, although in a more simple fashion and to a lesser degree, involves acting like a scientist – asking questions, doing literature searches, consulting with specialists, doing experiments, testing, and explaining. The skills that Scouts develop, team building skills, leadership skills, problem solving skills, are skills used daily by scientists.

Science in the Boy Scouts

Scouts spend time on science and science related activities. Scout leader Mr. R. stated of science and Scouting:

... they go hand-in hand. Old BP* ... when he designed the Scouting program from his travels and experiences in Mafikeng - he understood the importance of boys being able to bond with the outdoors... and set that up.

*Baden-Powell

Scout scientists and Scout leaders varied in their estimations of how much of an average Scout’s time, in the course of doing activities, merit badges, and rank advancements, is spent in science. Scout leader Mr. A. stated the average time a Scout spends on science related experiences is, “almost 100%. Everything you do is very much science related.” Scout leader Mr. F. disagreed, stating, “I would say, in a broad sense of science, 30 to 35% maybe, maybe more.” Dr. Sonnenberg stated, “it’s at least half” (Sonnenberg, 2008). Dr. Porchia tended to agree with Mr. F., estimating the average time spent on science related activities by Scouts as between 20 and 50 %.
I remember ... it wasn’t always science based stuff. I don’t know ... maybe twenty, thirty percent - that’s just out of Boy Scouting time. ... back then, you didn’t think you were doing science half the time ... with some of these things. But probably twenty, thirty percent, because - the meetings ... you said your Pledge of Allegiance to the flag ... stuff that you needed on campout trips ... I can’t answer that question ... I don’t know. I think ... low, like twenty, thirty percent, but it could be as high as forty, maybe fifty percent of the time (Porchia, 2008).

If the total amount of time that a boy spends doing Boy Scout related activities is, at a minimum, at least 20% science related, Scouts are spending a great deal of time involved with science.

**Merit Badges and Activity**

Two of the major ways Scouts learn science in the Boy Scouts are through merit badges and through activities/experiences. The interviewees were divided in their opinions as to whether merit badges or activities were more influential in developing a Scout’s scientific knowledge base. Some of the interviewees thought that Scouts learned more science through working merit badges than they learned through experiences/activities. Dr. Sonnenberg stated that a Scout developed most of his science knowledge through working on merit badges, but also through the times when he was made to question:

I think it’s pretty hands down that it would be the merit badge program. ... It really came through the merit badge program ... it would be the connection to any time we were asked to be inquisitive. Whether it was learning how to tie knots, learning how to make a campfire, learning how to do metalworking or leatherworking. It would be asking and being prompted to ask - how do we do that? How do I do that? How do I achieve this? How do I get from this point to that point? ... that sort of question asking... (Sonnenberg, 2008).

Scoutmaster Mr. R. stated that Scouts learned more science from doing merit badges than they learned from activities/experiences:
I think they learn more out of doing ... No, out of doing merit badges, because merit badges are centered around the stuff that they would normally do. ... it gives them an opportunity to look at nature. Boys will do stuff, but merit badges direct them into the more depth of doing ...

Scout D. also seemed to think that Scouts learned more science through the merit badge program than they learned experientially.

I think the merit badge would probably help me learn more, because camping’s not always, unless it’s a specific kind of campout, it’s not always necessarily focused, but the merit badges ... outline things for you to learn, things for you to work on in a specific subject. ... I think the organization and the concentration of the material that the merit badges give you ... line up with the fun experiences that you have in Boy Scouts as a whole ... making science fun to learn and making you want to learn it.

Scout K. believed that the merit badge program and experiential learning were equally important venues of science education in the Boy Scouts. He believed that Scouts who were “just hanging” learned from other Scouts who had done merit badges. The incidental learning through conversation was, to Scout K., an important way Scouts learn science in the Boy Scouts, as were the free-choice activity experiences provided in Boy Scouts that are separate from and in addition to the merit badge program.

They’re both important. Merit badge science, you get the essential question, you can actually answer it and learn throughout the essential question of what the answers would be, then you can experience it in Scouting. ...you bring it up when you’re walking on a trail and you tell your other friends about it. It helps out with the bonding experience with Scouts.

Learning more for text reasons would be merit badge. Experiential would be summer camp, because at summer camp we actually have to go around and name forty plants. Doing that at summer camp really helps out. ... there’s a whole bunch things we have to do at summer camp, like constellations, animals, plants, to earn a pipestone, which is a special honors program.
Boy Scout Science May Be Taught Subtly

While some of the merit badges and activities done in the Boy Scouts are obviously science centered and related, some science that boys encounter in the Boy Scouts is not as obviously science. According to science teacher/Scout leader Mrs. C., there are, “... many different opportunities to learn science without it being blatantly, (she made her voice low and growly) ‘This is science.’”

Scout K. referred to this subtle science education when he said, “Camping merit badge, that has like, I don’t know, like one or two that deal with learning about different things. Archeology, it’s not really one requirement, but it’s science over all, overall, but some people don’t see those as science.”

Scientist Dr. Porchia remembered learning science without realizing that he was learning science.

“You never really noticed it. Subtly...you do it and you just don’t realize. Not like huge, major science. Nothing like I’m doing. ... I mean, back then, you didn’t think you were doing science half the time...” (Porchia, 2008).

Scientist Dr. Sonnenberg didn’t realize that other kids were not learning the things he was learning and taking for granted.

...it really wasn’t until I hit college that ... I really became clear of just what constitutes things I learned in Scouts and things that most everybody didn’t learn through day-to-day life. ...it’s just something ... that I took for granted. I’m sure most kids do take it for granted that they’re getting all this useful stuff shoved into their head when they’re not looking.

... a lot of fun, because you’re always doing it outside or, even though you’re doing possibly mundane stuff, but you do it on a college campus or you go to a park ... you’re not it at home with mom and dad or in the schoolroom. It’s more digestible I think (Sonnenberg, 2008).

Scout leader Mr. A. thinks that boys will learn in spite of themselves, that the element of fun makes learning inevitable.
Any time that you can put an element of interest and intrigue and something kids will like to do, its very nature is something ... they’ll be learning in spite of themselves. I think that element of fun - the learning sort of sneaks up on them.

Science activities and learning are so much a part of Scouting that boys are learning science, having science experiences, and doing hands-on science without being aware that the fun things they are doing and learning are “science.” The memories of these fun experiences are what Scouts take with them into their science classes and are what they can use to construct science knowledge.

Camping

Camping, the favorite thing of Scouts, is a science learning activity. Boys often join the Boy Scouts because of the opportunities it affords them to go camping, not for the opportunities to learn science. The science boys learn while camping is incidental, but no less valuable or real than science they learn intentionally. The science boys learn while camping is science that is significant - science that has personal meaning because it is experienced and lived science. The science experiences that boys have while camping are experiences they can remember and build on when they meet the topics again later.

Scout B. listed camping as one of his reasons to join the Boy Scouts:

“It was ... the camping experiences, it’s great. And we do camping and I enjoyed having my friends - a lot of best friends.”

Dr. Thompson, paleoclimatologist, whose research involves climbing ice-covered tropical mountains to retrieve ice cores from higher than 18,000 feet above sea level, said camping was one of the reasons he joined the Boy Scouts. When asked if his Boy Scout experiences had influenced his career choices, Dr. Thompson replied,
"I think it ... certainly provided an experience of camping out, working in mountains. I still do that. (chuckling) So it probably played a role in that."

Dr. Thompson expanded on his winter camping experiences as a Scout in West Virginia,

“I remember a lot of discussions about ... You go out in the winter. The important thing is not the number of covers you put over the top of you, but the number of covers you put under you, to insulate yourself from the cold environment. I still use that when I go to camp on a snowfield in the Himalayas. You want to have a good insulation between you and the snow surface so you don’t conduct the heat into this cold mass. The first time I learned that was with Boy Scouts” (Thompson, 2008).

Dr. Leo Porchia, biochemist, also credited Boy Scout camping with affecting his life and career choices,

“...Scouting, we did camping, we shot weapons ...you worked for goals. I joined the Army after high school, so you could say, yes, it did. I was predisposed to know all those things that you do in the Army, with essentially just real guns, and camping in different places, and more ... So, I would say, yes, it did. It affected me, in the long run” (Porchia, 2008).

Scout leaders, Scout scientists, and Scouts interviewed for the project associated camping with learning science. Science teacher/Scout leader Mrs. C. stated that the way boys learned informal science,

“...the appreciation of why you do your merit badges, comes from the fun things of camping and canoeing or going out with a gang just to go look at some stars through a telescope ...”

Scout leader Mr. F. said,

“things like camping, wilderness survival require you to be acutely aware of what’s going on around you, where you are. So they are teaching some science. I think this is the most important science ...”

Scientists also discussed that setting up a campsite engendered problem solving skills and use of the scientific method in Scouts. Mr. Lundy, geologist, stated that his
experiences as a Scout setting up a camp fit into his definition of science. He stated the use of the scientific method can be developed when boys camp.

I think that it’s simply setting up a campsite. You go into a campsite; you have some information about what makes a good campsite. You look at the drainage area. You look at setting up where your fire-pit’s going to be. You look at setting where your tent, how you’re going to set up your tent. How are you going to arrange your operation? Are you going to set up some camp tool facilities, or equipment, or whatever else? I don’t like to necessarily use the word methodically, but you take a look at the parameters that you want to employ, and you employ those parameters. Then you assess what’s happened. If it rains and the water comes running down through your tent, then you know what’s wrong with this picture and then you make some determination that maybe we need to assess what went on here so we don’t have this experience, because wet sleeping bags are not a lot of fun. So yes, I think that you develop that capacity, call it scientific method, quote, unquote. Then you apply this. I think that that’s one of the things that Scouting does. Scouting says, “Hey, look, there’s a method and some procedures for doing this.”

... the science, I think, is there. And, even simple sanitation on a campout, what is, and here’s an obvious example of, taking some science and learning how to live in a sanitary environment (Lundy, 2008a).

Dr. Jason Sonnenberg says that through camping experiences, Scouts can learn teambuilding and problem solving skills, which are used daily by scientists.

For example, if you have to set up a camp, you can’t do it alone. We used these Eureka tents, four man tents, in my troop, and by the end of that, I could - you could blindfold me and I could put that sucker together by myself in the rain, but I couldn’t do twenty of them in a time frame that would get everybody in out of the rain. Even when I became really, well, better than average as far as cooking and being able to plan a meal for forty people or thirty people, I still couldn’t do it alone. And so, in the immediate formation of groups, leadership, or teambuilding... those skills are used daily in what I do. ...

The other thing that comes very quickly to mind is problem solving. So, you... have campsite number... While you would love the tents all running in a particular order, maybe north-south, but there’s rocks in the way, or... you have plans and then have to modify them or problem solve.... Be it as simple as how to lay out the camp to what to do with someone who’s been injured and you’re out hiking, or any of that, requires a certain amount of problem solving and emergency preparedness skills. The problem solving is used constantly. You
Scouts credited their camping experiences with learning science.

J. I think the feeling of just being outside, even when you’re not specifically learning something. You learn a lot about the environment by being out there, experiencing the surrounding, what’s actually going on.

B. ... it’s like we see some interesting things and go - hey, look at that. Maybe we look more at, what we really do focus more on - oh, that looks interesting rather than - oh, how did that come to be? But, yeah, we do some stuff like that, and I think that if people can go back to that - oh, yeah, I remember that - in Scouting, in their science class, then they learn. It comes right back to you ... Certainly I think that going outside and camping you’re going to learn some sciences of course ... you get to appreciate ... the wilderness, the area, the environment itself.

K. Experiencing the outdoors helps, and then we learn about botany, and different things, different plants, different animals. How, like when we’re climbing a mountain, like how that mountain was formed, like by a volcano, or how it, it was started. Like a rock, geology, botany, and animal sciences. Different things like that help with science.

R: So, when you’re just out camping and stuff, you think those experiences are very important for you learning science? K.: Yeah.

R: So, when you’re hiking and just
K.: Hiking, like when you need to stay away from poison ivy, ‘cause that would get you in a whole lot of trouble. These berries are poisonous, ... these are edible. These animals are dangerous; these ones are safe.

Scouts thought that just being outside, looking at interesting things, and learning to appreciate the environment helped them learn science; boys thought that the experiences they had while camping would help them in their science classes. Incidental
science learning, memorable science-related experiences, and problem solving skill development are the unintentional side effects of Boy Scout camping.

Experiences

Whether a Scout learns more from science from experiences or from working on a merit badge may depend on his learning style. Some Scouts, who may have a more experiential style of learning, may learn more science through experiences and activities than they learned through working on merit badges. Scout leader Mr. A., a merit badge counselor, thought experiences were the most important way Scouts learned science.

R: So you’re saying that not just merit badges, but experiences?
A: Yes, very much experiences. Experiences teach better than anything else.
R: So, how do you think boys learn best?
A: Definitely with their hands. With their hands, get their hands on it, get down and nitty-gritty...they need to be down doing, instead of just sitting. I know that even in any of my merit badges, I try to have either experiments, where they can see....or that kind of stuff. ...just completely, they need to be doing.
R: It’s not just the merit badges, it’s -
A: Everything. It’s the natural experience. It’s walking on a trail and saying, “Hey, guys. Come here and look at this.”

Dr. Thompson thought experiences were more important than merit badges in engendering interest and understanding in Scouts.

... the experience of doing - trial and error - failures. Failure is ... important. (chuckled) I think absolutely it is the experience. ... experience is probably the more important. Merit badges, it’s ... a recognition ... like an award. It’s not the award that counts, it’s the journey to getting the award that counts. To me, that is experience (Thompson, 2008).

Scout J. believed that learning experientially, including independent exploration, was the most important way Scouts learn science. When asked where he learned the most science, Scout J. replied:
I’d say camping with my troop, because, when we’re actually camping in our troop, we do a lot of merit badges stuff, as well as a lot of time we’re just free on our own to where we can just kind of go explore and learn exactly what is going on. Then, when we get to our merit badges, we can actually work from what we did and we actually know what is going on, so it makes it fun.

R: So, the just going camping and just exploring and doing and just being outside is like, important for your science. And probably the most important thing was?
J: Just the being there.
R: Just the being there?
J: Yes.

Scout J. definitely felt he learned science incidentally, just by being outside and camping.

R: When you go camping or activities, other than merit badges, do you think you learn any science?
J: I think the feeling of just being outside, even when you’re not specifically learning something, you learn a lot about the environment by being out there, experiencing the surroundings, what’s actually going on.

Scout J. credits experiences with interesting him in science.

R: Is there anything that you really remember as something that really made a difference and interested you in science?
J: I’d say when we were at Sea Base. Being out on the ocean there, near the coast is a very fun experience, to see storms coming in, or storms already being over land, but not near you, where you could watch them from a safe area, and could see what’s going on during the storm and how long they last. See how they move, and circle, and then actually see rain, where it falls, where it’s not, you can see it coming toward you, be able to go around the rain ... being ready and prepared for when it hits. You’re not completely surprised.

Dr. Sonnenberg saw a difference between people who had participated in a merit badge-type program and those who had not. Choosing to participate in a merit badge program, choosing to give up playtime to work on “something which is known to be constructive,” engenders time management skills and achievement orientation in a goal directed context.
...if you look at folks that grew up in a family that went camping a lot, or did a lot of outdoor activities, or did a lot of the same hiking, backpacking skill sets ... when we all got back together to school, there were things that they didn’t get. ... You could tell ... that the merit badge program wasn’t there. They still learned how to tie knots, and go hiking, and how much water to carry, and all those more camping out - outdoorsmanship sort of things, but they didn’t have that extra bit of – ‘Hey, did you think about why this important to the nation?’ or, “Did you think about this?” or, ‘Did you have to do that disciplinary sort of stuff?’ The merit badge program sets you up, in the abstract sense, of moving through a goal oriented system ... which is going to ask you to partition some ... time from swimming or playing ... to doing something which is known to be constructive, whether the full depth of that is appreciated is not material, ...you’re given a choice (of)...how to spend your time. ...Not only do you get the chance of how to choose to spend your time... but the opportunity’s there, if you want to and if you choose to participate in it - you can get a lot out of it, without even realizing it. ‘I’m going to take two hours to do this merit badge, and then I’m going to go swim for the rest afternoon.’ That’s a sort of decision making process ... is fundamental to just about anything you can think of. When it’s presented to you, and you’re not forced into it ... that’s what the crowd that doesn’t have a merit badge program won’t get (Sonnenberg, 2008).

Science teacher/Scout leader Mrs. C. stated that Scouts learn science both through the merit badge program and experientially. Mrs. C. did not feel that the merit badge program was the only way Scouts learned science in the Boy Scouts. She believed that the merit badges brought out the formal scientific concepts, but the appreciation of science came from the fun activities that are part of the Boy Scout program.

I think they learn science in Scouting by participating in all the activities ... The merit badges bring out formal concepts ... how to write papers, how to communicate your concepts... But the non-formal part, the appreciation of why you do your merit badges, comes from the fun things of camping and canoeing or going out with a gang just to go look at some stars through a telescope because somebody brought it - sitting around the campfire, sharing ideas, thinking about philosophy. There (are) many opportunities to just know there’s more out in this world than just being a boy.
Merit Badge Work Different From Schoolwork

Working on a merit badge is different from doing schoolwork. According to the interviewees, merit badge work is much more hands-on; much less writing is required. One way that merit badge work is different from schoolwork is that boys may choose whether to do the merit badge work. The boy has to want to do the work; no one forces him to do it. Some of the merit badge requirements must be done independently, as independent research projects. Merit badges also require one-on-one interaction with the merit badge counselor. There may be more mud and dirt involved in a merit badge project than a school assignment, more physical interaction with the environment. Scout leader/merit badge counselor Mr. R, when asked if doing merit badges was different from doing schoolwork, replied:

There is a lot more hands-on. There is a lot more opportunity for hands-on, there’s a lot more independent research...he’s interacting with the merit badge counselor, but he’s got to go out and do his own independent research on it. Merit badges are set that they have to read this, and interpret this, and discover this, and do this for a while ... some of the different merit badges, like Mammal (Study) merit badge, you have to go out into an area and observe the wildlife in that particular area. ...You’ve got to interact with them, you’ve got to do that independently ... if you’re there with somebody else, you’re not going to create opportunities to see very many critters at that point and time. So, that independent learning ... has to take place. The initiative, the ‘you’ve got to want to do it’ ... It doesn’t get done unless a lot of self-discipline takes place, and a lot of self-motivation in that regard. They’ve got to want to do it. It just doesn’t happen otherwise.

(Boy) Scouts has been doing that for generations. They get the kids out in the merit badges - they work together and independently ... work on the projects that they have to write a report for. They have to do the discovery. They have to do their own research. They’ve got to find the right book that has the right material and prepare the research as well. The initiative and the learning process - they get a lot more exposure that way.
You put them in the field, they’re going to get down and dirty. It’s not a hands-off process. Most of them jump into it. They want to touch it ... they’ll pick it up, they want to study it, they want to turn it over. ... that’s why the biological ... the geological, physical science merit badges of Boy Scouts, kids get INTO. They get their hands-on in that process. They’ll go out and look for the leaves. They’ll climb the trees. They’ll press the leaves. They’ll do whatever they need to do ... a lot more hands-on. More interaction with science. ... If they’ve got a good instructor, the *Nature* merit badge... get(s) ‘em down and dirty with nature in that regard. They go back looking for stones in *Geology* merit badge ... they’re going to start rooting through, digging with shovels... looking through dirt piles and washing things off - which creates mud.

Scout leader Mr. R. wishes the school educational programs were more like that of the Boy Scout merit badge program, including the use of single-sex education.

I just wish that more of the educational processes in the public schools were like the merit badge process. A little more hands-on. I am a proponent of separating the boys from the girls.

Merit Badges Help in School

The informal science experiences that Scouts get while camping and doing other Boy Scout activities are very important in helping Scouts do well in their school science classes. Scout leader/science teacher Mrs. C. was asked how important, for her class, the informal science experiences that students had outside of class were. Mrs. C. replied:

They are very important. You can see it - the difference in attitude of the students that have had enough in their life experience to come into a class and go, ‘I see the value in what Mrs. C. is presenting me. There’s a value here.’ ...It just seems to be more of a natural fit for them to be in a science class ... they’re over awkwardness. They know how to interact with other people. They’re not vying for power plays and they’re more into the intellectual part of it. They’re ability primed for receiving education.

Mrs. C. stated that students who have done merit badges have a basis on which to build knowledge, they are “groomed” to receive education. She stated that students that have done merit badges have a:
...very good basis to work with ...Well groomed to receive education. There (are) many kids out there that ... they know they need education, but they’re not really groomed for it. They don’t understand how to approach it, what to do with it, how to learn the hard way.

Scout J. thought that Scouts should do a merit badge in the subject before taking the subject in school, as taking the merit badge gives a Scout a basic understanding of the topic, which can help the Scout in the school setting. J. thought that doing a merit badge after a school subject could provide reinforcement in the concepts, but wasn’t as much “fun” as learning some of the information before a class and building on that information in the classroom. Doing the merit badges before taking the school class in the subject gave him a, “one-up on everybody else in ... class.”

I’d say before, because then you have somewhat of an understanding ... it can actually help you out in school ... if you’re doing it afterwards, most of the time you’re already going to know about it, and it’s not always as fun that way. It’s kind of boring ... kind of doing the same stuff again you already know... Reinforcement, a little bit, but just for me, it’s more fun when I learn something a little bit, and to build on that, rather just going right into it and being done with it and having to do it again in a little bit.

Scout J. found it, “helpful, very much,” to establish a base of knowledge before taking a class in school. J. found the merit badges helped most during the first few weeks of school.

I’d say the most like the ten, the first couple weeks of school, when we were struggling, that’s when we covered most of our geology and weather type stuff. I knew most of that stuff, so I was able to be on top of things and be pretty good at that.

Scout D. believed that previous familiarity with the subject material enabled him to increase his depth of learning.

... just by experiencing the subject matter beforehand, it really familiarizes yourself with it, and allows you to learn it better.
Scout K. also believed that doing merit badges provided a background basis for his school classes. When asked if doing merit badges helped him do better in school, Scout K. answered:

I think so. If I’m doing Citizenship in the Nation, or Citizenships before I start history, or if I do some sciences before I start that science class, it really gives you a background basis on something. It really helps you to actually learn before you start the class, so you know, OK, so this does this, and you actually have the experience from it. And then, sometimes, merit badge counselors do it out in the field, so you get to actually have hands-on experience with it, and you’re telling your class about it. You actually know what it does.

Scout leader Mr. A, who was in college, stated that merit badges helped him in school, even at the college level.

...some of the merit badges helped me amazingly. ...a lot of my Mammal Studies, my Reptile and Amphibian - Fishing – not so much, because it’s almost more ... skill oriented, but you do learn about fish. Since it’s a little more skill oriented, it’s not quite as school appropriate. But definitely all those hands-on merit badges – Geology has helped me. I just got done with a year - two semesters of environmental science... definitely the stuff applies to schooling, especially if you are going into a biological field. But, even any of the fields, it is going to be useful to have the problem solving that you get from it.

Not all Scouts profit as much as they should or could from the merit badge program. Some Scouts do the minimum on the requirements, just to get the badge. Scout B. confessed to be, occasionally, one of the Scouts who just did the badge work “for gain.” When asked if doing merit badges helped him in school, Scout B. replied:

It’s given me some idea of certain subjects, I would say. I’m more of the person who just likes to get the merit badge for gain. I also, sad thing is, I also do a lot of stuff from a ... just the basics of it.
Even while confessing to doing merit badges for gain, and just doing the minimum, Scout B. stated that doing merit badges gave him an interest in the topic and helped him in school, providing a “little bit of a knowledge base going in to the subject.”

It does give me some interest ideas. The merit badges also help me with how I learn in some cases. It can help me with my learning in school.

Scout B. found that when he went in to a class, even though the class was not necessarily easier, he had a general idea of the subject.

I won’t say it was easier, but I had a general idea of it - at least ... the basics ... get into deeper stuff and then you start getting lost again, but then you start learning. ... I think it gets .... easier ... it helps. It gives ‘em a little help rather than like starting off without nothing at all in their head. It’s better to have some idea of what you are about to learn, rather than ... going in and not knowing the subject.

Most merit badges I’ve taken ... never ... had (a) relation to school.... I took \textit{Leatherwork}, \textit{Woodcarving}, and \textit{Art}, but ... I can’t really connect it to my school classes. But some, the ones that do have relation, I think they ... have helped a lot. Most of the required ones at the least ... \textit{Communications} merit badge helped me speak better or present better. ... \textit{Aviation} will teach you ... the physics of how planes fly, so I think there are some sciences in there.

Scout B. took his \textit{Aviation} merit badge before he took physics. His physics class recapped some of the information he learned while doing the \textit{Aviation} merit badge.

...they did recap how planes (fly) ... but more about (the) physics (of) planes than they taught about how planes would use the wind pattern. How wind goes, and wind directions. How to use the physics of motion - about going to get to their destination. I thought, oh, yeah, that was mentioned in \textit{Aviation} merit badge (chuckled).

Scouts, even while doing a merit badge for gain, just doing the minimum to pass the requirements, develop an experiential knowledge basis on which to build further knowledge. Doing a merit badge prepares Scouts for their school classes, or, if they take the merit badge after a school class, reinforces the concepts taught in the class.
Experiences Help in School

Scouts believe that their Boy Scout experiences help them do better in school, causing them to come into the classroom with questions about their experiences. When asked if “any of the things you have done, or places you have gone in Scouts” helped him to better in science in school, Scout J. replied:

I’d say Northern Tier probably helped me the most out of any of them. ‘Cause I was actually out there in the middle of nowhere, pretty much, where I didn’t see anybody but just other animals and things. We were actually able to experience them in their natural habitats, and ... at the zoo they’re always locked up...it was just great for me.

Scout J. believed his outdoor experiences help him in school because they cause him to question what is going on:

I’d say you actually have questions. Being out there in the wilderness, you have questions about what actually is going on out there and when you get in school, you actually discover what exactly you were looking at and how those things work, not always just how things work ... but are actually getting to experience them, actually more fun.

R: So you, you gained experience and questions that you were able to look at later.
J: Yes.
R: So, the experience made you more interested in what you were learning at school?
J: Yes, because I had already known a little bit about some of the stuff and had questions about it that I wanted to be answered. It kept me interested.
R: Is that why you think it helps?
J: Probably. Because it made questions in my mind about how things work as well as gaining experience from the wilderness.
R: So you went in to some of your classes with questions that you wanted answered, so you were more involved in the classes?
J: Yes.

Scout B. also thought that, even though he learned more science at summer camp than he learned experientially, Boy Scout experiences helped him in school. Scout B, when asked if he learned any science while just out camping with his troop replied:
Sometimes and sometimes no. I have to be honest about it. It’s like we see some interesting things and go - hey, look at that! Maybe we look more at - what we really do focus more on - oh, that looks interesting - rather than - oh, how did that come to be? But we do some stuff like that. I think that if people can go back to that - oh, yeah, I remember that in Scouting - in their science class, then they learn. It comes right back to you how that is. ... I think that that is very important. Like those experiences we have like help us a lot in the classroom sometimes. If you can remember back, even little things can probably help a lot, too.

Mr. Lundy stated that remembered experiences are like hands-on experiences because they are direct and focused:

It’s interesting, talking ... if you bring this up, once in a while in a conversation, somebody will say, “When I was a Scout, we went out and we did this.” And, you know that the fact that they recall that experience, that it meant something to them. That recall and that encounter helped stimulate that interest, whatever it might be. ... I think it is subtle ways ... Sometimes they are direct, that you can measure, and then, sometimes, it’s a little more down the road a ways, where they unconsciously become aware of some things and know about some things that other people don’t know about. It’s that Scouting experience, that if they stopped to think about it - here, maybe here’s where I found out about this. We went did Geology merit badge out there ... that, to me, is where that young person is saying, “Ok, yeah, you know, in the back of my mind over here, I’ve had that experience already. I remember that kind of thing.” That’s a secondary experience, because it’s so direct and it’s so focused. The thing I like about it is that it’s like the lab, it’s like the hands-on (Lundy, 2008a).

Experiences and merit badge work provide a knowledge basis for Scouts, preparing them for school classes and enabling them to understand the concepts taught in school.

Boy Scout Participation Helps with Grades In School

Scouts believed that participation in Boy Scouts helped their grades in school. Scouts believe that they are prepared for their classes and have an advantage over students that have not had the benefit of Boy Scout experiences and training. Scout J., comparing himself to others in his school classes stated:
I’d say I had a fair advantage over the rest of the other people. I know some people are just naturally smart, and learn very, very easily, but, somebody else who would normally be going in like me at my same level ... I have an advantage over them, just because I know kind of what is already going on and I’m more interested in some of the stuff because I have questions.

Career Information Provided

Scout leader Mr. R. stated, “...the merit badge process gives the boys the opportunity to look at vocational opportunities...” Mr. Lundy, geologist, echoed this statement when he recalled his experience with the merit badge program:

... the merit badges opened up the vistas of all the other careers ... opened up the interest levels. Everything ... starting out with the simple things like ...

Woodworking or Leatherworking ... Geology ...fit along with my interests, and that was one of the things that I enjoyed the most. ... a lot of the merit badges tweaked ...my interest in ... learning...

Paleoclimatologist Dr. Lonnie Thompson credited the Boy Scout merit badge program with developing his interests.

... you’re attracted to certain things because of your interests. ... Boy Scouts was very important in developing and allowing those interests to develop in a structured environment, and so that probably was very, very important in that regard.

Dr. Porchia, biochemist, gave a list of merit badges that would be helpful in pursuing a career in biochemistry:


All those things ... you need for my field. Computer Science - Computers, you need to know how to use a computer - definitely how to use a computer. Chemistry - that was definitely. Plant Science - I put that on the list because a lot of the things that we use, a lot of the compounds we study, do come from plants. Apogen was one of the projects I was working on; that is actually from a lot of plants and seems to be an anti-cancer agent. Public Speaking - part of my job was to present my data in front of groups. I still hate it, but I have to do it. That helps
out - presenting in front of a group ... *Insect Study* ... we use sometimes insect cells ... sometimes insects are used as a source of information ... in genetics, you usually use fruit flies ... insects are a very good, easy way of getting genes ... *Medicine*. I worked on cancer ... if I was just going to talk about thyroid cancer, I could talk about ... *Environmental Science* mixed in with *Medicine*.... All those things fit in (Porchia, 2008).

The National Science Education Standards lists Science as a Human Endeavor as a standard for both grades 5-8 and grades 9-12 (National Science Education Standards, 1996). This standard encompasses the study of science careers as done as merit badge requirements. Requirements focusing on careers in the field give relevance to a merit for a Scout.

Merit badges, activities, and experiences are part of the Boy Scout science education program. Each boy is different, what reaches one boy will not reach the next, so the combination of experiences and merit badges is an important factor.

**Importance of Merit Badge Experiences**

Dr. Thompson thinks it is very important for young people to have a wide variety of experiences.

...you often wonder ... all the experiences you have, and at the time, they may seem very small and insignificant and maybe for someone else, they wouldn’t lead in a certain direction, the direction they do for you as an individual. But I think that’s why it’s very important for young people to have a wide range of experiences. It’s because we are all different. We don’t know which one is really going to get us, as an individual, started on a certain road (Thompson, 2008).

Free choice is important in the Boy Scout merit badge program as not all people have the same interest in each merit badge. Scouts are interested in different subjects, different merit badges appeal to different Scouts. According to Dr. Porchia, they try to make it fun, because *Geology* is not the greatest merit badge in the world, not like the *Environmental Science* or *Basket Weaving*.
Basket Weaving. I liked that one ... if you think about it; it is really the basis of culture. It’s the development of using a natural resource, which would be wood, vines, whatever, and making it into something, a receptacle, that holds things. That is, to me ... one of the bases of the culture. Because if you can’t hold stuff, there’s no reason to stay in a location. If you can’t store it, you have to follow it. And if you’re following it, you’re following the food supply. ... I think it’s a very interesting one. It’s one of the perfect things, meaning it was a lot of fun and there was a little bit of a science involved to it (Porchia, 2008).

While Dr. Porchia did not like the Geology merit badge, it was the favorite for geologist Sherman Lundy.

Geology ...fit along with my interests and ... was one of the things that I enjoyed the most. ... the Astronomy merit badge, I enjoyed ... (it) was kind of neat to get up and take a look at the constellations ... Bird Study ... Soil and Water Conservation ... those were things that I really found interesting. I think the Soil and Water Conservation paralleled with the Geology, too ... in addressing some of the issues, finding solutions to some of the problems. It was kind of neat, too, in the neighborhood ... one of the things we did is that we went out and we built a series of check dams in a couple little ravines, as part of the requirements ... just (to) make sure the idea worked (Lundy, 2008a).

Dr. Thompson recalled working on several merit badges that allowed his interest in the outdoors and the environment to develop.

There was one that had to do with Animal Husbandry* ... (as) the result of that, I developed a chicken business ... selling eggs ... Rhode Island Red hens. ... another ... had to do with Conservation. Because I had a penned chicken lot, I remember sowing the whole place in grass and planting trees (chuckled) so they had a nice place in which to live. ... out of those, I know that there was an experiment that I did in science on the evolution of how chickens develop. ... it takes them twenty-eight days from the time a hen sets before the chickens are hatched ... getting the sequence of development of the chicken and ... using that in a science fair project. But, there was also Weather ... merit badge, I recall. I remember working on that one ... at the time I had a weather station in the roof of the barn on the farm where I lived and did daily weather records in the morning and the evening, and forecasts and things like that. I think that ... the requirements for the various merit badges ... certainly developed a wide range of interests. My interest was always outdoors and the environment, but I think in many ways Boy Scouts allowed that to develop much more than it would have without them.
I also had a merit badge on, what do they call it? Rifles? ... Shooting ... when I went to the military, I was a sharpshooter. But, when I went to my first expedition to Tibet, because I knew how to shoot a gun I would go on the hunting expeditions with the Mongols to get sheep for our meat supply for our camp. They’d have shooting contests, and of course, I was very good. The Chinese had never touched a rifle (laughed) and ... just terrible. So those skills start often at a young age and you don’t know, at the time when gathering those, how those may come back to serve you at a later date. I have a very good relationship with the Mongols simply because I can ride a horse and shoot a gun. (chuckled) Those start, in part, with the Scouting and at an early age (Thompson, 2008).

*Previously, Animal Husbandry was a merit badge category from which a Scout could select a merit badge to complete his Eagle requirements (Stallings, 2007).

Scouts may have less free choice about completing the *Environmental Science* merit badge (Appendix D) than about doing other merit badges because *Environmental Science* is an Eagle required badge, although Scouts do have a choice about when and where to take it. *Environmental Science* is the only Eagle required merit badge that contains only science requirements; Scouts have a mixed reaction to this merit badge, some Scouts love the badge and others hate it.

Dr. Jason Sonnenberg, although he has had a strong commitment to positive environmental practices and recycling for a long time, did not like doing the *Environmental Science* merit badge.

I never wanted to become a biologist. And I’ll tell you, (chuckled) it’s from having to endure *Environmental Science*. ... You essentially get to watch grass grow three different times (chuckled) for an hour to three hours each time. Oh, that was terrible. (chuckled) It directly influenced that I didn’t go into that route. Essentially, I did well in biology in high school in my classes and have an interest in it, but ... it really pushed me more toward the hard physics and chemistry than the alternative.

Even with his aversion to the *Environmental Science* merit badge, Dr. Sonnenberg felt that:
It’s a good thing ... if you’re worried about patterns of migration ... you have to stop and watch the grass grow for a while. Luckily, now we have digital cameras that can do it for us. I’ve thought about that a lot over the years, because I absolutely hated it... there’s something to be said for the attempt at the discipline to get up in the morning, and watch it while the sun’s arising, then go back and watch the same patch of grass during the afternoon and again in the evening, then to have to write something about it. ... if it were up to me, the decision would be to keep it... I think the beneficial part is the discipline ... maybe that will be the first time that you have to get yourself up before the whole rest the camp, go sit in a chair, and watch nature roll by before everybody’s up on a day at summer camp, when you’re quote unquote, not at school. I think that challenge is more important than the potential losses to biology (Sonnenberg, 2008).

Dr. Leo Porchia, biochemist, liked the *Environmental Science* merit badge, crediting some of his fascination with science with the research he did while working on the badge.

...the *Environmental Science* merit badge... I really like that one. I don’t know if it’s because we stayed up all night one night, staying in front of a little creek ...one of the requirements is ... you go someplace in the forest ... and make essentially a dirt square. You come back a couple hours later and you see what footprints came in. Then you try to figure out what the footprints were. I loved that one. I think that merit badge really got me into wanting to be more of a scientist ...(Porchia, 2008)

The four current Scouts interviewed felt that the *Environmental Science* merit badge helped them in school. When Scout J. was asked what merit badges had helped him most in school, he replied:

I would say *Environmental Science* because ... my freshman year we had a lot of environmental science stuff we ... learned about ... as well as ... *Geology*

R: You’d say *Environmental Science* and *Geology* were the main influential merit badges for you in school?

J: Well, most influential, and then *Weather*, just slightly. We didn’t cover a whole lot of that in school work ... I learned a lot in that merit badge, too.

Scout D. stated that he gained quite a bit of knowledge while doing the

*Environmental Science* merit badge, which was very helpful in school.
From a just knowledge standpoint, I think *Environmental Science* was a lot of fun because I put a lot of work into that - learned a couple new things ... the way soil irrigation works. When you put a lot of work into something, it really makes it stick in your mind more. ... I enjoyed just reading about all the information and being able to apply it in experiments that we did for the merit badge.

When asked which merit badges had helped him most in school, Scout D. replied:

I did the *Geology* badge, it helped me because I was doing *Earth Science* class at the time, so when I’d go into class and, maybe a week later we learned something, it was like, “Oh, yeah, I remember doing that.” You already know what you’re talking about. And especially the *Environmental Science*, when you did a unit on conservation, you’re like, “Oh, I already know that.” So then, the information just seems to make more sense. You don’t have that learning block as if you’re learning it for the first time.

Scout B. also credited the *Environmental Science* merit badge as being one of the most helpful merit badges for school.

... the Citizenship merit badges, they helped me with ... social studies and ... *Environmental Science* merit badge ... helped me with environmental science...

we’re in science class, in biology class or ... environmental science class, and we don’t actually have that ... weird looking tree ... oh, that’s how it happened - How that tree became ...

Scout K. stated,

*Environmental Science* really helped me out with biology. ... Getting to see how the animal lives and what environment it needs to be in to live...

Even when a Scout does not complete a merit badge, he often gains knowledge about the subject, which he may use later. According to Scout leader Mr. A.:

... the sciences in Scouting, a lot of boys don’t look at them till they’re older, which I think is appropriate for most of them. They take a little bit more cognitive ability to piece the parts together, but when you actually get a little bit older and you look back at it - I realized that I don’t regret taking any of my merit badges. I took all of them except for *Insect Study*. I actually took *Insect Study* - didn’t have a big enough collection. It did truly give me a good basis on my future as a conservation biologist. I have all sorts of knowledge. It’s
one of the best things in the world when you go to visit a college campus - you walk around, and you see trees and you can identify them.

Eagle required Environmental Science, loved or hated, is an important merit badge for helping boys learn about the environment and about the principles of conservation. Referring to the whole merit badge program, Dr. Sonnenberg stated, “aside from the watching the grass grow experience, the merit badge program was a positive thing all the way around” (Sonnenberg, 2008). The other Scouts interviewed, past and present, seemed to agree.

4.4.2 Methods Used in Boy Scouts

Scout leadership

Scoutmasters/ Scout leaders

Scoutmasters and Scout leaders are very influential in the lives of the boys in their troop. The volunteer work that these leaders do may have a lasting impact on the boys in their charge. Dr. Thompson remembers his Scoutmasters and the influence they had on his life:

...we were very fortunate to have two Scoutmasters who were really, really involved and took time away from their work for the benefit of a group of boys. We did all kind of projects.

... like in all things, there are good Scoutmasters and not so good Scoutmasters - we were very fortunate to have two very good, dedicated people. And those make all the difference in the world when you’re young and you’re just developing your skills, the way you look at things, your ethics - moral part of what’s right.

I think Scouting, if it’s done right - I think we were very fortunate in our Scout leaders - inspires young people... I think if you inspire a young person you don’t have to make it hard, because they will learn because they want to. If you kill the enthusiasm, then they will never learn (Thompson, 2008).
One of the requirements for each rank advancement is to have a Scoutmaster conference, a one-on-one discussion with the Scoutmaster concerning what the Scout has learned while completing his rank requirements, what the Scout has contributed to the patrol and troop, and the goals of the Scout (The Boy Scouts of America, 1998). These interviews may be intimidating for a young boy, but they also prepare him for participation in future interview situations according to Dr. Sonnenberg.

...for each rank advancement, you had to sit and chat with your Scoutmaster... It’s intimidating as heck ... a tricky situation that teaches you very early on how to interact with people who’re up above you in age and experience. It also... makes it a whole lot easier ... a lot of things happen in that sort of format, interviews, job stuff, you name it. I took a science career, but those sorts of oral examinations happen in most every field you go, if you go along far enough (Sonnenberg, 2008).

Volunteer participation, especially participation of men working with boys in Scouting is very important. Boys might not realize, while they are Scouts, how much time a Scout leader invests in the lives of the Scouts in his troop.

Scout K. did not realize the true work and worth of a Scoutmaster who allows the boys to lead the troop while he monitors and guides.

Our Scoutmaster is basically just a moderator ... making sure everybody stays safe, and if we actually do have a problem, he’ll make sure that everybody’s in order and listening to our SPL. But that’s all he does.

Dr. Sonnenberg feels fortunate there were several adults that made the time commitment to serve his troop:

We were lucky. We had a lot of adult leaders, and we had a lot participation of the adults, which doesn’t always happen these days. But, it worked (Sonnenberg, 2008).
Scout J. likes the fact that his troop leadership is from adult men, men from whom he receives a different perspective on life than he does from his mother or from female teachers.

Well, I like a lot in our troop ... all the adult leaders that are men ... we learn a different side of life pretty much.

One reason Scout J. appreciates the male leadership of his troop is that the boys are able to be just guys, to be away from women, to have the freedom to do boy type activities:

... a chance to get away from society and be out in the middle of nowhere pretty much .... Kind of be on our own for a week... just escape from being around women all the time ... you’re more free with more people than you are at home, where mom’s always on you about being clean and everything. And you’re away from that. Live on your own for a little bit.

Merit Badge Counselors

Boy Scout merit badge counselors have a very important role in the science education of America’s young men. According to Dr. Thompson, the merit badge system helps a Scout begin to develop his experimental style by:

... having a structure in which you can investigate various parts of your environment and sit down with an adult and go over what you’ve done, and what you’ve found. They can see if there’s a flaw or something missing (Thompson, 2008).

A Scout’s work with a merit badge counselor, according to Scout D., parallels work in the real world.

Well, in the case of merit badges, you basically do the work. You try to learn something by doing the work, and then, by conferring with your counselor, you gain insight on what you did well, what you did wrong. ... this helps you become better as a person. In a lot of ways, that’s really like the real world, ’cause you set out, you learn, you learn science, you learn what’s already there, and you try to learn, extrapolate on what you know could be, and then, speaking with the counselor is kind of parallel with speaking with your superiors or perhaps your colleagues. ... what could work and new ideas, what you can come up with.
The job of the merit badge counselor is not to push the boys through the badge or to insist that the boys finish the work; the job of the merit badge counselor is simply to make sure the boy understands the material and completes the requirements. To complete a merit badge,

there’s a set of things you have to do with a goal in mind. There’s not a teacher pushing you through that - there might be a merit badge counselor pushing you through, but in at least in my experience, merit badge counselors are not pushing too hard. ... ultimately the boy has to want to get to the end (Sonnenberg, 2008).

Scout leader/science teacher Mrs. C. said that her job description as a merit badge counselor was to:

... give students an opportunity to get their hands on things, experience things, not necessarily come up with right or wrong answers, but logic, a lot of logic ... Put things in a logical way ... express it logically. ... give them opportunities to problem solve.

The merit badge system is only as good as the merit badge counselors. If a merit badge counselor is not excited about the subject, if he/she adds or subtracts anything from the merit badge requirements, which is against Boy Scout policy (The Boy Scouts of America, 2008g), the boys he/she counsels will not have a good or effective learning experience. Scout B. stated:

I still think that the merit badge is only as effective as the person who counsels it. Sometimes ... merit badges can be ... easier than they should be because the counselor ... says, “Oh, you do this and this and you get a badge.” ... I think with that kind of attitude in counseling, it can hurt. Sometimes it might not hurt, but Scouts won’t get as much out of it as they should. So, that sometimes can happen.

Dr. Sonnenberg, in talking about problem solving skills, his ability to teach, and his experience as a merit badge counselor, said:
... you’re mentoring, you’re teaching, and you’re passing knowledge. Whether it’s tying knots to campfire building or what have you - oh, that’s poison ivy, stay away from it - you’re passing knowledge, which is what teaching is. It’s also what science is, ‘cause if you’re at the forefront of human knowledge, the knowledge is just going to drop over dead if you don’t share it with somebody. All of that is communication, which is transfer of knowledge, which is something that’s core to Scouts. Just to make the whole organization work - you can’t safely take a new person out camping if they don’t know what to bring with them, or how to behave, or how much to eat, or why you don’t want to sleep up against the side of the tent. All these sorts of things - it’s knowledge passing. That and the problem set skills, I use all the time. I would say that’s easily 75 to 80 percent of what I do.

R: And you learned it in Scouts.

Absolutely. It came other places too, church and school, but, by golly, it was honed very well in Scouts. Very, very well (Sonnenberg, 2008).

Participation in Scouting makes a difference in a boy’s life

Science teacher/Scout leader Mrs. C. says she and many other teachers see a difference in their students between those that are/were Scouts, both girls and boys, and those students that are/were not Scouts.

I think you could get quite a few other teachers to say the same thing. Boys that are in Scouts initiate things, especially in laboratory situations. They initiate things, they find things, they can be a leader, they can be a follower ... better at just staying on task - still having fun, but staying on task. The leadership skills come out beautifully ... you go - that young man, or young lady was Scout. I would say that there are plenty of opportunities to make ... that kind of an observation of what’s going on in the laboratory.

Boy Scouts and Girl Scouts alike ... they’re usually the president or the secretary of the National Honor Society, they’re the members in my finest Olympiad teams. They’re student council representatives. You see them there. They may be the basketball, the football player, but that’s usually not the case. These kids are more on the lines of being actively involved in the human parts of things, sharing things, serving. Service is more their driving force, not just teamwork, although, they’re very good at teamwork.

You will see those kids in leaders ... They might be ones that start a chess club or an interest club of some kind. It’s really cool.
Scout leader Mr. A., who works with adult training, sees a difference in leadership skills between people who were Scouts and people who were not Scouts.

...most of the kids that I know and run into that are not in Scouting program - there is a difference between them and ... Scouts...

R: What do you see as the difference?
Mr. R: Self-assuredness, manners, patriotism, functionality out there. I deal with adults now ... somebody’s a Scout, ...eventually we start talking about it, and their ability in a leadership role, to watch them take command, if you will, of a table full of people. It’s there. I can spot the Scouts. Girl Scouts as well as Boy Scouts. But particularly the Scouts. I can spot them. We usually get around to talking about it, eventually.

R: Do you think it’s because they went through Scouting or would they have been that way anyway?
Mr. R: No. I don’t have a crystal ball, but ... I think that (it is) part of who they are based on the experiences they had in the Scouting program. I don’t think you can separate them. I’ve known too many of the leadership there. They go back to their Scouting days, and they really once took charge back then and they learned their leadership, the important leadership roles and they understood how to fail successfully and how power doesn’t lead in that regard. I think that you’ll find your better leaders are those that have been through the Scouting program.

The Scout leadership program is a major factor in Boy Scout science education program. Having trained leaders to provide leadership, to promote activities and troop outings, and to make sure the troop goes camping, is an important factor in the experiential learning of Scouts. Scientists credited the learning of leadership skills as one of the most important ways the Boy Scout program influenced their scientific careers.

The merit badge counselor program is another major factor in the Boy Scout science education program. The mentorship of a professional or of a knowledgeable adult in the field of the merit badge encourages interest and the development of science content knowledge through the merit badge program.
Single-sex Education

There are times when boys like to be with just boys, away from women and feminine influences. Scout B. thought that the Boy Scouts should be for boys only because, “there are some things in Scouts that... just should be for boys.” The reason Scout B. gave for having Boy Scouts be a single-sex organization was that “guys can learn from each other.” Scout B. stated:

There’s got to be a guy thing once in a while. I think that Boy Scouts is... (a) place where guys can learn from each other ... I think there’s some skills that they need to learn from each other, as guys and friends and all that.

Scout J. concurred, indicating that guys needed to, “escape from being around women all the time.” Scout J. indicated that being away from women allowed boys to learn a, “different side of life.”

Scout K. felt that the experiences away from home, with all boys, was a “growing up” time that was less “confusing” than when girls were present.

I feel growing up with people that are like you, all boys, you actually get to experience a time away from home, from your mom and your dad. It’s all boys growing up together. And so, they’ve got a start on life I guess. Time to grow up. In Venturing Crew, it’s different, ‘cause, it’s separated. And it’s different ‘cause the girls have to stay away from the boys tent-wise and everything, and it’s kind of confusing, but with the boys, you just go with the flow.

Girls and boys have different learning styles. Scout B. stated, “if guys and girls were together, they would have ... different teaching in some cases."

According to Scout leader Mr. R:

My daughter learned totally different than my son. If I sit back in class and teach adults, I have to say things more than once, in more than one way, because I have to deal with the ladies that are in class versus the guys that are in class. There’s a totally different mindset of learning. How people dwell and understand and
connect, and the connectivity to a management skill, totally different. Totally different.

Scout K. thought that it was sometimes hard to keep up with girls in an academic setting. Scout K. was asked if he learned differently in co-ed classes compared to how he learned in an all boy environment. K. responded:

Maybe a little bit differently. Because...the girls kinda bring on the competition, if you could say it like that. I don’t know how to put it. It’s really hard to keep up in class sometimes, but if it’s like all guys, sometimes I may seem a little bit more even with everybody else and knowing a lot.

Scout K. thought there were times when it was good to have girls in class, especially in a writing class.

More of the girls know different things than guys do and they bring different perspectives in. It kind of helps out, when the girls bring different perspectives in... like in writing emotionally. Guys don’t do that a lot, but some do. But... the emotional side is important when writing, so it helps out a lot.

Females can be a distracting influence for boys. Scout leader Mr. R. stated, “I am a proponent of separating the boys from the girls,” because, “There are differences and distractions. Boys get distracted fast enough as it is.”

Scout J. agreed with Mr. R. that females are distracting. Scout J. believed that he learned differently when he was with just guys than when he was in a co-ed situation.

As you get older, uh, you become attracted to the other sex, so, sometimes you become distracted in learning if you’re in a co-ed place. Whereas, if you are with all guys, then, sometimes you don’t focus (on) it and it becomes a little bit more fun learning.

Scout D. thought that a group of just boys might be more tempted to goof off.

I don’t think I can say true objectively since I’ve never been to an all boys school, or anything like that. ... I can reasonably assume that when you’re with guys, especially ones that are your close friends, you might be more apt to goof off ... not be really clear about what’s going on maybe. If ... you’re surrounded by all
girls, especially ones that maybe you know that well or have no desire to talk to, then you might be more focused on your schoolwork. But, I think in my case, if I really want to learn something, that it doesn’t make too much of a difference.

Scout K. thought that younger Scouts might be more tempted to show off if girls had been members of the troop. Boys with just boys are not as apt to show off as when they are with girls.

‘cause people ... try to show off, try to show up everybody else. All of us together ... we just keep going with what we’re doing. We don’t care if we’re doing better with anybody else, we’re just all together. If we’re with girls ... probably try to show off - I’m better than you.

Scout D. thought that girls might prove to be a distraction; he was glad the Boy Scouts provided a place where boys don’t have to feel nervous about being with girls.

Scout D. was glad that there were both a single-sex organization and a co-ed organization to provide experiences in both single-sex and co-ed venues.

...even though it might be a little bit of a distraction, just boys being with boys means that they don’t have to be nervous about being with girls. All the differences between most guys and most girls allows them to focus on what they like to do together and have more fun together, develop their interests a little bit better. So, I think it’s good that there’s an organization like Boy Scouts that does something like that and then also an alternative like Venture Crew, where those that want can join a co-ed experience.

Boys value their single-sex Boy Scout program, even when they are members of the co-ed Venture Crew. Boys who were members of both the Boy Scouts and Venture Crew were asked, “If you had to pick just one, which one would you pick? Which one would you stay with?”

Scout D., “I’d probably say Boy Scouts.”

Scout K., “Boy Scouts.”
Learning styles

Teaching boys the way boys learn has been the basis of Boy Scout educational methods from the inception of the Boy Scout program. Lord Baden-Powell recognized that boys learn better when they are outside, when they are active, and when they are physically involved; he incorporated this knowledge about boys into his educational program. Scout leader Mr. R., when asked if the Boy Scouts did a good job of teaching boys the way boys learn, stated:

Oh, absolutely. Absolutely. It’s from the days of Baden-Powell when he did the Brownsea Island - it was all hands-on learning...

Mr. R. stated that the Boy Scouts have used teaching methods that appeal to boys from the beginning.

They’ve been doing it for quite the while, since 1911 here in the United States and since 1907 in England. So, the process works. Thousands upon thousands have gone through it and stuck with it...

Dr. Sonnenberg, when referring to the hundred years that the Boy Scouts has been educating boys, stated, “They’ve got a lot of practice at it.” Dr. Sonnenberg did not believe that schools necessarily reach boys the way boys are, as school is, “more formal. And, traditionally ... the male gender is not encouraged to follow that route.” Dr. Sonnenberg, whose learning styles included hands-on, visual pictures, and analogies, “absolutely” believed Boy Scout educational methods met these learning styles. (Sonnenberg, 2008).

Hands-on

Scouts are tactile/visual learners. Of the four modalities of learning - auditory, visual, kinesthetic, and tactile, as detailed by the Dunn and Dunn Learning Styles Model,
tactile was the preferred mode of learning by most Scouts. Sixty percent of Scouts who participated in the learning styles assessment for this research learned tactually. Learning visually was the second most preferred modality with 42% of Scouts learning visually. Hands-on activities fit the learning styles of most Scouts as “hands-on” refers to tactile learning, learning by doing.

Many Scouts, Scout leaders, and Scout scientists referred to the Boy Scout use of hands-on activities. Scout leader/science teacher Mrs. C. believed that Scouts learn by participation, that the hands-on activities are very important, as these types of activities incorporate more of the senses.

Anything hands-on, if you can wrap your hands around it, it helps you wrap your mind around it. It’s giving you more access to more of the senses. If you can, incorporate as many of the senses as possible. When you’re reading, you’re just basically incorporating sight, maybe sound. You can’t truly feel what you’re reading with your hands. You can’t taste it. And you can’t smell it, as well. When you are out in nature and doing - even in chemistry, you can smell an acid or a base and tell if it’s an acid or a base, basically by the smell.

Scout Leader Mr. A. said that the best way for young boys to learn was to incorporate visual and tactile activities.

Especially with young boys, you don’t want to lecture them. You want to get them out in the field, you want to have them looking, you want to have them doing. Learning through play is the best way to work out here.

Mr. A. thought that boys learned best through tactile input; he stated that his learning style was also visual and tactile, that mixing ways of presenting information is beneficial.

Definitely with their hands. With their hands, get their hands on it, get down and nitty-gritty... They need to be down doing, instead of just sitting. ...just completely, they need to be doing... Activities.

That’s the way I’ve learned throughout the years. You can sit me down in front of a book and say, “Here, learn these trees,” but if I can’t go out there and see the
trees and see how they work, I'm not going to pick it up. ... My learning style is very much hands-on. I can do so much bookwork before my brain just shuts down for the day. So, it’s good to mix it up.

Scout leader Mr. F. was also of the opinion that boys need to learn tactually.

You also have to do it as much hands-on as you can. Let them do the experiment. Let them learn. The thing that Scouts enjoy most in my merit badges are when we spill oil on pans and try to clean it up. It’s a rather simple experiment but they all remember it for years. It is that kind of hands-on experience.

Mr. F. described the learning styles of boys as incorporating visual and tactual elements.

They have to grab it and work with it immediately. They don’t want to read directions. We’ve been notorious for not wanting to read directions. Just pick it up and use it. ... Hands-on. Generally, they may be visual, too. Ah, but you may do the motions, some touch - observing. 

Scout leader Mr. R. believed that Scouts learn through tactile experiences. When Mr. R. was asked to describe the way boys learn, he replied:

You lay it on the table, they’re going to get up to it, up close to it. You put them in the field, they’re going to get down and dirty. It’s not a hands-off process. Most of them jump into it. They want to touch it ... they’ll pick it up, they want to study it, they want to turn it over. ... that’s why the biological, the geological, physical science merit badges of Boy Scouts - kids get into. They get their hands-on in that process. They’ll go out and look for the leaves. They’ll climb the trees. They’ll press the leaves. They’ll do whatever they need to do on there - a lot more hands-on.

Mr. R. said that doing Scouting merit badges included hands-on and book learning - tactile/kinesthetic and visual learning. Mr. R. stated:

there is a logical pattern of learning that has to take place at that point. I would say there would be a pattern of progressive learning. As a boy prepares to take a merit badge, he is going to have to crack the book open and start to look at materials and then begin to relate the materials from the written page on to the actual life subject that he is taking a look at. So, it’s a hands-on process. It’s book learning. Its’ a blended learning from ... the reading of material, the subject material, the interaction with the subject matter expert, and then the interaction with the plant or the mineral, or the subject matter itself. So, a lot of visual learning, auditory learning, kinesthetic learning that takes place.
Scout scientist Mr. Lundy equated hands-on with minds-on. Boys who are involved doing something hands-on are mentally engaged and learning.

My favorite ... terms in science are hands-on - mind-on. That’s my favorite litany. I like that approach because that’s what Scouting merit badges are. They’re hands-on-minds-on. If you look at them, they’re focused and they’re direct. You get a chance to get out and do something. You don’t beat it into the ground. You get enough to stimulate your interest and curiosity over here, and when you walk away from it, you’ve got some neat experiences. That’s what I like about it (Lundy, 2008a).

Dr. Leo Porchia was also a proponent for hands-on learning, which he first experienced in the Boy Scouts. Dr. Porchia stated that his learning style was better matched in the Boy Scouts than in school. When asked how Boy Scouts made it easier for him to learn, Dr. Porchia answered:

...school is not that much hands-on. ...maybe it is now, I don’t know, but it was a lot of book reading. Scouting, it was not more reading, as you can see, you do reading, but you have to actually work. Number two here in Geology. Pick three sources that can be extracted or mined from the earth for commercial uses.* Well, I could ramble off three, but you need to be sure, so it involves a little bit of research on your own. Then ... review a geological map in your area with your counselor and describe different types of rocks and estimate the ages of the rocks for each setting. That’s a little bit more hands-on than just reading that the rocks form layers and the layers are very time dependent so, depending on the coloring - it’s junk. Here you are actually learning and you start developing your own independent thinking. ... I think the difference between school and Scouting was that there was hands-on. We did do it, and I think that really helps...
*(The Boy Scouts of America, 2008c).

Dr. Porchia said the most important way he learned science as a Scout was hand-on; hands-on is the only way to learn science.

Definitely hands-on. I think that’s the only way you can really learn science. I’d say that with a caveat - you need to read. You definitely need to read. I can read how to do a certain type of synthesis, but it’s so different when you get up there and actually do it. Pipetting, putting the liquid (in the) tube. I can tell you how to do it, but until you really hold the tube, hold the pipette, and you’re actually doing
this motion, you don’t really understand what’s going on. All in the experiment - physically. Now, in the tube, you might not know what’s going on, but even as scientists, we don’t know what’s going on in the tube. We’re trying to figure that out (Porchia, 2008).

Visual

Scout leaders recognize that Scouts learn visually. Scout leader Mr. F. stated that boys learn, “Hands-on. Generally they’re somewhat…visual, too.”

Scout B. recognized that Scouts have different individual learning styles.

...some ... can see things much more clearly than others can. Some can handle ... seeing how things are done in Scouting and how to do it ... I think everyone in Scouting has a different learning style...

Scout B. said that the most common ways Scouts learn were through visual and tactile means. B. also thought Scouts learn auditorily, perhaps confusing the auditory modality with an affinity for learning with peers, which is more communication than listening. When asked if there is a learning style common to most Scouts, B. replied:

I think it’s more visual and also touch. Also hearing, ‘cause ... for team building, you have to have good communication with each other to work as a troop. ... the ones that I think are more often used ... hearing learning styles and hands-on.

Knot tying, according to Dr. Sonnenberg, is a good example of how Boy Scouts incorporates both visual and tactile learning styles.

Knot tying is a good example. You actually do it. You can look at the pictures ... they have nice step by steps in the book, but doing it and doing it repetitively in Scouts, in our group, in our troop meetings or activities, or putting up tents or tarps, or all that other stuff, really reiterated it.

Dr. Sonnenberg uses word pictures to communicate the science he studies, crediting Scouting with helping him learn science by helping him to visualize pictures and involving him in hands-on activities.
Communicating what I do, without boring the gourd out of everybody, requires being able to speak science in pictures. (quietly laughed) ...it’s really hard. It really causes you to stop and say, “OK, how do I take this relativistic quantum mechanics picture and put it in the term that my mother, who never had high level physics, would even comprehend or much less care about?” So, I have had to learn how to come up with those sorts of analogies just to express what I do on a daily basis. It also is the way I tend to learn. If you’re telling me something, I’ll reiterate ... is this the right picture to think about? ... It comes back to Scouts a bit because they did ... a lot of pictures, a lot of let’s go do it, try this - hands-on, let’s go, not just talk about tying bandages, let’s go do it. I think that came ... and chemistry is a bit of a hands-on science.

...The text in Scout manuals of any sort are always...very well laid out, and they’re written for the average dummy. That’s always very helpful, but I definitely quickly went to the pictures first, and then read the text later. Look at the picture, alright, what are we trying now? (Sonnenberg, 2008).

Not Auditory

Scouts tend not to be auditory learners. (Only 14% of the Scout learning styles sample were auditory learners.) Often auditory learning instruction is associated with a lecture format where students sit and listen to what the instructors is saying. Most Scouts do not learn well in a lecture-type learning environment. According to Scoutmaster Mr. F., “...most of the time they’re turned off by sitting there and listening to somebody talk.”

Scout leader Mr. F. stated:

If they have to sit, they will, sometimes. Some of them will. Every boy is different. You try to tailor to every boy. Ideally, you work one-on-one.

Scout leader Mr. A. felt boys learned better from experiences, that most students, especially boys, were not auditory learners.

Experiences teach better than anything else. You can sit anyone down in a lecture and you have a couple boys or girls that are good at listening. But, especially with young boys, you don’t want to lecture them. You want to get them out in the field, you want to have them looking, you want to have them doing.
Scout leader Mr. R. did not feel that classroom situations were effective in teaching Scouts, saying:

...as a merit badge counselor working with Scout Camp myself, the classes can only sit in a classroom for so long, then you’ve got to get out and start doing things. The differences between a regular classroom and a Scout learning merit badge process - totally different. Totally different. They may sit there in a classroom atmosphere for a little bit, but the merit badges themselves, their very nature are get out and do.

Scout scientist Mr. Lundy believed boys must be involved if they are going to pay attention and learn. If boys were not involved, they would not be learning. Mr. Lundy stated that hands-on activities were much better at keeping boys focused and learning than were lectures.

You get them involved in the system, because if you do too much lecturing, then it’s your bag over there and this kid’s sitting out here in left field drawing airplanes, or listening to his headset. If you get them involved then they’re going to pay a little more attention to what’s going on (Lundy, 2008a).

Scouts themselves prefer hands-on activities to lectures. Scout K., whose troop is boy led, boy run, stated that the Scouts in his troop decided to get rid of the lecture format and had implemented a much more hands-on style in the meetings.

Our troop used to lecture, but now the boys - we’ve decided to get rid of the lectures and so a lot of hands-on things like, learning knots. We use the knot ropes. Everybody uses the knot ropes. Setting up tents to make sure they’re clean - we do that every week ... the troop meeting after a campout. ...different things - hands-on, like orienteering - we get out maps of all over Ohio and teach kids symbols - this is a house on a topographic map ... we have a knuckle demonstration to do elevation of the topographic maps. ...a lot of different hands-on things instead of lectures.
Teamwork/peer group/friends

A Scout’s peer group of friends is influential in Scouting. According to Scout leader Mr. A., “I worked up here at camp because of the influence of other friends and how much fun it seemed.”

Some Scouts prefer to learn in a group while other Scouts prefer to learn alone. Of the Scouts assessed for learning style, 36% always preferred to work with peers while 31% preferred to work alone, 31% of Scouts depended upon the circumstances as to whether they wished to learn alone or with their peers. The Boy Scout educational program is designed to meet the needs of boys who wish to work alone and boys who wish to learn with friends. According to Scout leader Mr. R.:

They can do it with others; they can do it independently. So, it’s a case those that like to work a little more independent(ly) have the same opportunity that those who like to work together - they can work with a buddy and pursue the same merit badge.

Scouts may be peer oriented, but they still need to develop team-member skills. Scout leader Mrs. C. stated that Scouts are, “very good at teamwork.” Dr. Porchia stated that he learned how to work with others, to become a functioning member of a team, while he was a Scout.

Working with others. That’s definitely something I learned in Scouting versus school. A partner/team. In school when you work with a group, it’s usually two or three, it’s not really a team. In Scouting, you did learn how work as a team. You learned to follow a guide. You learned more about your topic (Porchia, 2008).

Learning to be a functioning member of a team is taught through the patrol method, a peer tutoring method. According to Dr. Sonnenberg:
the Scout program is set up in the patrol style, where you have older members teaching the new ones. Teaching was just a natural thing (Sonnenberg, 2008).

Members of a team work with and learn from each other in order to reach individual and collective goals. According to Scout D.:

When you’re working on a merit badge, a lot of the time you’re working with fellow Scouts who also want to do the merit badge. As you do that, you learn from each other as you’re working on the same thing, then you can help each other out getting that merit badge ...Working together is like achieving some sort of goal as a team of research scientists would.

The majority of Scouts learn well with their peers. The Boy Scouts hones this learning style preference to learn as a peer group, using this preference to develop teamwork skills in boys, helping them to become efficient, effective members of a team of peers.

Motivation

Scouts must do the work if they want to progress in the Boy Scouts. According to Scout leader Mr. R.:

The initiative, the “you’ve got to want to do it”...It doesn’t get done unless a lot of self-discipline takes place, and a lot of self-motivation in that regard. They’ve got to want to do it. It just doesn’t happen otherwise.

Most Scouts, 45% according to the learning styles assessment, are motivated circumstantially. Some Scouts, (14%) are totally self-motivated, whereas 33% are or tend to be motivated by others. The motivation by others may include motivation by rewards. Scout leader Mr. F. thought that Scouts were “very definitely” goal oriented, reward oriented, and hands-on. Mr. F. believed that:

Physical, tangible rewards are important. It doesn’t have to be very impressive, it just has to be a reward. It has to be fun, it becomes fun to do it, because you are going for that goal, that reward.
According to the Scout leader Mr. A., a reward could mean, “a patch ...a temporary tattoo,” given to, “reward them for what they’re doing.” The merit badge system of the Boy Scouts is a reward system to motivate Scouts to learn. The merit badges are physical rewards for completing the requirements of a merit badge.

According to Dr. Sonnenberg:

The merit badges are actually like steps or reward systems ... it’s just all intrinsically built into a lot of what we call Boy Scouting, whether by design or by default, but it’s there (Sonnenberg, 2008).

The merit badge reward system in the Boy Scouts influenced both Dr. Sonnenberg and Dr. Porchia.

The whole structure of moving up through leadership roles, the reward system of merit badges and all that, was ... something ... that I keyed into really well ...that reward system really motivated me to do a lot of what I did. ...that whole reward system... really was important to me (Sonnenberg, 2008).

I found Scouting to be more fun slash goal driven, where in school, where you would learn some of these skills, it would be just ... get through it. ... The difference is, in Scouting you get only a reward of a merit badge and in school you get a reward of a grade. ... I think the grade may affect your personal ... your overall life more than the badge, but I think the accomplishments ... I did better projects when I was in Scouting than I did in high school and middle school (Porchia, 2008).

Merit badges are a tangible reward, a motivator for the 86% of Scouts that are not self-motivated. The competitions, the public recognition, and the sense of accomplishment a boy feels, are all factors in motivating learning in boys through the merit badge reward system.
Global/Analytic

Scoutmasters teach scientific principles more than scientific facts (Jarman, 2005).

Most Scouts are global and integrated learners; global learners learn by looking at the big picture, they do not build up their information fact on fact (Searson & Dunn, 2001).

Scouts refer to learning the overview as learning the basics. Scout D. stated:

what I learned in Scouts, basic principles of physics and chemistry, really gave me a head start, a willingness to learn because of the fun experience I had. It made learning about the stuff further in school more fun for me. I think it gave me a better head start when I was going into sciences, once I started the classes in school.

I really can kind of remember, “Oh, I remember doing experiments like that with different size marbles in Boy Scouts and the Lune rockets that we did,” the different properties of physics, so, I think a lot of the basic principles kind of relate back ...

I could just emphasize the fact that Boy Scouts and Cub Scouts, if nothing else, really just introduces science in a fun, kind of casual way. Maybe not that hard or challenging of concepts at first, but they basically introduce you to science and get you excited about learning it, which, as you develop and grow, you apply that open-mindedness and willingness to learn to other aspects of your life, which can really help you learn in the end.

Scout B. agreed about Boy Scout science providing the basics.

I had a general idea of it. At least ... the basics. ... It’s better to have some idea of what you are about to learn, rather than going in and not knowing the subject.

Boy Scout science provides Scouts with the basic concepts, the overview, preparing global and integrated learners for further learning and for knowledge construction. The minority of Scouts who are analytical learners build knowledge through acquiring facts through their explorations into the details of the merit badge topics and by working with merit badge counselors.
**Self-Efficacy**

Boy Scout participation can affect a boy’s self-efficacy, his beliefs in his own abilities. Mastery experiences, according to Bandura, are the most influential in forming self-efficacy beliefs (Bandura, 1986). When a Scout completes a merit badge, he is awarded the merit badge patch. The Scout is not compared with other Scouts, there are no grades or comparisons on merit badge work. To earn the patch, the Scout must fulfill the requirements to the satisfaction of his mentor – no letter grades are given.

I found Scouting to be more fun slash goal driven, where in school, where you would learn some of these skills, it would be just ... get through it. ... The difference is, in Scouting you get only a reward of a merit badge and in school you get a reward of a grade. ... I think the grade may affect your personal ... your overall life more than the badge, but I think the accomplishments ... I did better projects when I was in Scouting than I did in high school and middle school (Porchia, 2008).

The merit badge patch is a representative symbol to the boy that he has succeeded in “mastery” of the merit badge topic. The patch that a boy earns for completing a merit badge is a recognized symbol for Scouts and Scouters, proclaiming that the owner of the patch satisfied requirements in the field of the patch. Scientists, Scout leaders, and Scouts recognized the importance of the merit badge and the merit badge patch to Scouts.

Scout leader Mr. F. recognized that boys are goal oriented and that physical symbols were important to boys. He stated:

Physical, tangible rewards are important. It doesn’t have to be very impressive, it just has to be a reward. It has to be fun, it becomes fun to do it, because you are going for that goal, that reward.
Even though the earning of a merit badge is not a competition, boys make a competition of how many merit badges they have earned. When asked if having the physical symbol of the merit badge patch was important, Dr. Sonnenberg replied:

... the getting the physical badge and then being able to display it on your sash were huge. And it’s totally, if you want to be a bit vulgar, a pissing contest, or a bravado thing, but it is what it is, and, at least for me, ... it was a huge motivating factor. And it wasn’t that I was running around bragging that I’d got one or two more merit badges than somebody else, it was the fact that, “Look, I got something for what I did.” And you’ve got to remember, and this is important, or was important to me, ... because I didn’t have the baseball trophies on the wall, I didn’t have the soccer awards, I didn’t have the swimming award. The academic award, you were usually... well, maybe you were made fun of for, but it wasn’t something you were going up and bragging that I was the best in the spelling bee, which I wasn’t. You’re not going out and bragging about that, whereas you might say, “Well, I was on a city-wide winning team for - whatever you’re in.” It gave something that subtly and very quietly suggested - I have made, I have achieved something, I have done something, just no different than those people that did the sports. That ... coupled with the recognition of the award banquet, whether it’s a parent’s night or it’s at a formal Scout thing in the winter where you get up, someone’s applauding for you. You get recognized as one of the people that worked and got something. That whole reward system really was important to me.

Being able to wear the patch is a way a Scout has of saying, “subtly and very quietly ... ‘I have made, I have achieved something, I have done something ...’” When asked if it would have been different without the physical patch to wear on the sash, Dr. Sonnenberg replied, “...it was a constant reminder that ... I had done something” (Sonnenberg, 2008).

Scientists Dr. Porchia and Dr. Thompson agreed with Dr. Sonnenberg, that earning merit badges could be a competition.

I remember working on all the merit badges and the different projects ... I forget, I had thirty-some or forty - a huge number. It was always a kind of a competition between my ... friends ... we were working on different merit badges and meeting the requirements and getting more than the other. (chuckled) ... I think that you
learn a lot in that process, and I think we all benefited from going through it (Thompson, 2008).

It was competition at one point. You’d look at people’s sashes draped over their Class As. The only time you ever see them was when you wore your Class As, and if you didn’t wear your Class As a lot, you never knew. But, you want to see the person with the most, and then you like to see the person with the least. You saw that person, if it was you, you didn’t want to be that person. So, it was nice to complete a merit badge and have it there and it was nice to have a good number. ... It did have a nice little accomplishment to have them badge, but at the same time, I’m not a person that basks in all of the rewards you can get. I’m the person that likes to do certain things, get it done, and then get a little praise for what I’ve done.

... so, yes, I think the goal of actually getting to a merit badge or that little circle at the end ...whether or not you wore it ...was important (Porchia, 2008).

Perhaps awards earned in Boy Scouts, how many merit badges earned, Arrow of Light, election into the Order of the Arrow, Eagle, and Eagle Palms, may remain a remembered mastery experience all of a Scout’s life. Many Scouts, past and current, regardless of age, remember the awards earned in Boy Scouts:

Scout J. I was a webs, or an Arrow of Light Scout.

Scout D. Arrow of Light ... Order of the Arrow.

Scout K. Arrow of Light ... Order of the Arrow for Scouting.

Scout leader A- ... since Tiger Cubs ... Eagle Scout with two Palms.

Scout leader R. Got in at eight years old and never been out. ... Order of the Arrow ... Eagle ... one Palm.

Scientist Dr. Leo Porchia - ...Tiger Cubs all the way up ... Order of the Arrow... Eagle (Porchia, 2008).

Scientist Dr. Jason Sonnenberg. I did not start at Tiger ... Arrow of Light ... Order of the Arrow ... Eagle (Sonnenberg, 2008).

Scientist Dr. Lonnie Thompson - I had thirty-some or forty - a huge number. (Thompson, 2008).
Scientist Sherman Lundy - Eagle, with three Palms. ... I earned probably most of the Scouting science merit badges – in fact I think I earned them all at the time. (Lundy, 2008a).

Scouts may keep their Boy Scout awards and recognitions for life. Dr. Lonnie Thompson still has his Life Badge (Thompson, 2009). Dr. Larry Enochs, self-efficacy researcher in Science and Mathematics Education at Oregon State University, carries the documentation for his Eagle Scout rank, which he earned in the 1950s, in his wallet every day. Dr. Enochs earned over 80 merit badges when he was a Scout; he credits the Boy Scouts as being, “the second most influential factor in my educational attainments after my mother” (Enochs, 2008).

Dr. Porchia never sewed all his merit badges on to his sash, just having them was enough; he did not want to make the boys feel bad who did not have as many as he.

... the merit badges are not easily achieved, but some are ... my parents taught me never to gloat. ... I felt bad for like certain people ... that couldn’t get the hard ones and could have a hard time with the easy ones. So, why should I make myself feel better by making them feel worse (Porchia, 2008).

Scout scientist Dr. Sonnenberg, when asked if having done the merit badges and having the merit badge symbol helped him in school, answered:

Yes. A confidence booster ... it was a confidence builder. ...I remember thinking in grade school ... I may not be able to do x, y, and z, but you can drop me off in the middle of the woods and I’ll walk out alive. It’s sort of a mental fortitude or - I guess the best word is confidence. Absolutely (Sonnenberg, 2008).

Current Scout, K., agrees with Dr. Sonnenberg about the importance of having done merit badges. He, like Dr. Porchia, does not have them all sewn on a sash,

but the actually seeing that I got a merit badge shows that I took the time out of school and out of other things to work on something with a person I don’t even know, or counselor I wouldn’t know, or a counselor I do know. Making the
phone call to ask them if I could do a merit badge really shows that also, the confidence thing - that I was able to do it and kind of builds up my ego. That’s the word. (laughed)

R: How important is it that you have that symbol that says, ‘I can do this, I did it?’

K: It really helps out with the confidence. It really helps out showing, OK, I know this, I should know this, just think back to where you did this, and it reminds me that I’m doing good in the class.

R: So that physical symbol, the doing it, and knowing that you’ve done it, is it –

K: A really good confidence builder.

Boy Scout experiences, especially leadership experiences, are important in developing a sense of confidence in Scouts.

K: Teamwork is essential in Scouting. Like, learning different leadership roles, like SPL, ASPL, Patrol Leader; it’s like showing the democratic process inside the Scouting learning how to be a leader. I was SPL for six months and it really helped. It was AWESOME to teach me to be a leader. It was the best thing for me. Since then I’ve been a lot more - taking control, not taking control, but helping out to be a leader in the group. Before I would be the follower, now I’m the leader, ‘cause it’s really helped out.

R: So when you go to school and are in a lab group, are you now one of the leaders in the labs?

K: I think so. I try to stick out in the group now and try to help lead the group. Before, I was too nervous to do something wrong, but now, I’m good enough to express my opinion, be able to say what I think’s right. Just to make sure that my opinions are also expressed.

R: So, it gave you confidence?

K: I think so. A lot of confidence.

Dr. Jason Sonnenberg stated, “there’s a corollary between experience in Scouts and things that I’m not intimidated by now” (Sonnenberg, 2008).
Fun

“I learn most when I am having fun and don’t think I am actually learning.”
Scout J.

Science in Scouting is Fun

All the Scouts, Scout leaders, and Scout scientists interviewed agreed that it was very important that Scouting and science in Scouting was fun for the boys. When asked how important it was for science in Scouting to be fun, the interviewees responded:

Really important (Sonnenberg, 2008).
Extremely important. Scout leader Mr. F.
It’s paramount (Thompson, 2008).
Very important. Scout leader Mrs. C.
Very (Porchia, 2008).
I think Scouting fun is what keeps a lot of people in it. Scout J.
It’s very important. Scout K.

Scout leaders, Scouts, and scientists had several reasons why it was important that science in Scouting was fun. Scout leader Mr. A. thought that fun brought boys in and kept their attention:

... that’s what keeps your attention. Anything that’s fun, to me that’s very much what brings you into it.

Scout leader Mr. F. believed that boys would want to return if their experiences were fun. He also believed that boys had fun when they set goals and worked for rewards:

...If it is fun, they’ll want to come back and do some more. They’ll enjoy it. They won’t be turned off by it. And they’ll learn that they have to do math and the like
along with that. So, very, very important, that it be fun. And perhaps there’s a reward. ... Physical, tangible rewards are important. It doesn’t have to be very impressive, it just has to be a reward. It has to be fun, it becomes fun to do it, because you are going for that goal - that reward.

Scout D. believed that when science in Scouting was fun, Scouts could get a new view of a subject that he may have disliked in school; the fun science experiences in Scouting could change a boy’s opinion.

I think it is important for all the Scouting experience to be fun and especially science learning. Learning, ... for all subject matters, making them just as fun, ... giving a Scout a new view of the subject he might not like in school but he finds it more engaging, more fun in Scouting; it could be very good and very important.

Dr. Thompson agreed with Scout D. about the importance of fun in Scout science. When Dr. Thompson was asked if it was important that science is Scouting was fun, he replied:

It’s paramount. For a young person, the last thing you want to do is to kill their enthusiasm. Scouting, if it’s done right ... inspires young people ... If you inspire a young person, you don’t have to make it hard, because they will learn because they want to. If you kill the enthusiasm, then they will never learn. And so, to me, it’s an important combination. We learned the basics, but if you are real excited about something, you will learn those basics. They don’t have to be forced on you. ... it’s something that we need to do better in this country because of the number of young people going into science and engineering has been dropping for many years now. I think the key to reversing that is for young people to realize that science can be exciting (Thompson, 2008).

Fun is reason for Scouts to join and stay

Fun is often the reason a boy will join the Boy Scouts. Scout B. attend a Scout meeting and joined the Boy Scouts because it seemed like a fun thing to do. What attracted Scout B. and made him decide to join was:

the camping and ... a place from out of house. ... every Monday night I would go out to a meeting, and ... we play games, we have meetings, also we work on
advancements and have a good time. ... the camping experiences, it’s great. We do camping and I enjoyed having my friends...

Scout leader A. believed that fun is what kept Scouts in the program. He stated:

it’s very important that it’s fun, because that’s what, once again, it keeps you roped in. It keeps your attention on it ... Scouting in general is a great way of teaching boys how to truly respect what they’re doing, and to take something seriously ... It shows them how fun stuff can be.

Scouts learn when they have fun

Scout leader Mr. F. thought that boys learned because they were having fun; boys have fun when they experiment, when they do hands-on activities. Scout leader Mr. F. said boys learn when:

...they’re having fun in the outdoors. You can’t just throw ideas at them. You have to intermix it with having fun. You also have to do it as much hands-on as you can. Let them do the experiment. Let them learn.

According to Dr. Porchia, “fun is hands-on,” and hands-on is, “the only way you can really learn science.” If boys are not given hands-on, if it is not fun, if it feels like work, boys will resist learning. According to Dr. Porchia,

You’re talking about an age group that...if it feels like work they’re going to put up a fight. So, you have to make it fun. You have to give them a hands-on. I mean, fun is hands-on or watching the TV. And that’s another way to get around the hands-on, just watch it, see it. But, I mean, reading, forcing it, ... those are all things that will turn anybody off from anything. So it has to be fun (Porchia, 2008).

Scout D. made an insightful comment about the significance of having fun and creating memorable experiences on the learning process of boys when he stated:

I think, as in many cases, learning to a person is not significant unless there’s an important connection made in the process. That’s instinctual, because if something was not important to you, then was no reason to learn it. By making something fun, you piled whatever knowledge you learned into a positive memory, and therefore, it stays in your mind as opposed to if you were just
reading it in a book or doing homework and it wouldn’t be very fun to do. You’d probably forget it as soon as you do the test and then you wouldn’t have to know it anymore. But, by making it fun, it stays with you and it becomes a part of you.

When Dr. Thompson was asked if he had fun as a Scout, he replied:

Oh, yes. Yes, yes, lots of fun. I remember staying up late at night working on these projects because I enjoyed them. My interests in weather and climate started at a very age. You never know exactly where it starts, because life’s complex; sometimes it relates to teachers that you happen to have at an early stage in a classroom - elementary school (or) your interactions in the Boy Scouts (Thompson, 2008).

Scout science may not be “ha-ha” fun, but interesting and engrossing. Scout scientist Mr. Lundy expressed what many boys may feel: “I find it’s fun ... to learn something different, something new.”

Mr. Lundy explained that:

...doing some things that you do in geology, where you have rocks and minerals - identify kinds of things ... you don’t have to be entertaining, but you want to make it exciting to learn something new, encounter something a little different, but also that knowledge is not something that’s dry and dull. If you can do this... you stimulate the interest of the young people, and they gain that curiosity, too. If they gain that curiosity, then they begin to take on those characteristics and they want to learn a little more. So, I want to create an environment... that says, “this isn’t ha-ha fun, but isn’t this really neat?” (Lundy, 2008a).

Fun has several different meanings; as defined in this paper, fun includes the feeling of enjoyment at a task or learning. Scout leader/science teacher Mrs. C.’s definition of fun was not identical to the definition of fun as defined for this paper; her definition did not seem to include enjoyment of a task. When Mrs. C. was asked if Scouts would do some of the science activities if they were not fun she replied:

Well, I’d say ... making science fun ... keeps them engaged ... When it’s 90 degrees outside, and you’re trying to beat the heat, sometimes that’s a challenge, too. It might not be fun, but the gratification you get, after overcoming adversity, doing the best you could to make things as comfortable as you can, and make
wise choices ... let’s say, for going to Philmont. You just can’t walk into this mountain and expect to come out without thinking a lot of things through. Trying to think of the best way to cross a stream that’s flooded, or - you don’t know what the situation is, yet you’ve been trained, and learned how to deal with things - that might not be called fun, but, boy your feel gratification when you come out of it! But then, for younger kids, fun. That’s important. You (chuckled) generally know for 12 year old, your 11 year old, you’ve got to have fun.

The Boy Scouts, according to Scout D., always linked science with enjoyment and friends. Because science activities were enjoyable, science was cool, in contrast to school where science was just another subject to study.

Cub Scouts and Boy Scouts - they had science-based activities and they always linked it with enjoyment, something that you do with your friends. “Hey, science is something cool.” Whereas in school, it’s just another subject that you study. You might not always look at it with enthusiasm if it’s keeping you from playing video games or anything while you’re doing it as homework at home.

The fun in Scouting science includes the excitement and the laughter, but it also includes learning with friends, the enjoyment of learning something new, and the gratification of completing a task.

Science in Scouting is Fun

Scout science experiences were more fun for Scout K. than were school science experiences except for labs. Scout K. stated that Scout science was more fun than school science:

Cause I actually get to experience it, being outdoors. ... labs at school are fun. ... Basically, it’s a really good experience to do Scouting to learn science. The experiential, and then the text, and then everything together really helps out ... it’s a really good, fun experience to do.

Scout D. thought that the fun experiences in Scouting lined up with the merit badge material, making boys want to learn science because it was fun.
I think the organization and the concentration of the material that the merit badges give you line up with the fun experiences that you have in Boy Scouts as a whole, making science fun to learn and making you want to learn it.

**Fun combats Social Pressure**

Scouts often have to resist peer pressure from classmates who deride them for their membership in the Boy Scout organization. Often the reason a boy stays in the Scouting program is because it is fun. The boys enjoy the camping experiences, the fun of being with friends.

... some people try to tear you down, saying, “Oh, Scouting is lame ... you need to stay away from it ... it’s for younger Scouts.” But, Scouting is fun. You get outdoors. You’re not sitting on the couch being a couch potato all day. You get the exercise you need. You actually get out and hang with friends, while other people are just sitting at home ... degrading you, when you’re having fun. Scout K.

Dr. Porchia agreed with Scout K. concerning the social pressures to conform that were place upon many Scouts by non-Scouts. Dr. Porchia seemed to think that fun activities could hold a younger Scout in the program, but, as a boy got older, his motivation might change. A boy’s focus on a goal, his desire to achieve his Eagle, might be what kept him in the program, rather than the fun of being a Scout.

The interesting thing about Scouting is you have to live with a lot of social pressures. Some people are afraid to admit that they’re Scouts because ... when it’s not the normal, the majority picks on it. ... Scouting is a minority amongst ... students ... ages of about seventeen, eighteen. ... When you’re kids, camping’s fun, and Scouting is perfect fun, but when you get older, camping’s not as much fun. If you’re a Scout, you’re wearing the weird shorts ... dealing with the social pressures ... A lot of people drop out after the first year, second year, but, to get to Eagle, that’s an accomplishment (Porchia, 2008).

Often the majority of the students who are teasing the Scouts because of their Boy Scout membership do not know what Scouting is about and pick on the Scouts because
the Scouts are in the minority, especially older Scouts. Scouts, who persevere and earn their Eagle, even if Scouting may not be as much fun as an older Scout, feel a justified sense of accomplishment.

Fun is important in Scouting to keep boys involved, to keep boys in the program, to help boys resist peer pressure, to interest boys in science, and to give them memorable experiences upon which to build knowledge. Scout fun includes the “ha-ha” fun, but it also includes the feeling of enjoyment while learning and while completing a task, the fun of “excitement” and adventure.

4.3.3 Locations used in Boy Scouts

Merit badges can be earned at summer camp, troop meetings, and one-on-one with merit badge counselors. Merit badge requirements can be completed during campouts, trips, or other activities. As over 85% of merit badges have a significant science content requirement, this means that Scouts can learn science in each of these places while doing a merit badge.

Scouts can earn rank advancement requirements, many of which require acquisition of science knowledge, at summer camp, during troop meetings, and on campouts or trips. Many Scout activities lead to science content acquisition in Scouts. These activities, which may be conducted in many places, include summer camps, trips and campouts, and troop meetings.

Opportunities for science knowledge acquisition pervade the Boy Scout organization’s educational materials and the activities in which Scouts participate. Scouts science acquisition may be intentional or incidental, as when science content
knowledge acquisition was not the major goal or focus of an event, activity, or trip. A Scout may pick up incidental science knowledge while helping with a service project, during a troop meeting, goofing off with other Scouts at summer camp, or on a campout or trip.

Science learning in the Boy Scouts occurs in many different places. Table 4.3 gives a partial listing of the places and activities where science learning occurs in the Boy Scouts, according to a survey of Scout leaders from the pilot study.

The Boy Scout science education program is an integrated program of activities, merit badge work, and experiences. Scout leaders feel that the overall Scouting environment introduces boys to science. The four main areas where boys learn science in the Boy Scouts are the outdoors, on trips, in meetings, and doing merit badges (Figure 4.3).
### The overall Scouting environment

<table>
<thead>
<tr>
<th>Outdoors</th>
<th>Caving</th>
<th>High Adventure trips</th>
<th>Trips</th>
<th>Meetings</th>
<th>Merit badges</th>
</tr>
</thead>
<tbody>
<tr>
<td>whitewater rafting, wilderness survival trip, hiking, backpacking, scuba diving, rappelling, learning to water-ski, out there interacting with the environment, campouts, summer camps, exploring our earth, meeting people</td>
<td>Old Man’s Cave, Mammoth, exploring our earth</td>
<td>Northern Tier, Sea Base, canoeing, Florida Keys, scuba diving, Philmont Ranch in New Mexico, backpacking, exploring our earth</td>
<td>the park, visit places, trips to various parts of the state, trips outside the state, Ohio Power, tour of the large earth-moving equipment that a strip mine uses, Virginia, Blue Ridge Mountains, and wherever it is we go to do our things, exploring our earth, meeting people</td>
<td>our meetings, summer camps, Service Project, educational program, meeting people</td>
<td>summer camps, working with an individual merit badge counselor</td>
</tr>
</tbody>
</table>

Table 4.3 Locations Where Scouts Encounter Science
4.5 Merit Badge Science Content Acquisition

The Geology merit badge was selected as the representative merit badge to determine if the merit badge program of the Boy Scouts was effective in engendering content knowledge, boys were tested on their content knowledge before and after earning the Geology merit badge. Scouts who had previously taken the Geology merit badge, Rocks and Minerals option, were given a posttest to determine if they had retained any geology content knowledge.

4.5.1 Control

The Geology merit badge control group was composed of 44 boys (average age = 12.9) who attended summer camp. The Scouts making up the control group took a pretest and posttest at the same times and places as did the boys who did the Geology merit badge at the camps, but the control group did not do the merit badge. The control
group varied in age, grade, and Scout rank, but did not differ significantly from any of the
treatment groups.

Figure 4.4: Control Group Frequency by Age

Figure 4.5: Treatment Group Frequency by Age
4.5.2 Treatment Groups

The study compared treatment results at four treatment location types: summer camps, a Merit Badge College, a landmark, and troop activities. Only treatment data with the Rocks and Minerals option of the Geology merit badge were included in the analysis. Thirty-three boys (average age = 13.0), in two different troops, participated and earned their Geology merit badge by working with a merit badge counselor as a troop. Eleven boys at three different camps (average age = 13.0) earned their Geology merit badge and participated in the study. Thirty-six boys (average age = 12.3) participated in the study at the landmark location, and there were 14 participants (average age = 13.0) at the Merit Badge College. Age was not a significant factor on the treatment results.

4.5.3 Longitudinal Group

The 23 boys in the longitudinal sample completed the Geology merit badge before the study; the time length between the completion of the merit badge and the posttest was unknown and varied within the sample. The boys were of different ages, grades, and Scout ranks. These Scouts took a posttest, the pretest scores were imputed as the average sum of the pretest scores across the control and treatment groups. No significant difference was observed in the imputed pretest score when the three 5th grade pretest scores were removed from the pretest sample. The average age of the longitudinal sample was 14.75 years; the average age of the control was 12.9 years. Age and grade level were highly correlated ($\rho = .984$). A one-way ANOVA technique measured the effect of age within the treatment groups. Age was not a significant factor when looking at its effect on the treatment groups (longitudinal vs. control) when predicting the score.
differential (Tables 4.4, 4.5). The longitudinal sample retained some geology content knowledge; the longitudinal sample posttest scores were, on the 23-question assessment, 3.4 questions higher than the imputed pretest average score, a 14.78% change (Tables 4.6, 4.7). The retention of geology content knowledge in the longitudinal sample was significant at a 95% confidence level (p<.001).

UNIANOVA SCORE DIFF BY AGE

<table>
<thead>
<tr>
<th>Age</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>-1.0000</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>-2.5789</td>
<td>3.13255</td>
<td>19</td>
</tr>
<tr>
<td>12</td>
<td>-2.3333</td>
<td>3.81945</td>
<td>18</td>
</tr>
<tr>
<td>13</td>
<td>-1.6957</td>
<td>3.12519</td>
<td>23</td>
</tr>
<tr>
<td>14</td>
<td>-.5714</td>
<td>4.64963</td>
<td>7</td>
</tr>
<tr>
<td>15</td>
<td>-2.2500</td>
<td>4.19325</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>-1.6667</td>
<td>3.51188</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td>-4.2000</td>
<td>2.28035</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>-2.1250</td>
<td>3.40653</td>
<td>80</td>
</tr>
</tbody>
</table>

Table 4.4: Longitudinal Score Differential by Age
### Tests of Between-Subjects Effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>49.318(^a)</td>
<td>7</td>
<td>7.045</td>
<td>.585</td>
<td>.766</td>
</tr>
<tr>
<td>Intercept</td>
<td>127.805</td>
<td>1</td>
<td>127.805</td>
<td>10.608</td>
<td>.002</td>
</tr>
<tr>
<td>Age</td>
<td>49.318</td>
<td>7</td>
<td>7.045</td>
<td>.585</td>
<td>.766</td>
</tr>
<tr>
<td>Error</td>
<td>867.432</td>
<td>72</td>
<td>12.048</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1278.000</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>916.750</td>
<td>79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) R Squared = .054 (Adjusted R Squared = -.038)

Table 4.5: Tests of Between-Subjects Effects

### Univariate Analysis of Variance

### Dependent Variable: SCORE DIFF

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.1667</td>
<td>3.3961</td>
<td>36</td>
</tr>
<tr>
<td>Longitudinal</td>
<td>-3.4448</td>
<td>3.63829</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>-.6310</td>
<td>4.01433</td>
<td>59</td>
</tr>
</tbody>
</table>

Table 4.6: Longitudinal and Control Univariate Analysis of Variance

### Parameter Estimates

### Dependent Variable: SCOREDIFF

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>t</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-3.445</td>
<td>.697</td>
<td>-4.945</td>
<td>.000</td>
<td>-4.840 -2.050</td>
<td>.300</td>
</tr>
<tr>
<td>[trtgroup=C]</td>
<td>4.611</td>
<td>.892</td>
<td>5.171</td>
<td>.000</td>
<td>2.826 6.397</td>
<td>.319</td>
</tr>
<tr>
<td>[trtgroup=L]</td>
<td>0(^a)</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>

Table 4.7: Longitudinal and Control Parameter Estimates
4.5.4 Location Comparisons

The pretest/posttest differential scores of the control sample were compared to the pretest/posttest differential scores of the combined treatment groups, excluding the longitudinal sample and the museum sample. (The museum scores were not included, as the treatment was a different option of the *Geology* merit badge, Surface Processes; the treatment groups included received the Rocks and Minerals option of the *Geology* merit badge.) The combined treatment groups improved their test scores by 2.1 questions, a 9.13% gain in content knowledge, significant at a 95% confidence level (p<.001) (Tables 4.8, 4.9).

Descriptive Statistics

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.1667</td>
<td>3.13961</td>
<td>36</td>
</tr>
<tr>
<td>Program</td>
<td>-2.1250</td>
<td>3.40653</td>
<td>80</td>
</tr>
<tr>
<td>Total</td>
<td>-1.1034</td>
<td>3.64842</td>
<td>116</td>
</tr>
</tbody>
</table>

Table 4.8: Program and Control Score Differentials

Parameter Estimates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>t</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound Upper Bound</td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.125</td>
<td>.372</td>
<td>-5.713</td>
<td>.000</td>
<td>-2.862 -1.388</td>
<td>.223</td>
</tr>
<tr>
<td>[trtgroup=C]</td>
<td>3.292</td>
<td>.668</td>
<td>4.930</td>
<td>.000</td>
<td>1.969 4.614</td>
<td>.176</td>
</tr>
<tr>
<td>[trtgroup=T]</td>
<td>0^a</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>

a. This parameter is set to zero because it is redundant.

Table 4.9: Score Differentials Between Treatment and Control Groups
Location has a significant effect on the treatment at a 95% confidence level (p<.001). The Scouts at summer camp increased their scores by an average of 4.1 questions, a 17.8% increase. The Scouts who worked as a troop with a merit badge counselor improved their scores by an average of 3.0 questions, a 13% increase. The Scouts at the Merit Badge College improved their scores by an average of 2.07 questions, a 9.0% increase. The Scouts at the landmark improved their scores by an average of 0.91 questions, a 4.0% increase (Tables 4.10, 4.11).

Descriptive Statistics

<table>
<thead>
<tr>
<th>Location</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camp</td>
<td>-4.0909</td>
<td>2.30020</td>
<td>11</td>
</tr>
<tr>
<td>Landmark</td>
<td>-.9091</td>
<td>3.53875</td>
<td>33</td>
</tr>
<tr>
<td>Merit Badge College</td>
<td>-2.0714</td>
<td>1.97929</td>
<td>14</td>
</tr>
<tr>
<td>Troop</td>
<td>-3.0000</td>
<td>3.80476</td>
<td>22</td>
</tr>
<tr>
<td>Control</td>
<td>1.1667</td>
<td>3.13961</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>-.7887</td>
<td>3.48621</td>
<td>142</td>
</tr>
</tbody>
</table>

Table 4.10: Score Differentials and Location
Parameter Estimates

Dependent Variable: SCOREDIFF

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>t</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.167</td>
<td>.510</td>
<td>2.287</td>
<td>.024</td>
<td>.158 - 2.175</td>
<td>.037</td>
</tr>
<tr>
<td>Camp</td>
<td>-5.258</td>
<td>1.054</td>
<td>-4.987</td>
<td>.000</td>
<td>-7.343 - -3.173</td>
<td>.155</td>
</tr>
<tr>
<td>Landmark</td>
<td>-2.076</td>
<td>.738</td>
<td>-2.814</td>
<td>.006</td>
<td>-3.534 - -.617</td>
<td>.055</td>
</tr>
<tr>
<td>Merit Badge College</td>
<td>-3.238</td>
<td>.964</td>
<td>-3.359</td>
<td>.001</td>
<td>-5.144 - -1.332</td>
<td>.077</td>
</tr>
<tr>
<td>Troop</td>
<td>-4.167</td>
<td>.828</td>
<td>-5.031</td>
<td>.000</td>
<td>-5.804 - -2.529</td>
<td>.157</td>
</tr>
<tr>
<td>Control</td>
<td>0a</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>

a. This parameter is set to zero because it is redundant.

Table 4.11: Score Differential Significance by Location

A full factorial model, which consisted of all interactions, was performed. No interactions were deemed significant; therefore, a main effects model was produced. The treatment group, location, Scout rank and age were put in as main effects. The treatment group and location were deemed significant. Next, the control group was set as the reference when comparing location. The control differed from the troop treatment by 5.298 (p < .001). Comparing all locations to the troop, no locations were deemed significant. The model shows significant differences between the treatment groups, however, when the troop was set at the reference, in the post hoc comparisons, there were no significant differences between the locations (Tables 4.12, 4.13).
Univariate Analysis of Variance

Tests of Between-Subjects Effects
Dependent Variable: SCOREDIFF

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>437.048a</td>
<td>11</td>
<td>39.732</td>
<td>3.778</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>11.932</td>
<td>1</td>
<td>11.932</td>
<td>1.135</td>
<td>.289</td>
</tr>
<tr>
<td>trtgroup</td>
<td>230.734</td>
<td>1</td>
<td>230.734</td>
<td>21.940</td>
<td>.000</td>
</tr>
<tr>
<td>Location</td>
<td>97.561</td>
<td>3</td>
<td>32.520</td>
<td>3.092</td>
<td>.030</td>
</tr>
<tr>
<td>ScoutRank</td>
<td>59.765</td>
<td>6</td>
<td>9.961</td>
<td>.947</td>
<td>.465</td>
</tr>
<tr>
<td>Age</td>
<td>12.567</td>
<td>1</td>
<td>12.567</td>
<td>1.195</td>
<td>.277</td>
</tr>
<tr>
<td>Error</td>
<td>1093.711</td>
<td>104</td>
<td>10.516</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1672.000</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>1530.759</td>
<td>115</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .286 (Adjusted R Squared = .210)

Table 4.12: Model for Score Differential by Location
Scout scientist Sherman Lundy felt that the enthusiasm and excitement for science boys got by participating in Boy Scout activities and merit badges were as important as their content knowledge acquisition. Mr. Lundy felt that this enthusiasm for science was what stimulated many Scouts to enter a scientific profession. Mr. Lundy felt that an
extremely important part of the merit badge program was for boys to meet scientists who were working in the profession of the merit badge. Another important part of the merit badge program that stimulated interest in the subject, according to Mr. Lundy, were the field trips, where boys were able to see a location in person. These field trips made the science relevant to the boys. Mr. Lundy wrote:

One item of interest I would add to your study, and it is often overlooked by researchers, is the support and enthusiasm for the subject area that provides Scouts with the stimulus to continue their interest in the topic. From previous classroom experience, many of those who chose to enter the field of geology either had a previous interest or gained that interest from participating in the Geology Course at the Secondary Level as an example. The Geology merit badge program serves that purpose for the Scouts:

1] Supports an already exiting interest in a topic.
2] Creates an interest in a topic worthy of further examination.

In effect, they may not have gained a tremendous amount of new knowledge, but were stimulated to pursue this interest, area, or curiosity.

The other thing of importance in the MB program is an introduction to concepts and ideas. The Scouts who took this Geology MB class were introduced to real life Geologists, went into a mining operation, saw first-hand what happens, and learned the uses of the products from the mining operation; they had the opportunity to examine some aspects of geology which will serve as building blocks for additional academic and real life experiences in the classroom and in their world.

Often, in the case of the merit badge, an idea, or a concept, or even the introduction of these topics as real life subject areas is the successful goal. Keep in mind you have a variety of learning levels ranging from a 6th grader to possibly 12th graders whose levels in learning will range from information and awareness to a lot of information with career implications. While content mastery is an important goal, especially in a classroom setting, content in the merit badge includes information and generating interest in the topic (Lundy, 2008b).
5. CONCLUSIONS

My feeling is, that if we are to make a difference in the future ... we’re going to have to inspire millions of young people. Certainly one of the ways we can do that is through Scouting and teaching at an early stage that we are part of a bigger system, and as such, we have to be very concerned about ... our individual actions, how they may total up to impact the environment in which we live and our children will live. I think Scouting is a good way to do that.

Dr. Lonnie G. Thompson, Ph.D.
Winner of the National Medal of Science
Time Hero of the Environment, 2008
National Academy of Science Member

5.1 Summary

5.1.1 National Science Education Standards

The Boy Scouts of America is a significant part of the American educational system providing educational services to 14% of the available population of boys. The Boy Scout education program has a significant science component, both in activities and in the merit badge and rank advancement programs.

The merit badge requirements of the 121 current merit badges and the rank advancements were mapped onto the National Science Education Standards; 103 merit badges (85.12%) have at least one science requirement as indicated by the National Science Education Standards. The first three rank advancements, Tenderfoot, Second Class, and First Class have science requirements not tied to the merit badge program; the other rank advancements, Star, Life, and Eagle, require Scouts to earn Eagle required
merit badges. Only three of the ten “must do” and the two “choose one” Eagle required merit badges do not have at least one science requirement; 75% of the Eagle required merit badges have at least one science requirement. In 2007 Scouts earned 1,628,500 merit badges with at least one science requirement, including 72,279 Eagle required *Environmental Science* merit badges (The Boy Scouts of America, 2008f).

By participating in the Boy Scout merit badge program and the Boy Scout rank advancement program, boys are exposed to science information deemed important by the National Academy of Science as referenced in the National Science Education Standards. Personal Health/Personal & Community Health is a National Science Education Standard covered by 70% of the Boy Scout merit badges. When Scouts meet with professionals in the field of study, discuss career options in the field, and/or discuss what education is needed to become a professional in the field, a requirement for 36.4% of the merit badges, Scouts meet the National Science Education Standard - Science as Human Endeavor, a topic in History and Nature of Science.

Both Inquiry and Science and Technology are emphases of the Boy Scout merit badge program. Of the 121 merit badges, 58.6% have an inquiry-based requirement; 73.6% of merit badges have a science and technology requirement. Of the 10 “must do” Eagle required merit badges, 40% have an inquiry requirement, 50% have a science and technology requirement.

5.1.2 Aspects of Boy Scouts Impacting Science Learning and Interest

Boy Scouts provides science experiences to boys through merit badges, camping, events, trips, adventure, activities, incidentally, and through “the overall Scouting
These experiences can provide a base for science knowledge construction, either at the time of the experience or later, upon reflection or encountering additional information in school or elsewhere. Scout scientists and Scout leaders estimated the amount of time that Scouts spend doing science-related activities to be between 20% and 100% of the time. If Boy Scout activities are, at a minimum, at least 20% science-related, Scouts are spending a great deal of time involved with science.

The experiences a Scout has in Scouting and in doing a merit badge may be more influential in promoting his love and enjoyment of science than the content knowledge the boy gains from doing a merit badge or rank requirement (Jarrett & Burnley, 2007; Lundy, 2008b). Scouts like fun; if an experience is fun, boys will remember the experience and may use the memory to construct science knowledge.

Fun is a very important concept in Boy Scout Science as well as in the whole Boy Scout program. Boys join the Boy Scouts and stay in the Boy Scouts based on the fun factor of Scouting; the fun factor in Scouting combats the social pressure to drop out of Scouting that many boys face. Boys learn when they have fun; Scouts learn science in the Boy Scouts because Boy Scout science is fun. The Boy Scouts is a free choice activity; boys will not choose to participate in Scouting if it is not fun. This fun, while it includes excitement and adventure, also includes meaningful activity. Activities may be deemed fun because they provide meaningful enjoyment and a sense of accomplishment.

Boy Scout experiences and instruction engender interest in science. The experiences and knowledge that a boy acquires in the Boy Scouts may be used, at that time or at a later date, as a basis on which he may construct science knowledge. Scouts
may learn incidentally and/or purposefully; Scouts may not always recognize that they are learning. The knowledge and experiences a boy has in Scouts may help him in school; he may be better prepared to learn. Scouts have an experiential base on which to construct knowledge; they may have learned concepts while studying for a merit badge.

5.1.3 The Impacts of Participation in Boy Scout Science

The scientists interviewed stated the science experiences they had as Scouts fit their definitions of science. Scientists stated that skills they learned in the Boy Scouts, both experientially and through the merit badge program, helped them in their work as scientists. The scientists listed problem-solving skills, relevant use of the scientific method, leadership skills, teamwork skills, and first aid skills as skills they learned and honed in the Boy Scouts and currently use in their work as scientists.

Scouts like the camping and outdoor experiences in the Boy Scouts. These outdoor experiences and environmental training, as in Leave No Trace (The Boy Scouts of America, 2008m), engender environmental consciousness and responsibility to care for the environment.

Scouts believed that doing merit badges helped them in school. Doing merit badges and earning the merit badge patch engendered self-efficacy in Scouts. Self-efficacy was also engendered in Scouts by participation in activities and experiences. This self-efficacy translated into Scouts believing they did better in school because of their participation in the merit badge program and their Scouting experiences.
5.1.4 Learning Style Preferences of Scouts

Scouts are tactile/visual global learners. Scouts learn by getting the big picture, not necessarily the tiny details, and they learn by doing and seeing. Scouts are hands-on learners who like to eat and snack while learning and studying. The Boy Scout educational material targets the tactile/visual learner by including many pictures and diagrams in instruction manuals, merit badge pamphlets, and the Boy Scout Handbook, and by having Scouts participate in hands-on activities. Scouts “do” things. They “do” projects, they “do” hands-on activities, and they “do” the requirements. Boys learn the safety rules and precautions before they are allowed to “do” dangerous activities like building fires, using knives and axes, scuba diving, water skiing, and climbing mountains.

Boy Scout educational material, including the merit badge pamphlets and the Boy Scout Handbook, present a big picture overview of the subject matter. This global, big picture emphasis fits the global/integrated learning style of most Scouts. The Boy Scouts makes other provisions for different learning styles of Scouts, too. Merit badges can be done alone, or with peers. Boys are rewarded with merit badge patches for completing merit badges because, in most cases, Scouts’ motivation is external or dependent upon the circumstances.

Although most Scouts were global, tactile/visual learners who needed to eat or snack while learning, Scouts mapped onto three different clusters in their learning style profiles. The largest group of Scouts, 42.8% of the sample, were visual/tactile global learners who were always hungry. This type of Scout preferred to work with his peers,
was motivated by others, did not always persist in finishing a task, learned best in the evening, and preferred to be able to move around and sit informally while he studied.

The second distinct Scout type was in the minority, making up only 17.1% of the sample. This type of Scout preferred variety in his learning situations; he could learn visually, tactually, auditorily, and kinesthetically. He did not like authority; he preferred not to be told what to do or how to do it. This type of Scout liked to learn with his peers and, although self-motivated, this type of Scout did not always follow through to finish a task. This type of Scout learned best in cooler temperatures where he could move around and eat. This Scout preferred to learn in the morning, not in the afternoon or evening and was more reflective than other types of Scouts, but was still a global or big picture learner.

The third distinct Scout type, 40% of the sample, was typically a studious person. This type of Scout preferred to learn alone instead of with his peers and preferred a formal seating arrangement in a quiet area while he studied; he learned best in the evening, not in the morning. This type of Scout was task persistent, usually finishing what he set out to accomplish. He did not move around and did not necessarily need to eat while he studied; he did not prefer variety in how he learned. This type of Scout did not learn kinesthetically, by moving, or by hearing; he was a visual/tactile learner, learning hands-on. This Scout was also a big picture person, a global learner.

Scouts also clustered into three modality clusters; Scouts who could learn in any modality, but were especially strong kinesthetic/tactile learners, comprised 28.6% of the participants. This cluster was the only cluster with a strong auditory learning style.
The second learning modality cluster, 42.9% of the participants, was composed of strong tactile learners who did not learn well kinesthetically. Members of this cluster could learn auditorily or visually depending on the circumstances. The only strong way members of this cluster learned was tactually, hands-on.

The third learning modality cluster, comprised of 28.6% of the participants, were strong visual learners. The members of this group did not learn well either kinesthetically or auditorily. Members of this group could learn tactually depending on the circumstances.

The only learning style modalities which would enable all Scouts to learn with their strengths are tactile and visual. Scouts need hands-on activities where they can see and do.

5.1.5 Content Knowledge and Merit Badge Participation

Scouts gained geology content knowledge by earning a Geology merit badge. Geology content knowledge gained through doing a Geology merit badge was retained long term; boys who had previously completed a Geology merit badge retained their knowledge, doing significantly better on the post-test than boys who had never taken a Geology merit badge. Boys taking a Geology merit badge in any location significantly improved content knowledge scores when compared with boys who did not take a Geology merit badge. Scout scores did not differ significantly by location, but boys achieved their highest scores at summer camp, followed by troop activities, and a Merit Badge College. The lowest increase in scores was seen at a one-day event not run by Scouts. Enthusiasm for geology and science was not measured.
5.2 Conclusions

Science learning in the Boy Scouts is based on experiences, activities, and trips, in addition to working on merit badges and rank advancement. Each of these ways of acquiring science knowledge is important and may help a Scout build his experiential science content knowledge.

In 2005, Ruth Jarman published the results of her study on Science learning through Scouting, which she identified as an understudied context for informal science education. Jarman stated that science experiences in Scouting, which is an informal education venue, “exemplify science ideas encountered within the school curriculum.” She theorized that if Scouts can remember their experiences and relate them to the school topic, the experiences may connect for the Scouts and help them to develop “deep conceptual understanding” (Jarman, 2005). Jarman based her theories on work done by Gerber, Gilbert, Rennie, McClafferty, and Stocklmayer. In informal education the “experience is everything.” Experiences that are just for fun can have significant consequences (Stocklmayer & Gilbert, 2002).

Jarman, who studied Cub Scout science education in the United Kingdom of Great Britain and Northern Ireland, identified four contexts in which science was transmitted in UK Scouting.

- the Progressive Training Programme (which corresponds to Rank Advancement Requirements for US Scouts),
- Proficiency Badges (similar to US Scouting merit badges),
- Special Events, such as visits to science centers or working on environmental projects,
- incidental learning in which science learning is not the primary goal of the activity, but is a potential outcome of a particular activity or experience (Jarman, 2005).
Scouts, Scout leaders, and scientists who were Scouts seemed to agree that science education in the Boy Scouts also transmits science knowledge to Scouts through the same four contexts identified by Jarman. Scout leaders, in both the pilot study and the Scout leader interviews, made reference to merit badges, being outdoors, learning to identify plants and to recognize animal tracks (rank advancement requirements), and special events such as visiting caves, thus referring to each of the four categories enumerated by Jarman. The merit badges, in the eyes of the Scouts, Scout leaders, and scientists were not the only, and maybe not even the most important, way Scouts learn science. Many of the Scouts, past and present, and the Scout leaders interviewed seemed to indicate that experiences that Scouts had were very important in terms of how much science a Scout learned. This is in accordance with Stocklmayer and Gilbert, who state that future learning can be based upon preceding experiences. A successful experience will mediate learning in the future when a person encounters similar information, even though learning in the present may be delayed; the key is the engagement of the individual (Stocklmayer & Gilbert, 2002).

A major concept that emerged from the interview data is that science content acquisition by Boy Scouts can occur in any location. When science content acquisition locations mentioned by Scout leaders were mapped onto the four ways that Scouts can acquire science content, science content knowledge was shown to be acquired in a multiplicity of locations (Figure 5.1). Science content knowledge acquisition is not limited to place, but can occur in multiple locations, wherever Scouts are.

“Wherever it is we go to do our things,” sums up the Scout leaders’ opinions of
where science content knowledge acquisition occurs. Science can be learned in Scouting in any location. Science content knowledge acquisition in Scouting is pervasive and experiential.

Boy Scout Science Education, Learning Locations and Learning Activities

<table>
<thead>
<tr>
<th>Merit Badge</th>
<th>Rank Advancement</th>
<th>Activities</th>
<th>Incidental Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meetings with Merit Badge Counselor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer Camp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Campouts, High Adventure, Trips</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Troop Meetings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Projects</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.1: Boy Scout Locations and Activities

5.3 Discussion

To reach the greatest number of Scouts according to their preferred learning modalities, Scout leaders should concentrate on tactile and visual activities as tactile and visual modalities were strong in, or at least in certain circumstances, preferred by, members of all three modality clusters. Auditory and kinesthetic modalities were, at least in one of the modality clusters, not a preferred way to learn. Scouts need hands-on activities, not lectures. Activities for Scouts need to be fun and relevant.

Scouts learn experientially through activities and experiences that they see as being relevant; the relevance may be seen to be immediate or future. The amount of science content knowledge gain that can be measured after a Boy Scout experience may

264
not be as important and the enthusiasm for and excitement about science that the experience engenders in the boy.

5.4 Suggestions for Future Research

This study was the first comprehensive study on science education in the Boy Scouts of America. Many questions which can only be answered by future study have resulted from this research.

Participation

Further study is warranted to determine if participation in high adventure activities, including but not limited to Philmont, Sea Base, and Boundary Waters increases the participation and retention of older Scouts, and/or engenders within them with an increased sense of conservation and environmental responsibility.

Comparison of the science grades of boys who are Scouts with science grades of boys who are not Scouts is warranted. A Likert-type assessment of science enthusiasm comparison between boys who are Scouts and boys who are not Scouts is warranted by this study.

A survey of scientists to determine what percent of scientists were influenced by participation in the Boy Scouts, and/or what scientific field is most influenced by participation in the Boy Scouts is a topic for further study.

Learning Styles

Further study, with an increased number of participants, is warranted to compare the learning styles of Scouts with the learning styles of boys who are not Scouts, as there are no comparison studies between Scouts and boys who are not Scouts. A comparison
between boys who started in Scouts but discontinued their Scouting participation and boys who continued in the Boy Scout program would be worth exploring.

Camp

Further study at summer camp locations is warranted to determine if meeting with a merit badge counselor at scheduled times or working on a merit badge on a free-choice timetable engenders more content knowledge and excitement about the subject.

Self-efficacy

Further study in the self-efficacy engendered in Scouts as a result of their participation in merit badges is warranted. Further study is warranted in the area of self-efficacy engendered by Boy Scout experiences. A study on remembered mastery experiences may also be a topic for future study.

Programs

Further study is warranted to determine what percentages of merit badge events offered by various locations strictly adhere to the merit badge requirements. Further study is warranted to determine the efficacy of the merit badge program administered by Scouts, programs that follow the merit badge requirements without adding or subtracting to the requirements, and programs that do not meticulously adhere to the requirements. Further study is warranted to determine which type of merit badge event presentation is most conducive to the learning styles of Scouts. Further study may be conducted on the efficacy of programs including Scouts and Cub Scouts compared with the efficacy of programs specific to Scouts or Cub Scouts. Enthusiasm for science engendered by participation in Boy Scout activities and programs is a topic for future research.


Bulunuz, M. (2008). *Development of interest in science and interest in teaching elementary science: Influence of informal, school, and inquiry methods course experiences.* Georgia State University, Atlanta, GA.

choice science education complements national formal science education efforts.
In J. H. Falk, E. Donovan & R. Woods (Eds.), Free-choice science education: 
How we learn science outside of school (pp. 44-63). New York: Teachers 
College.


477-484.


In E. T. Higgins & R. M. Sorrentino (Eds.), Handbook of motivation and 
Guilford Press.


Research methods in the social sciences (pp. 49-55). London: Sage Publications, 
Ltd.

differences in brain structure, function, and chemistry. Biological Psychiatry, 
62(8), 847-855.

Understanding of Science, 6(1), 87-101.

(Eds.), Research methods in the social sciences (pp. 215-225). London: Sage 
Publishing Ltd.

Dawson. (2000). Upper primary boys' and girls' interests in science: Have they changed 


Dunn, R., Denig, S., & Lovelace, M. K. (2001). Two sides of the same coin or different strokes for different folks? Teacher Librarian, 28(3), 9-16.


272


APPENDIX A

COMPARISON OF BOYS TO GIRLS
Comparison of Boys to Girls (Using 100 Girls as a Reference)

<table>
<thead>
<tr>
<th>Early life</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceived</td>
<td>115</td>
<td>100</td>
</tr>
<tr>
<td>Born</td>
<td>105</td>
<td>100</td>
</tr>
<tr>
<td>Die first 27 days of life</td>
<td>129</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School K-12</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursery school enrollment</td>
<td>112</td>
<td>100</td>
</tr>
<tr>
<td>Elementary enrollment</td>
<td>107</td>
<td>100</td>
</tr>
<tr>
<td>High school enrollment</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>High school graduation</td>
<td>96</td>
<td>100</td>
</tr>
<tr>
<td>High school dropout</td>
<td>400</td>
<td>100</td>
</tr>
<tr>
<td>Science class enrollment</td>
<td>94</td>
<td>100</td>
</tr>
<tr>
<td>A grades</td>
<td>&lt;50</td>
<td>100</td>
</tr>
<tr>
<td>D and F grades</td>
<td>233</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>College and University</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>College enrollment</td>
<td>77</td>
<td>100</td>
</tr>
<tr>
<td>Associate’s degree</td>
<td>67</td>
<td>100</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>73</td>
<td>100</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>62</td>
<td>100</td>
</tr>
<tr>
<td>First professional degree</td>
<td>107</td>
<td>100</td>
</tr>
<tr>
<td>Allopathic school admit</td>
<td>87</td>
<td>100</td>
</tr>
<tr>
<td>Med. School 2005 graduate</td>
<td>112</td>
<td>100</td>
</tr>
<tr>
<td>Psychiatry 2005 resident</td>
<td>89</td>
<td>100</td>
</tr>
<tr>
<td>Doctorate</td>
<td>92</td>
<td>100</td>
</tr>
</tbody>
</table>

Educational problems K-12

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Special education classes</td>
<td>217</td>
<td>100</td>
</tr>
<tr>
<td>Emotional disturbances</td>
<td>324</td>
<td>100</td>
</tr>
<tr>
<td>Learning disabilities</td>
<td>276</td>
<td>100</td>
</tr>
<tr>
<td>Attention deficit disorder</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>Ritalin prescription</td>
<td>400</td>
<td>100</td>
</tr>
</tbody>
</table>

Appendix A.1: Comparison of boys to girls
Appendix A.1 continued

School Discipline K-12

<table>
<thead>
<tr>
<th>Discipline referrals</th>
<th>900</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspension</td>
<td>250</td>
<td>100</td>
</tr>
<tr>
<td>Expulsion</td>
<td>335</td>
<td>100</td>
</tr>
</tbody>
</table>

Suicide and Incarceration

<table>
<thead>
<tr>
<th>Suicides age 15-19</th>
<th>549</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incarceration age 15-17</td>
<td>837</td>
<td>100</td>
</tr>
<tr>
<td>Incarceration age 18-21</td>
<td>1429</td>
<td>100</td>
</tr>
</tbody>
</table>

(Association of American Medical Colleges, 2006; Cole, 1997; Gurian & Stevens, 2004; Hales & Delanoche, 2005; Mortenson, 2006; Pollack, Kleis, & Dodge, 2006; Public Policy Institute of California, 2001).
APPENDIX B

NATIONAL SCIENCE TEACHERS POSITION STATEMENT:

INFORMAL SCIENCE EDUCATION
Preamble

NSTA recognizes and encourages the development of sustained links between the informal institutions and schools. Informal science education generally refers to programs and experiences developed outside the classroom by institutions and organizations that include:

- children’s and natural history museums, science-technology centers, planetariums, zoos and aquaria, botanical gardens and arboreta, parks, nature centers and environmental education centers, and scientific research laboratories
- media, involving print, film, broadcast, and electronic forms
- community-based organizations and projects, including youth organizations and community outreach services

A growing body of research documents the power of informal learning experiences to spark curiosity and engage interest in the sciences during school years and throughout a lifetime. Informal science education institutions have a long history of providing staff development for teachers, and enrichment experiences for students and the public. Informal science education accommodates different learning styles and effectively serves the complete spectrum of learners: gifted, challenged, non-traditional, and second language learners.

NSTA strongly supports and advocates informal science education because we share a common mission and vision articulated by the National Science Education Standards:

- Informal science education complements, supplements, deepens, and enhances classroom science studies. It increases the amount of time participants can be engaged in a project or topic. It can be the proving ground for curriculum materials.
- The impact of informal experiences extends to the affective, cognitive, and social realms by presenting the opportunity for mentors, professionals, and citizens to share time, friendship, effort, creativity, and expertise with youngsters and adult learners.
- Informal science education allows for different learning styles and multiple intelligences and offers supplementary alternatives to science study for non-traditional and second language learners. It offers unique opportunities through field trips, field studies, overnight experiences, and special programs.
- Informal science learning experiences offer teachers a powerful means to enhance both professional and personal development in science content knowledge and accessibility to unique resources.
• Informal science education institutions, through their exhibits and programs, provide an effective means for parents and other care providers to share moments of intellectual curiosity and time with their children.
• Informal science institutions give teachers and students direct access to scientists and other career role models in the sciences, as well as to opportunities for authentic science study.
• Informal science educators bring an emphasis on creativity and enrichment strategies to their teaching through the need to attract their noncompulsory audiences.
• NSTA advocates that local corporations, foundations, and institutions fund and support informal science education in their communities.
• Informal science education is often the only means for continuing science learning in the general public beyond the school years.

—Adopted by the Board of Directors
July 1999

("NSTA position statement: Informal science education", 1999)

Appendix B.1: National Science Teachers Position Statement: Informal Science Education
APPENDIX C

MERIT BADGE REQUIREMENTS

MAPPED ONTO THE

NATIONAL SCIENCE EDUCATION STANDARDS
Appendix C.1 Merit Badge & Rank Requirements mapped onto the Grades 5-8 National Science Education Standards

<table>
<thead>
<tr>
<th>5-8 Standards</th>
<th>Inquiry</th>
<th>Physical</th>
<th>Life</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge A1</td>
<td>B1</td>
<td>C1</td>
<td>D1</td>
<td>E1</td>
<td>F1</td>
<td>G1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A2</td>
<td>B2</td>
<td>C2</td>
<td>E2</td>
<td>F2</td>
<td>G2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B3</td>
<td>C3</td>
<td>D2</td>
<td>E3</td>
<td>F3</td>
<td>G3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**American Business**

**American Cultures**

**American Heritage**

**American Labor**

**Animal Science**

**Archaeology**

**Archery**

**Architecture**

**Art**

**Astronomy**

**Athletics**

**Auto Mechanics**

**Aviation**

Continued
### Appendix C.1 continued

<table>
<thead>
<tr>
<th>5-8 Standards</th>
<th>Inquiry</th>
<th>Physical</th>
<th>Life</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge</td>
<td>A1 A2 B1 B2 B3 C1 C2 C3 C4 C5 D1 D2 D3 E1 E2 F1 F2 F3 F4 F5 G1 G2 G3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backpacking</td>
<td>1 1 1 1</td>
<td>1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basketry</td>
<td>1 1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bird Study</td>
<td>1 1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bugling</td>
<td>1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camping</td>
<td>1 1 1 1 1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canoeing</td>
<td>1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td>1 1 1 1 1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cinematography</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czn Community</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czn Nation</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czn World</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climbing</td>
<td>1 1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coin Collecting</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collections</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composite Materials</td>
<td>1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers</td>
<td>1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooking</td>
<td>1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crime Prevention</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycling</td>
<td>1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dentistry</td>
<td>1 1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued
### Appendix C.1 continued

<table>
<thead>
<tr>
<th>5-8 Standards</th>
<th>Inquiry</th>
<th>Physical</th>
<th>Life</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Badge</strong></td>
<td>A1</td>
<td>A2</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>C1</td>
<td>C2</td>
</tr>
<tr>
<td><strong>Disabilities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Awareness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dog Care</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Drafting</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electricity</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Electronics</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Emergency Preparedness</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Engineering</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Entrepreneurship</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Science</strong></td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Family Life</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Farm Mechanics</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Fingerprinting</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Fire Safety</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>First Aid</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Fish &amp; Wildlife Mgmt</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Fishing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Fly-Fishing</strong></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
### Appendix C.1 continued

<table>
<thead>
<tr>
<th>5-8 Standards</th>
<th>Inquiry</th>
<th>Physical</th>
<th>Life</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge</td>
<td>A1</td>
<td>A2</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>C1</td>
<td>C2</td>
</tr>
<tr>
<td>Forestry</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Gardening</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Genealogy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Geology</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Golf</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Graphic Arts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hiking</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Home Repairs</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Horsemanship</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Indian Lore</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insect Study</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Journalism</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landscape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Architecture</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Law</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Leatherwork</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lifesaving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Mammal Study</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Medicine</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Metalwork</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Appendix C.1 continued

<table>
<thead>
<tr>
<th>5-8 Standards</th>
<th>Inquiry</th>
<th>Physical</th>
<th>Life</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge</td>
<td>A1</td>
<td>A2</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>C1</td>
<td>C2</td>
</tr>
<tr>
<td>Model Design and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorboating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Music</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nature</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear Science</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Oceanography</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Orienteering</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Painting</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Fitness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photography</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pioneering</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Plant Science</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Plumbing</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pottery</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Health</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Public Speaking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulp and Paper</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued
### Appendix C.1 continued

<table>
<thead>
<tr>
<th>5-8 Standards</th>
<th>Inquiry</th>
<th>Physical</th>
<th>Life</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Badge</strong></td>
<td>A1</td>
<td>A2</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>C1</td>
<td>C2</td>
</tr>
<tr>
<td>Radio</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Railroading</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reptile &amp; Amphibian Study</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rifle Shooting</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rowing</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salesmanship</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scholarship</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sculpture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shotgun Shooting</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small-Boat Sailing</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow Sports</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil and Water Conservation</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space Exploration</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stamp Collecting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surveying</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued
Appendix C.1 continued

<table>
<thead>
<tr>
<th>5-8 Standards</th>
<th>Inquiry</th>
<th>Physical</th>
<th>Life</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge</td>
<td>A1</td>
<td>A2</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>C1</td>
<td>C2</td>
</tr>
<tr>
<td>Swimming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textile</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Theater</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic Safety</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Truck</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Transportation</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Veterinary Medicine</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Water Sports</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Weather</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Whitewater</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wilderness Survival</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wood Carving</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Woodwork</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Continued
Appendix C.1 continued

<table>
<thead>
<tr>
<th>Rank Advancements</th>
<th>Inquiry</th>
<th>Physical</th>
<th>Life</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-8 Standards</td>
<td>A1</td>
<td>B1</td>
<td>C1</td>
<td>C2</td>
<td>C3</td>
<td>D1</td>
<td>D2</td>
</tr>
<tr>
<td>Tenderfoot</td>
<td>A2</td>
<td>B2</td>
<td>C3</td>
<td>C4</td>
<td>C5</td>
<td>D3</td>
<td>E1</td>
</tr>
<tr>
<td>Second Class</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>First Class</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Star</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eagle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Geology: 1 1 AC BC B D D D 1 1 1 1 1 1

Eagle Required
Eagle Required - Choose one
No science requirement
Optional science requirement
Ctzn = Citizenship
### Appendix C.2 Merit Badge & Rank Requirements mapped onto the Grades 9-12 National Science Education Standards

<table>
<thead>
<tr>
<th>9-12 Standards</th>
<th>Physical Science</th>
<th>Life Science</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge</td>
<td>A</td>
<td>1</td>
<td>A</td>
<td>2</td>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>2</td>
<td>B</td>
<td>3</td>
<td>B</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>4</td>
<td>B</td>
<td>5</td>
<td>B</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>1</td>
<td>C</td>
<td>2</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>4</td>
<td>C</td>
<td>5</td>
<td>C</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>1</td>
<td>D</td>
<td>2</td>
<td>D</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>4</td>
<td>D</td>
<td>5</td>
<td>D</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>1</td>
<td>E</td>
<td>2</td>
<td>F</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>2</td>
<td>F</td>
<td>3</td>
<td>F</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>4</td>
<td>F</td>
<td>5</td>
<td>F</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>1</td>
<td>G</td>
<td>2</td>
<td>G</td>
<td>3</td>
</tr>
</tbody>
</table>

#### American Business

#### American Cultures

#### American Heritage

#### Animal Science

#### Archaeology

#### Archery

#### Architecture

#### Art

#### Astronomy

#### Athletics

#### Auto Mechanics

#### Aviation

---

Continued
### Appendix C.2 continued

| 9-12 Standards | A | A | B | B | B | B | B | B | C | C | C | C | C | D | D | D | D | D | D | E | E | E | E | F | F | F | F | F | G | G | G |
| **Badge**      | A1| A2| B1| B2| B3| B4| B5| B6| C1| C2| C3| C4| C5| C6| D1| D2| D3| D4| D5| D6| E1| E2| E3| E4| E5| E6| F1| F2| F3| F4| F5| F6| G1| G2| G3|
| **Backpacking**| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Basketry**   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Bird Study** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Bugling**    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Camping**    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Canoeing**   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Chemistry**  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Cinematography** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Ctzn Community** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Ctzn Nation** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Ctzn World** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Climbing**   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Coin Collecting** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Collections** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Communications** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Composite Materials** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Computers**  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Cooking**    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Crime Prevention** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **Cycling**    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Continued
<table>
<thead>
<tr>
<th>9-12 Standards</th>
<th>?</th>
<th>Physical Science</th>
<th>Life Science</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Dentistry</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Disabilities</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Awareness</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dog Care</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Drafting</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Electronics</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Emergency</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Preparedness</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Energy</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Engineering</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Entrepreneurship</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Family Life</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Farm Mechanics</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fingerprinting</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fire Safety</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>First Aid</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fish and Wildlife Mgmt.</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fishing</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
### Appendix C.2 continued

<table>
<thead>
<tr>
<th>Badge</th>
<th>Physical Science</th>
<th>Life Science</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fly-Fishing</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forestry</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gardening</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genealogy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Geology</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golf</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphic Arts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hiking</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home Repairs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horsemanship</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indian Lore</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insect Study</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journalism</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landscape Architecture</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Law</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leatherwork</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifesaving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mammal Study</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicine</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metalwork</td>
<td>1 1 1 1 1 1 1</td>
<td>1 1 1 1 1</td>
<td>1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued
### Appendix C.2 continued

| 9-12 Standards | A | A | B | B | B | B | B | B | C | C | C | C | C | C | D | D | D | D | E | E | E | F | F | F | F | F | F | G | G | G |
| **Badge**      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Model Design and Building | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Motorboating   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Music          |   |   |   |   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Nature         |   |   |   |   |   | 1 | 1 | 1 | 1 | 0 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Nuclear Science|   | 1 | 1 | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Oceanography   |   | 1 | 1 | 1 | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Orienteering   |   | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Painting       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Personal Fitness |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Personal Management |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Pets           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Photography    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Pioneering     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Plant Science  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Plumbing       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Pottery        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Public Health  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Public Speaking|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Pulp and Paper |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Continued
## 9-12 Standards

<table>
<thead>
<tr>
<th>9-12 Standards</th>
<th>?</th>
<th>Physical Science</th>
<th>Life Science</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge</td>
<td>A1</td>
<td>A2 A2 B1 B2 B3 B4 B5 B6 C1 C2 C3 C4 C5 C6 D1 D2 D3 D4 E1 E2 F1 F2 F3 F4 F5 F6 G1 G2 G3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radio</td>
<td>1 1</td>
<td>1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Railroading</td>
<td>1 1</td>
<td>1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reptile &amp; Amphibian Study</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rifle Shooting</td>
<td>1 1</td>
<td>1</td>
<td>1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rowing</td>
<td>1 1 1</td>
<td>1</td>
<td>1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>1 1</td>
<td>1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salesmanship</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scholarship</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sculpture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shotgun Shooting</td>
<td>1 1</td>
<td>1</td>
<td>1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small-Boat Sailing</td>
<td>1 1</td>
<td>1</td>
<td>1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow Sports</td>
<td>1 1</td>
<td>1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil and Water Conservation</td>
<td>1 1</td>
<td>1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space Exploration</td>
<td>1 1</td>
<td>1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stamp Collecting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surveying</td>
<td>1 1</td>
<td>1 1 1 1 1 1 1 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued
### Appendix C.2 continued

<table>
<thead>
<tr>
<th>9-12 Standards</th>
<th>?</th>
<th>Physical Science</th>
<th>Life Science</th>
<th>Earth/Space</th>
<th>S&amp;T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge</td>
<td>A</td>
<td>A 1 2</td>
<td>B 1 2</td>
<td>D 3 4</td>
<td>B 5 6</td>
<td>C 1 2 3 4 5 6</td>
<td>D 1 2 3 4</td>
</tr>
<tr>
<td>Swimming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textile</td>
<td></td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>Theater</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic Safety</td>
<td></td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>Truck</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>Veterinary Medicine</td>
<td></td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>Water Sports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather</td>
<td></td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>Whitewater</td>
<td></td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>Wilderness Survival</td>
<td></td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>Wood Carving</td>
<td></td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
<tr>
<td>Woodwork</td>
<td></td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
<td>1 1</td>
</tr>
</tbody>
</table>

Continued
Appendix C.2 continued

<table>
<thead>
<tr>
<th>Rank Advancements</th>
<th>9-12 Standards</th>
<th>Physical Science</th>
<th>Life Science</th>
<th>Earth/Space</th>
<th>S&amp; T</th>
<th>Personal/Social</th>
<th>H&amp;N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badge</td>
<td>A1</td>
<td>A2</td>
<td>D1</td>
<td>D2</td>
<td>D3</td>
<td>D4</td>
<td>D5</td>
</tr>
<tr>
<td>Tenderfoot</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Second Class</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>First Class</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Star</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eagle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Geology*

- Eagle Required
- Eagle Required - Choose one
- No science requirement
- Optional science requirement
- ? = Inquiry

Ctzn = Citizenship


*(National Science Education Standards, 1996)*
APPENDIX D

ENVIRONMENTAL SCIENCE MERIT BADGE REQUIREMENTS
ENVIRONMENTAL SCIENCE REQUIREMENTS.

1. Make a timeline of the history of environmental science in America. Identify the contribution made by the Boy Scouts of America to environmental science. Include dates, names of people or organizations, and important events.

2. Define the following terms: population, community, ecosystem, biosphere, symbiosis, niche, habitat, conservation, threatened species, endangered species, extinction, pollution prevention, brownfield, ozone, watershed, airshed, nonpoint source, hybrid vehicle, fuel cell.

3. Do ONE activity in EACH of the following categories (using the activities in this merit badge pamphlet as the basis for planning and carrying out your projects):
   
   A.Ecology
   1. Conduct an experiment to find out how living things respond to changes in their environments. Discuss your observations with your counselor.
   2. Conduct an experiment illustrating the greenhouse effect. Keep a journal of your data and observations. Discuss your conclusions with your counselor.
   3. Discuss what is an ecosystem. Tell how it is maintained in nature and how it survives.

   B. Air Pollution
   1. Perform an experiment to test for particulates that contribute to air pollution. Discuss your findings with your counselor.
   2. Record the trips taken, mileage, and fuel consumption of a family car for seven days, and calculate how many miles per gallon the car gets. Determine whether any trips could have been combined ("chained") rather than taken out and back. Using the idea of trip chaining, determine how many miles and gallons of gas could have been saved in those seven days.
   3. Explain what is acid rain. In your explanation, tell how it affects plants and the environment and the steps society can take to help reduce its effects.

   C. Water Pollution
   1. Conduct an experiment to show how living things react to thermal pollution. Discuss your observations with your counselor.
   2. Conduct an experiment to identify the methods that could be used to mediate (reduce) the effects of an oil spill on waterfowl. Discuss your results with your counselor.
   3. Describe the impact of a waterborne pollutant on an aquatic community. Write a 100-word report on how that pollutant affected aquatic life, what the effect was, and whether the effect is linked to biomagnification.
D. Land Pollution
1. Conduct an experiment to illustrate soil erosion by water. Take photographs or make a drawing of the soil before and after your experiment, and make a poster showing your results. Present your poster to your patrol or troop.
   (2) Perform an experiment to determine the effect of an oil spill on land. Discuss your conclusions with your counselor.
2. Perform an experiment to determine the effect of an oil spill on land. Discuss your conclusions with your counselor.
3. Photograph an area affected by erosion. Share your photographs with your counselor and discuss why the area has eroded and what might be done to help alleviate the erosion.

E. Endangered Species
1. Do research on one endangered species found in your state. Find out what its natural habitat is, why it is endangered, what is being done to preserve it, and how many individual organisms are left in the wild. Prepare a 100-word report about the organism, including a drawing. Present your report to your patrol or troop.
2. Do research on one species that was endangered or threatened but which has now recovered. Find out how the organism recovered, and what its new status is. Write a 100-word report on the species and discuss it with your counselor.
3. With your parent's and counselor's approval, work with a natural resource professional to identify two projects that have been approved to improve the habitat for a threatened or endangered species in your area. Visit the site of one of these projects and report on what you saw.

F. Pollution Prevention, Resource Recovery, and Conservation
1. Look around your home and determine 10 ways your family can help reduce pollution. Practice at least two of these methods for seven days and discuss with your counselor what you have learned.
2. Determine 10 ways to conserve resources or use resources more efficiently in your home, at school, or at camp. Practice at least two of these methods for seven days and discuss with your counselor what you have learned.
3. Perform an experiment on packaging materials to find out which ones are biodegradable. Discuss your conclusions with your counselor.
4. Choose two outdoor study areas that are very different from one another (e.g., hilltop vs. bottom of a hill; field vs. forest; swamp vs. dry land). For BOTH study areas, do ONE of the following:
   A. Mark off a plot of 4 square yards in each study area, and count the number of species found there. Estimate how much space is occupied by each plant species and the type and number of nonplant species you find. Write
a report that adequately discusses the biodiversity and population density of these study areas. Discuss your report with your counselor.

B. Make at least three visits to each of the two study areas (for a total of six visits), staying for at least 20 minutes each time, to observe the living and nonliving parts of the ecosystem. Space each visit far enough apart that there are readily apparent differences in the observations. Keep a journal that includes the differences you observe. Then, write a short report that adequately addresses your observations, including how the differences of the study areas might relate to the differences noted, and discuss this with your counselor.

5. Using the construction project provided or a plan you create on your own, identify the items that would need to be included in an environmental impact statement for the project planned.

6. Find out about three career opportunities in environmental science. Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you (The Boy Scouts of America, 2008c).

Appendix D.1: Environmental Science merit badge requirements
APPENDIX E

QUOTES FROM OPEN ENDED SURVEY QUESTIONS
QUOTES FROM OPEN-ENDED SURVEY QUESTIONS

1) Merit Badges
   a) Do not help in school
      i) Don’t care, don’t pay attention
         (1) “because they boring (sic)” (6th)
         (2) “Because I never think about them in school.” (6th)
         (3) “I don’t pay atansyn. (sic)” (7th)
         (4) “I haven’t realy done any of those in school (sic)” (7th)
      ii) Not relevant
         (1) “because alout of the stuff I learn about ether not in school or I had already learned it. (sic)” (8th)
         (2) “ It has nothing to do with school.” (7th)
         (3) “Because we don’t learn these things in school.” (8th)
         (4) “unles thers a Math meret bage (sic)” (6th)
         (5) “It doesn’t have to do with Scouts.” (6th)
         (6) “It doesn’t change” (7th)
         (7) “I already did it” (6th)
         (8) “most of this isn’t covered in school” (11th)
      iii) Cover different topics
         (1) “What I do in school has nothing to do with any of the badges.” (10th)
         (2) ”Badges cover important things. School does not. The subjects are not covered in both.” “ Merit badges cover totally different (and more useful) things than school.” (entering 11th)
         (3) “It covers different and less information.” (9th)
         (4) “I don’t learn about areodynamics in school. (sic)” (7th)
         (5) “They do not teach subject related to merit badges (sic).” (entering 11th)
         (6) “While they do teach skills of self motivation and time management, they usually cover completely different topics than those taught in schools.” (entering 12th)
   iv) Don’t affect the grades
      (1) “It doesn’t help my grade (sic)” (6th)
   v) Don’t get to use what has been learned
      (1) “I never get to use anything I learn.” (entering 8th)
      (2) “During school I don’t think all the basic merit badges can help with my subjects. Now if someone needed first aid that’s different, but so far no.” (10th)
      (3) “Because the skills I learned haven’t really helped.” (6th)
   vi) Different
      (1) “Merit badges are fun and school isn’t.” (6th)
      (2) “I think that if you are good in school you will do well in merit badges.” (10th)
      (3) “Merit badges are easy, school is hard.” (6th grade)
b) Do help in school
   i) Prior knowledge/New facts
      (1) More knowledge
         (a) “They give me a larger knowledge and skill base.” (entering 9th)
         (b) “It teaches you facts you may have not learned yet.” (entering 10th)
         (c) “It supplements my studies.” (8th)
         (d) “Knowledge supplements school knowledge” (11th)
         (e) “you have pryer knologe (sic)” (8th)
         (f) “Gives you more knowledge” (9th)
         (g) “More knowledge for studies.” (6th)
      (2) An edge/ahead of the class
         (a) “It helps me in school because I learn ahead of the class.” (entering 7th)
         (b) “It helps because, for me I have a heads up on what I will learn later in school.” (6th)
         (c) “Because you are a step ahead in learning (sic)” (9th)
         (d) “because you have a little edge.” (6th)
         (e) “because then you know more” (6th)
         (f) “Because if were learning about it in scouts and school I can share a ton of facts to others. (sic)” (6th)
      (3) Do better in school
         (a) School
            (i) “It depends what merit badge and the subject in school.”(7th)
            (ii) “I can learn about things that are in both easily” (7th)
            (iii) “Yes because some of them have to do with what I learn in school.” (7th)
            (iv) “Because some merit badges are some classes in school.” (entering 7th)
         (b) Extra/Pre-knowledge
            (i) “Merit badges give me extra knowledge which help me in school. (sic)” (9th)
            (ii) “Because knowledge helps to understand a class better and have experience w/it.” (11th)
            (iii) “I feel that doing merit badges teaches you new things and in so doing helps you do better in school.” (entering 12th)
            (iv) “Pre-knowledge helps to understand a class better and have experience w/it.” (11th)
         (c) Home school
            (i) “Being homeschooled, they help me with my own teachings.” (11th)
            (ii) “Merit badges offer greater opportuinities in home scooiling (sic)” (12th)
(d) Grades
   (i) “because I know more of the stuff.” “It helps me get better grades.” (8th)
   (ii) “It helps you learn about it better and do better on the test like extra study time.” (entering 8th)
   (iii) “I think it gives us knolige for tests. (sic)” (6th)
   (iv) “Because in some classes the tests and quizes have to do with the stuff we learn in merit badges. (sic)” (6th)

ii) Understanding
   (1) “You understand more.” (7th)
   (2) “They help me remember things in school.” (9th)
   (3) “They further my knowledge.” (9th)
   (4) “It helps you learn more because things talk about at school may have been learn in boyscouts and may give you a better understanding. (sic)” (6th)
   (5) “You know the answers to a lot more questions. People consider me one of the smartest boys in the class.” (7th)
   (6) “I just know stuff that other people don’t.” (9th)

iii) Preparation
   (1) Preparation
      (a) “I have been prepared for things like siance (sic).” (entering 7th)
      (b) “Merit badges can prepare me for school work.” (7th)
      (c) “You will know wha to do dering clas. (sic)” (6th)
      (d) “It helped me and gave me background information for the next science I took.” (11th)
      (e) “Some details our teachers ask us are things that we cover by doing the merit badge.” (entering 10th)
      (f) “If we do a subject on the merit badge I know the basics.” (7th)
   (2) Learning
      (a) “I have learned more in fields such as science which helps in school.” (10th)
      (b) “The things that you learn during merit badges you can apply to school.” (10th)
      (c) “because I will now abot stuf that we learn. (sic)” (6th)
      (d) “u learn stuff you can use in school (sic)” (8th)
      (e) “Because some of them have to do with what I learn in school.” (7th)
      (f) “because when you do merit badges it will help you because you are learning more.” (6th)
      (g) “Because by doing merit badges you can learn things that can help you in school.” (6th)
      (h) “because it applies to what we are learning” (7th)

iv) Skills
   (1) School skills
      (a) “It gives more hands on activitys on subjects I’m studying (sic)” (10th)
(b) “The Badges help with how to study, and are helpful in different subjects. (sic)” (10th)
(c) “You learn a lot of new skills that could help you academically. (sic)” (7th)
(d) “Helps with hand writing and I would know things in class before they are taught. (sic)” (8th)
(e) “they help you read.” (7th)
(f) “because some of the skills help you, like math, SS, S.” (6th)
(g) “it helps me in math and science” (6th)
(h) “Taking merit badges helped me in school because some of the badges required research and writing.” (8th)

(2) Other skills
(a) “Because they help your mental skills.” (6th)
(b) “teach me many skills” (7th)
(c) “It teaches you how to do activities that helps you like being a leader! (sic)” (8th)
(d) “I have learned new skills that have helped me with many things” (8th)
(e) “You learn other skill (sic)” (10th)
(f) “Yes because it teaches you other skills.” (6th)
(g) “They help put uses to your skills in every day living” (12th)

v) Specific Badges/Subjects

(1) Badges
(a) “Citz. in community helps me in community/school activities.” (9th)
(b) “Personal Finance taught me a lot and I live with that knowledge.” (12th)
(c) “It will help me if we do a geology section in science class.” (7th)
(d) “Because the merit badges help you in a subject like geology helps you is since (sic)” (6th)
(e) “I did aviation badge and we talked about wind in scienc. (sic)” (8th)
(f) “After taking an aviation badge, I continued to write a report about planes in Language Arts and got an A+.” (6th)
(g) “I learned what mammals, reptiles, and amphibians do.” (6th)

(2) Subjects
(a) “I learn a lot by doing merit badges and they really helped me in life science” (9th)
(b) “It depends what merit badge and the subject in school.” (7th)
(c) “We are studying minerals in school.” (6th)
(d) “Some times it helps with activitys depending on what it is.(sic)” (9th)
(e) “Sometime it helps with some subjects and other times not (sic)” (8th)

vi) Help in future

(1) School
(a) “If you take science badges, it can help in science class by giving you the information long before you get to it in school.” (8th)
(b) “It helps because, for me I have a heads up on what I will learn later in school.” (6th)
(c) “It teaches you about safety and so does school.” (6th)
(d) “It helps me do better in school and outside school because it teaches me saftey and I learn a lot. (sic)” (7th)
(e) “Yes because it will help me in geolgy in science. (sic)” (6th)
(f) “Many of the merit badges are closely related to subjects at school. Learning those badges will give you a boost in school.” (8th)

(2) Life
(a) “Some merit badges help explain life.” (6th)
(b) “When taking merit badges you learn about many different things you may learn in school now or in the future.” (12th)

vii) Organization/Focus
(1) Mental
(a) “it can tran your Braun (sic).” (6th)
(b) “Because they help your mental skills.” (6th)
(c) “It helps me learn to study better & become more informed.” (9th)

(2) Focus/Organization
(a) “Doing merit badges help you to stay focused on school work.” (entering 7th)
(b) “They help me organize and better go through completing a task.” (9th)
(c) “Doing merit badges help you to stay focused on school work.” “It helps you learn to concentrate on what your doing. (sic)” (7th)
(d) “Because I am lising to summe one. (sic)” (6th)
(e) “helps me pay atencion. (sic)” (6th)

viii) Personal growth
(1) View/Connections
(a) “It gives you a wider view of everything.” (9th)
(b) “MB’s create a connection between learning pursuits and enjoyment put into completing them.” (11th)
(c) “You realize connections you wouldn’t have otherwise known.” (entering 12th)

(2) Personal growth
(a) “Some merit badges teach you things that are not taught in school.” (9th)
(b) “they make you a Better persone (sic)” (6th)
(c) “Doing merit badges teaches you self respect and dignity.” (entering 11th)
(d) “because I have to do them myself.” (7th)

2) Favorite Things
a) Camping
i) Special Reasons
(1) “I never go camping otherwise.” (entering 8th)
(2) “its the reason i joined. (sic)” (8th)
(3) “You get to see the world.” (6th)
(4) “Because it’s awsom. (sic)” (7th)
(5) “I don’t really know.” (6th)
(6) “We can run around but learn.” (7th)
(7) “We do it so often” (8th)
(8) “My troop camps a lot” (7th)
(9) “because I do” (6th)

ii) Fun
(1) Fun (fun in relationship to camping was cited 39 times, 22% of the 175 Scouts polled mentioned fun in relationship to camping.)
   (a) “It’s fun”
   (b) “fun just playing around” (8th)
   (c) “It is the most enjoyable & fun” (9th)
(2) Activities
   (a) “The camping and activities” “it is the most fun anyone can have.” (9th)
   (b) “I have nothing else to do on weekends and we do fun stuff.” (6th)
   (c) “Because they have camp fires and so much more fun things.” (7th)
   (d) “I like this best because it is an ativit is fun (sic)” (6th)
(3) Learning
   (a) “I have a lot of fun lerning how to do new things. (sic)” (10th)
   (b) “It gives me ability to learn and grow in a fun environment.” (11th)
      (i) “fun, time with friends” (10th)
(4) Friends
   (a) “It’s a lot of fun hanging around friends.” (7th)
   (b) “You get to have fun and interact.” (8th)

iii) Friends
(1) “It allows you to connect and have fun with other people.” (7th)
(2) “You get to have fun with your friends.” (cited many times)
(3) “Because i can be around my freinds (sic)” (6th)
(4) “Spend time with friends from other schools” (11th)
(5) “I get to hang out with friends” (9th)
(6) “Hanging out with friends” (9th)
(7) “I get to hang with all my friends in the troop.” (8th)

iv) Outdoors
(1) Fun
   (a) “It is really fun to be out in Nature.” (7th)
   (b) “we get to have fun and be outside” (7th)
(2) Outdoors/Outside
   (a) “beacus you are in the out doors. (sic)” (6th)
   (b) “I love the outdoors and being out in God’s creation.” (9th)
   (c) “because it’s with out doors. (sic)” (6th)
   (d) “to be outside and get all the fresh air.” (6th)
   (e) “I like collecting firewood and being outside.” (7th)
(f) “You get to be outside the city.” (6th)

(g) “I like to be outside.” (entering 10th)

(h) “because it is calm (sic)” (6th)

(i) “because I like the Out door & fellowship” (9th)

(j) “Because I like being outdoors and being with wild life.” (8th)

(k) “because I love the outdoors and hanging out with friends.” (10th)

(l) “I like this best because I love nature.” (7th)

(m) “I like the seasons.” (7th)

(n) “You get to stay out in the open air.” (8th)

v) Activities

   (1) “I like riding in cars with people.” (7th)
   (2) “because git to bo cool stuff (sic)” (6th)
   (3) “I like the wide variety of things offered at the outings.” (8th)
   (4) “exersize (sic)” (6th)
   (5) “Camping in the summer cause you get to go boating (sic).” (6th)
   (6) “I Do Becuse it’s hands on (sic)” (7th)
   (7) “I like this best because of the activitys (sic) my troop does.” (8th)
   (8) “Because you get to do fun activities.” (6th)

vi) Food/Sleep

   (1) “Badmition in free time and cooking (sic)” (11th)
   (2) “Because you can sleep in the great outdoors and home cooked meals.” (6th)
   (3) “I tend to sleep better than at home.” (10th)
   (4) “I like to sleep under the stars.” (entering 7th)
   (5) “You get to Leave home and sleep” (9th)
   (6) “I get to cook and see friends.” (6th)

vii) Escape

   (1) “Time away from home.” (entering 10th)
   (2) “I get to get away from my siblings and the activities are always fun.” (6th)
   (3) “because you get to do almost everything on your one (sic)” (6th)
   (4) “I’m with friends and can do stuff I can’t at home.” (7th)

viii) Adventure

   (1) “I like this the best because it’s an adventure.” (7th)
   (2) “You get to explore.” (entering 6th)

b) Outdoors

   i) “I like being outdoors and enjoy being outdoors.” (entering 6th)
   ii) “What you experience in the wilderness is nothing like a town or busy city.” (9th)
   iii) “I like the outdoors because I’m away from everything and it just gives me a break.” (6th)
   iv) “because it is calm (sic)” (6th)
   v) “Better than Being inside” (11th)
   vi) “Better than indoors.” (10th)
vii) “Because it interests me” (11th)
viii) “It’s funner than playing video games” (11th)
c) Merit Badges
i) Learn
   (1) “Because many Scouts LEARN their job.” (entering 7th)
   (2) “You know more things than anyone else.” (entering 12th)
   (3) “They give you more to do in the BSA. You also learn a variety of stuff that would seem non-Boy Scout related (ex: Computers, Graphic Arts, Entrepreneurship. (sic)” (12th)
   (4) “It is fun to do and learn different.” (6th)
   (5) “Because there is two merit badges that are related to science” (7th)
ii) Other
   (1) “You meet new people.” (8th)
   (2) “They can be fun.” (8th)
d) Knowledge/Learning
i) Fun
   (1) “Because it is funner to learn with friends. (sic)” (6th)
   (2) “Having fun learning. Because I think its better than sitting down bored. (sic)” (7th)
ii) Survival/Future
   (1) “I’ll learn what I want to do when I’m older. I’ll help me with getting a good job. (sic)” (7th)
   (2) “It teaches you how to survive in life. Because, you should be prepared for what life gives you.” (7th)
   (3) “Learning to survive” “its important to know if you get lost one day in the woods (sic)” (6th)
   (4) “because learning and working makes me strong and I love to learn.” (7th)
e) Friends/People
i) Friends
   (1) “Because I am an extrovert.” (entering 9th)
   (2) “Seeing friends because I don’t see them in school.” (8th)
   (3) “So I can socialize.” (6th)
   (4) “my patrol” “they are good people.” (6th)
   (5) “I like it because I have a lot of friends.” (7th)
   (6) “Fellowship” “Scouts is the time I spend with friends the most.’ (11th)
   (7) “frindes” “you see frindes (sic)” (6th)
   (8) “Meeting friends, going to XXX summer camp. I feel these are the most fun things to do in Scouting.” (10th)
ii) New people/help people
   (1) “Meeting new people. You have many friends to push you to eagle. (sic)” (10th)
   (2) “Meeting new people. I like meeting new people because you learn new things.” (12th)
(3) “Meeting new people. Meeting new people exposes you to different ideas and cultures.” (12\textsuperscript{th})
(4) “You get to meet people you don’t get to every day” (10\textsuperscript{th})
(5) “Getting to help people (sic)” “Because it makes me feel good.” (7\textsuperscript{th})

iii) Fun
(1) “Its (sic) fun to talk.” (6\textsuperscript{th})
(2) “Because you learn things in a fun way.” (entering 10\textsuperscript{th})
(3) “hanging out with my friends” “because it is fun” (9\textsuperscript{th})

f) Summer Camp
i) “It is fun.” (8\textsuperscript{th})
ii) “We have cooler thing to do at camp. (sic)” (6\textsuperscript{th})
iii) “It is fun and active.” (8\textsuperscript{th})
iv) “because it Rocks.” (6\textsuperscript{th})
v) “It’s fun. You can do whatever you want and the staff” (9\textsuperscript{th})
vi) “It is a fun way to be with your friends that are in Scouts.” (8\textsuperscript{th})
vii) “They vary in what you do” (9\textsuperscript{th})

g) Activities
i) “Its fun. (sic)” (7\textsuperscript{th})
ii) “It is fun to work with other scouts.” (7\textsuperscript{th})
iii) “Activities and camping, because without these I would not be in boy scouts. (sic)” (6\textsuperscript{th})
iv) “We do fun things, learn, and camp. It is what I like to do.” (8\textsuperscript{th})
v) “I get to go to OSU games” “because it is fun.” (6\textsuperscript{th})
vi) “Haunted trail” “I can scare people” (6\textsuperscript{th})

h) Hiking
i) “I walk a lot at home.” (6\textsuperscript{th})
ii) “backpacking” “You get to see things like wildlife, and rock formations you can’t see car camping.” (10\textsuperscript{th})
iii) “Because I like hiking” (7\textsuperscript{th})

i) Travel
i) “I see the world (well, in North America). Most people don’t get to experience it.” (entering 10\textsuperscript{th})
ii) “The placis you go becuis most of them are fun (sic).” (6\textsuperscript{th})

j) Adventure
i) “Going places and doing dangerous or not-normal things.” (11\textsuperscript{th})
ii) “It is fun to go places and camp.” (6\textsuperscript{th})
iii) “High adventure” “because it gives you a greater rush.” (entering 12\textsuperscript{th})
iv) “High Adventure, camping in extremes. I enjoy challenging myself.” (12\textsuperscript{th})

k) Ranks
i) “because its like the milatary (sic)” (6\textsuperscript{th})
ii) “They are fun” (5\textsuperscript{th})
I) Other
   i) “Uniform,” “I look cool.” (7th)
   ii) “nothing” “You do nothing” (6th)
   iii) “getting out of the house” “I get bored a lot” (6th)
   iv) “building fires” “because you can be able to cook.” (entering 7th)

Appendix E.1: Quotes from open-ended survey questions.
<table>
<thead>
<tr>
<th></th>
<th>Strong Preference</th>
<th>Preference</th>
<th>It Depends</th>
<th>Preference</th>
<th>Strong Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sound</strong></td>
<td>15 (42%)</td>
<td>2 (5%)</td>
<td>7 (20%)</td>
<td>1 (2%)</td>
<td>10 (28%)</td>
</tr>
<tr>
<td>Quiet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Light</strong></td>
<td>13 (37%)</td>
<td>2 (5%)</td>
<td>10 (28%)</td>
<td>2 (5%)</td>
<td>8 (22%)</td>
</tr>
<tr>
<td>Dim</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>9 (25%)</td>
<td>1 (2%)</td>
<td>12 (34%)</td>
<td>0%</td>
<td>13 (37%)</td>
</tr>
<tr>
<td>Warm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Seating</strong></td>
<td>16 (45%)</td>
<td>2 (5%)</td>
<td>8 (22%)</td>
<td>0%</td>
<td>9 (25%)</td>
</tr>
<tr>
<td>Informal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td>5 (14%)</td>
<td>2 (5%)</td>
<td>16 (45%)</td>
<td>8 (22%)</td>
<td>4 (11%)</td>
</tr>
<tr>
<td>Self-Motivated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conformity</strong></td>
<td>5 (14%)</td>
<td>4 (11%)</td>
<td>14 (40%)</td>
<td>5 (14%)</td>
<td>7 (20%)</td>
</tr>
<tr>
<td>Less Conforming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Task Persistence</strong></td>
<td>11 (31%)</td>
<td>6 (17%)</td>
<td>11 (31%)</td>
<td>0%</td>
<td>7 (20%)</td>
</tr>
<tr>
<td>Less Persistent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Structure</strong></td>
<td>6 (17%)</td>
<td>5 (14%)</td>
<td>13 (37%)</td>
<td>1 (2%)</td>
<td>10 (28%)</td>
</tr>
<tr>
<td>Prefers Less Structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alone/Peer</strong></td>
<td>11 (31%)</td>
<td>0%</td>
<td>11 (31%)</td>
<td>2 (5%)</td>
<td>11 (31%)</td>
</tr>
<tr>
<td>Alone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Authority</strong></td>
<td>8 (22%)</td>
<td>4 (11%)</td>
<td>11 (31%)</td>
<td>5 (14%)</td>
<td>7 (20%)</td>
</tr>
<tr>
<td>Prefers Less Authority</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Variety</strong></td>
<td>11 (31%)</td>
<td>5 (14%)</td>
<td>6 (17%)</td>
<td>3 (8%)</td>
<td>10 (28%)</td>
</tr>
<tr>
<td>Prefers Less Variety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Auditory</strong></td>
<td>4 (11%)</td>
<td>5 (14%)</td>
<td>14 (40%)</td>
<td>7 (20%)</td>
<td>5 (14%)</td>
</tr>
<tr>
<td>Does Not Learn best by Listening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td>2 (5%)</td>
<td>1 (2%)</td>
<td>10 (28%)</td>
<td>7 (20%)</td>
<td>15 (42%)</td>
</tr>
<tr>
<td>Does Not Learn best by Seeing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Kinesthetic</strong></td>
<td>11 (31%)</td>
<td>4 (11%)</td>
<td>8 (22%)</td>
<td>2 (5%)</td>
<td>10 (28%)</td>
</tr>
<tr>
<td>Does Not Learn best by Moving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tactile</strong></td>
<td>2 (5%)</td>
<td>3 (8%)</td>
<td>6 (17%)</td>
<td>3 (8%)</td>
<td>21 (60%)</td>
</tr>
<tr>
<td>Does Not Learn Best by Touching</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Intake</strong></td>
<td>3 (8%)</td>
<td>2 (5%)</td>
<td>10 (28%)</td>
<td>1 (2%)</td>
<td>19 (54%)</td>
</tr>
<tr>
<td>Does Not Need Intake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Morning/Evening</strong></td>
<td>1 (2%)</td>
<td>2 (5%)</td>
<td>13 (37%)</td>
<td>3 (8%)</td>
<td>16 (45%)</td>
</tr>
<tr>
<td>Prefers Morning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Late Morning</strong></td>
<td>9 (25%)</td>
<td>6 (17%)</td>
<td>17 (48%)</td>
<td>0%</td>
<td>3 (8%)</td>
</tr>
<tr>
<td>Does Not Prefer Late Morning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Afternoon</strong></td>
<td>4 (11%)</td>
<td>2 (5%)</td>
<td>13 (37%)</td>
<td>2 (5%)</td>
<td>14 (40%)</td>
</tr>
<tr>
<td>Does Not Prefer Afternoon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mobility</strong></td>
<td>6 (17%)</td>
<td>2 (5%)</td>
<td>8 (22%)</td>
<td>7 (20%)</td>
<td>12 (34%)</td>
</tr>
<tr>
<td>Stationary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reflective / Impulsive</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reflective</td>
<td>10 (28%)</td>
<td>2 (5%)</td>
<td>11 (31%)</td>
<td>6 (17%)</td>
<td>6 (17%)</td>
</tr>
<tr>
<td>Impulsive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Analytic/Global</strong></td>
<td>0%</td>
<td>1 (2%)</td>
<td>8 (22%)</td>
<td>7 (20%)</td>
<td>19 (54%)</td>
</tr>
<tr>
<td>Analytic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Learning Style: The Clue to You! (LS:CY) © 1998 by Burke and Dunn.

Appendix F.1: Learning Styles of Scouts
Cluster analysis searching for “Typical Scout”
Final Cluster Centers

<table>
<thead>
<tr>
<th></th>
<th>Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Sound</td>
<td>3</td>
</tr>
<tr>
<td>Light</td>
<td>3</td>
</tr>
<tr>
<td>Temperature</td>
<td>3</td>
</tr>
<tr>
<td>Seating</td>
<td>2</td>
</tr>
<tr>
<td>Motivation</td>
<td>4</td>
</tr>
<tr>
<td>Conformity</td>
<td>3</td>
</tr>
<tr>
<td>Task persistence</td>
<td>2</td>
</tr>
<tr>
<td>Structure</td>
<td>3</td>
</tr>
<tr>
<td>Alone/Peer</td>
<td>4</td>
</tr>
<tr>
<td>Authority</td>
<td>3</td>
</tr>
<tr>
<td>Variety</td>
<td>3</td>
</tr>
<tr>
<td>Auditory</td>
<td>3</td>
</tr>
<tr>
<td>Visual</td>
<td>4</td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>3</td>
</tr>
<tr>
<td>Tactile</td>
<td>4</td>
</tr>
<tr>
<td>Intake</td>
<td>5</td>
</tr>
<tr>
<td>Morning/Evening</td>
<td>5</td>
</tr>
<tr>
<td>Late Morning</td>
<td>2</td>
</tr>
<tr>
<td>Afternoon</td>
<td>5</td>
</tr>
<tr>
<td>Mobility</td>
<td>4</td>
</tr>
<tr>
<td>Reflective/Impulsive</td>
<td>3</td>
</tr>
<tr>
<td>Analytic/Global</td>
<td>4</td>
</tr>
</tbody>
</table>

Appendix F.2: Cluster Analysis Results of the Learning Styles of Scouts
Distances between Final Cluster Centers

<table>
<thead>
<tr>
<th>Cluster</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>4.644</td>
<td>5.230</td>
</tr>
<tr>
<td>2</td>
<td>4.644</td>
<td></td>
<td>5.589</td>
</tr>
<tr>
<td>3</td>
<td>5.230</td>
<td>5.589</td>
<td></td>
</tr>
</tbody>
</table>

Appendix F.3 Distances Between Final Cluster Centers

Number of Cases in each Cluster

<table>
<thead>
<tr>
<th>Cluster</th>
<th>1</th>
<th>15.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>6.000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14.000</td>
<td></td>
</tr>
<tr>
<td>Valid</td>
<td>35.000</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>.000</td>
<td></td>
</tr>
</tbody>
</table>

Appendix F.4: Number of Scouts in each Learning Style Cluster
The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

Appendix F.5: Cluster Analysis Statistics Learning Styles of Scouts
Cluster Analysis for Best Learning Modality for Scouts

Final Cluster Centers

<table>
<thead>
<tr>
<th></th>
<th>Cluster</th>
<th>Number of cases in each cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>10.000</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>15.000</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>10.000</td>
</tr>
<tr>
<td></td>
<td>Valid</td>
<td>35.000</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Cluster</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditory</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tactile</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Appendix F.6: Cluster Analysis for the Best Learning Modality for Scouts
APPENDIX G

TESTING INSTRUMENT
GEOLOGY ASSESSMENT

First name and last initial ________________________________

Please circle one:

Pretest (prior to Geology Merit Badge instruction) or Posttest (after Geology Merit Badge instruction).

Please answer the following questions by circling the **BEST** answer.

1- Which of these can determine the size of grains in igneous rocks?
   a- Amount of rare minerals
   b- Distance from a plate boundary
   c- Size of the volcano
   d- Cooling rate of molten rock

2- Which of the following properties refers to the colored powder resulting from rubbing a mineral against a harder surface?
   a- Hardness
   b- Luster
   c- Cleavage
   d- Streak

3- Metamorphic rocks whose minerals are arranged in layers or bands are called _____
   a- unfoliated
   b- nonclastic
   c- clastic
   d- foliated

4- Heat and pressure can transform igneous rock into metamorphic rock. What processes can transform igneous rock into sedimentary rock?
   a- Heat and pressure
   b- Rifting and subduction
   c- Erosion and sedimentation
   d- Evaporation and condensation

5- Which rock type most often contains numerous fossils?
   a- Igneous
   b- Sedimentary
   c- Metamorphic
   d- All of the above
6- Ricardo has an igneous rock in his rock collection. Where was this rock most likely formed?
   a- In a volcano
   b- On a forest floor
   c- On a coral reef
   e- At the bottom of the river

7- Which of the following is one reason that quartz is classified as a mineral?
   a- It can be manufactured
   b- It comes in different colors.
   c- It has specific crystal structure.
   d- It can be melted in high temperature.

8- Rocks are classified as igneous, sedimentary, or metamorphic based primarily on their
   a- geographic location
   b- grain size
   c- method of formation
   d- mineral composition

9- The internal crystal structure of a mineral most likely determines the mineral’s
   a- color, streak, and age
   b- origin, exposure, and fracture
   c- size, location, and luster
   d- hardness and cleavage

10- Which common rock is formed from the solidification of molten material?
    a- sandstone
    b- granite
    c- slate
    d- coal

11- To a geologist, the term “texture” is used to describe
    a) cleavage
    b) the size of the grains that form a rock
    c) the ability of a rock’s surface to reflect light

12- “Cleavage” is a property used to identify
    a) minerals
    c) soils
    b) rocks
    d) fossils
13- In the rock cycle, which type of rock can be melted to form magma?
   a) igneous rocks  
   b) sedimentary rocks  
   c) metamorphic rocks  
   d) all rocks

14- Earth material moves through the rock cycle only once, and then is permanently destroyed.
   a) true  
   b) false

15- Using the picture below to answer this question: Which rock layer is older?
   a- A  
   b- B

16- The principle of ____ says that the _____ rocks are at the bottom of an undisturbed sequence and the ____ rocks are at the top of that sequence.
   a) original horizontality; oldest; youngest  
   b) superposition; oldest; youngest  
   c) cross-cutting relations; youngest; oldest  
   d) original horizontality; youngest; oldest

17- All rocks are made of crystals or grains that are large enough to be seen without using a microscope or hand lens.
   a) true  
   b) false
18- The two major characteristics used to name an igneous rock are
   a) color and texture
   b) composition and streak
   c) cleavage and luster
   d) fracture and crystal habit

19- Sedimentary rocks most commonly provide information about the Earth’s _____;
   metamorphic rocks most commonly provide information about the earth’s ____.
   a) interior; surface
   b) surface; surface
   c) surface; interior
   d) interior; interior

Base your answers to questions 20 through 21 on the geologic cross section of bedrock shown below. A through G identify rock layers and Q represents a fault. Lines W, X, Y, and Z are locations of unconformities. The rocks have not been overturned.

20- Which rock or feature is oldest?
   a- rock A
   b- rock G
   c- fault Q
   d- unconformity Z
21- The unconformities shown in the cross section represent
   a- buried erosional surfaces 
   b- locations of index fossils 
   c- volcanic ash deposits 
   d- boundaries between oceanic and continental crust

22- Which of the following is a naturally occurring earth material that is used as a resource by humans?
   a) diamonds  
   b) clay  
   c) gypsum 
   d) all of the above  
   e) none of the above

23- This is a picture of
   a. The nitrogen cycle  
   b. Volcano formation  
   c. The rock cycle  
   d. Water cycle

Thank you so much for agreeing to be in this research study. You have done a good turn for me and for the Boy Scouts today. Thank you.

Appendix G.1: Testing Instrument for testing geology content knowledge