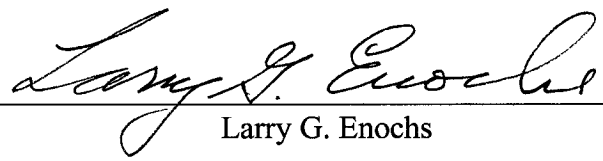
AN ABSTRACT OF THE THESIS OF

Vincent M. Smith for the degree of Masters of Science in Environmental Sciences presented on December 3, 2004.

Title: The Role of Formative Outdoor and Family Experiences on Environmental Belief Formation in Children and This Role's Implications for Environmental Education.

Abstract approved:



Larry G. Enochs

The purpose of this research was to determine the role of formative experiences in the home and family pertaining to environment on children's overall environmental beliefs. Students attending environmentally related and non-environmentally related summer camps at a children's science museum served as test subjects in this study. A written instrument was constructed for determining both environmental belief and level of prior experience with environment in the home. Students filled out the written instrument at the beginning of the first day of a five day

camp, at the end of the last day of camp, and six weeks after camp. In addition, select students were invited to participate in personal interviews.

All formative experiences chosen for investigation such as talking about the environment with family and spending time outdoors with family were found highly correlated with environmental beliefs and useful in an equation to model environmental beliefs. Students participating to a greater degree in the formative experiences under investigation were shown to have more pro-environmental beliefs in all iterations of the written instrument. However, these formative factors were found only moderately correlated and responsible for change in environmental belief over the period of an environmental education (EE) camp.

Students participating in an environmental education camp were found to differ meaningfully in their environmental beliefs from non-participating students after a summer camp program and again six weeks later. However, the changes in environmental belief for environmental education students were not found to statistically increase over the five day period. It is proposed that the EE experience served to stabilize environmental beliefs while the beliefs of non-EE students unexpectedly decreased over the five days.

In both the post-test and delayed post-test a measurement of family involvement was found more correlated with environmental belief than any demographic or other factor including whether the student participated in an environmental education camp.

Findings are used to inform existing models for understanding the formation of environmental beliefs as well as used to suggest changes in the current state of environmental education. Specific recommendations are given for ways to utilize the family and home as both a target for EE and as a source of EE.

The Role of Formative Outdoor and Family Experiences on Environmental Belief Formation in Children and This Role's Implications for Environmental Education

by
Vincent M. Smith

A THESIS

submitted to

Oregon State University

In partial fulfillment of
the requirements for the
degree of

Masters of Science

Presented December 3, 2004
Commencement June 2005

Masters of Science thesis of Vincent M. Smith presented on December 3, 2004.

APPROVED:

Major Professor, representing Environmental Sciences

Director of the Environmental Sciences Program

Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Vincent M. Smith, Author

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation for a knowledgeable and considerate committee. To Dr. Larry Enochs, Dr. Lori Cramer, Dr. Lynn Royce, Dr. Alex Stone, and Dr. Tony Vogt I extend a personal thank you.

I would also like to thank Dr. John Falk of the Institute for Learning Innovation for his time and effort in guiding this work. Acknowledgement is likewise extended to Dr. Kathleen Dean Moore for her creative inspiration and to Dr. Michael Kelrick for being a long time friend and mentor.

Finally, I wish to thank my wonderful wife, Tamara and our son, Ilan for their support and patience. To my family I owe the credit for this work. They have been both the inspiration and the reason for my commitment.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

Figure | Page

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

THE ROLE OF FORMATIVE OUTDOOR AND FAMILY EXPERIENCES ON ENVIRONMENTAL BELIEF FORMATION IN CHILDREN AND THIS ROLE'S IMPLICATIONS FOR ENVIRONMENTAL EDUCATION

CHAPTER 1

INTRODUCTION

> "If a child is to keep alive his inborn sense of wonder without any such gift from the fairies, he will need the companionship of at least one adult who can share it, rediscovering with him the joy, excitement, and mystery of the world we live in."
>
> ----Rachel Carson (Carson 1956, p.55)

DESCRIPTION OF PROBLEM

The number of non-formal educational initiatives designed to affect environmental knowledge, attitudes, and behaviors is increasing (National Environmental Education Advisory Council 1996). Simmons collected data from over 1,200 different non-formal U.S. environmental education centers in her work in 1991 (Simmons 1991). However, research indicates that many of these initiatives are not universally effective at altering beliefs long-term (Leeming, Dwyer et al. 1993). If interventions are only selectively effective then it is important to understand how educational, social, personal, and other factors affect the results of an environmental education initiative and what changes could be made to make these interventions more effective at altering belief systems (Knapp 1972; Hines, Hungerford et al. 1986; Eagles and Demare 1999; Hwang, Kim et al. 2000)

A growing body of significant life experiences (SLE) research has attempted to identify those formative life experiences responsible for the development of pro-environmental beliefs. However, this body of research does not appear to have been

applied to understanding the effectiveness a non-formal EE initiative. SLE research suggests that educational initiatives in addition to time spent outdoors, the influence of family, and several other formative factors are responsible for the development of pro-environmental beliefs (Chawla 1998).

The role of structured educational initiatives to affect environmental beliefs is not yet fully understood. Overall, little effort has been given to assessing the effectiveness of EE (NEEAC, 1996). The National Environmental Education Advisory Council has called for further development in this field in their reports to Congress (NEEAC, 1996). A variety of methods are endorsed as effective models for facilitating an education with a goal to alter knowledge, attitudes, and behaviors around the natural environment. It is unclear which, if any, of these initiatives are effective in altering environmental beliefs and whether this effectiveness is a result of the program or factors already determined by external development.

Despite the relative lack of EE evaluation, several studies have attempted to evaluate the effect of both formal and non-formal EE on knowledge, attitude, and behavior change and are reviewed in Chapter 2. These evaluations often find meaningful effects on knowledge (Culen and Mony 2003), attitudes (Dresner and Gill 1994), or behaviors (Aird and Tomera 1977). However, just as often, they find no meaningful effects (Kostka 1976; Armstrong and Impara 1991; Leeming, Dwyer et al. 1993). Many find complex relationships between attitude, knowledge, and behavior and may find the program only successful at one or more of these outcomes (Keiffer 1992; Culen and Mony 2003). Several studies demonstrate that while facilities may

have an effect on knowledge, there is little or no effect on attitude and behavior (Culen and Mony 2003). It has also been found that a change in attitude may not predict a change in behavior (Bickman 1972). Research suggests that while a few programs may be effective at altering beliefs short-term, long-term changes are rare.

In addition to selective effectiveness between EE programs, there may also be reason to consider that EE programs are selectively effective within the class population. Although this phenomenon is often removed by testing for a mean class effect, this observation has been reported (Kostka 1976). If students are not universally affected by a specific EE program, then factors outside of the program itself are contributing to the potential for the EE program to reach its goals.

International meetings hosted by the United Nations and national research on the part of the North American Environmental Education Association have developed standards for environmental education (UNESCO-UNEP, 1976) (UNESCO-UNEP, 1978) (NAAEE, 2000). In order to meet these standards it will be necessary to understand the specific factors influencing the success of EE to meet its objectives.

Therefore, while environmental education facilities continue to expand and reach the lives of more students each year, it is uncertain whether they are having any effect. The lack of conclusive evidence of program effectiveness suggests that not all methods are meeting their objectives and not all individuals are being reached. It is still unclear which, if any, of these efforts warrants continued development and funding. A more thorough understanding of those factors contributing to pro-environmental beliefs and to program success will inform these important decisions.

SPECULATIONS

There are likely many reasons why initial assessments have shown mixed results as to effectiveness in altering attitude, knowledge and behavior:

1. The methods and content utilized in EE programs are diverse and include summer camps, museum visits, wilderness expeditions, and class presentations all on a variety of topics. It may be that these diverse methods are not all universally effective (Leeming, Dwyer et al. 1993). Thus, it is likely that determining factors related to the success of an initiative itself is important. Recent research suggests that while EE has provided knowledge of issues, it has not equipped students with the skills to act on that knowledge. Other factors including the length of the experience and location of experience are also likely factors affecting program success (Bogner 1998).
2. The tools being used to assess knowledge, attitudes, and behaviors are often not tested for validity or reliability. Many of the evaluations have employed simple Likert style assessments that may fall short of determining attitudes and may not be useful in predicting behavior (Moorcroft, Desmarais et al. 2000).
3. Factors not directly related to the EE experience are important in determining success (Eagles and Demare 1999). These factors which include parental support, place of residence, social norms, prior experiences, etc. may be important factors in the EE process.

These factors may serve to prepare or inadequately prepare a student for an intervention and assist in retention or aid in the abandonment of ideas presented at an EE program.

4. It is also possible that these programs are having little or no impact on their students. The assessments that have demonstrated positive change may have been assessing the result of something other than the program; a specific individual, re-testing effects, current events, etc.

5. Finally, it is a possibility that non-formal programs that claim to provide an environmental education do not share any of the widely accepted goals of EE. These programs may profess to engage in EE, but may not address the standards or goals of EE as a discipline.

Although a series of possible explanations exist for the discrepancy in EE effectiveness, this research explores those factors not directly related to the program itself, or area three above. While differences in the style and content of the programs themselves are certainly important factors, often overlooked factors include the personal and environmental factors found in the home before, during, and after the educational intervention. These factors, which are themselves educational initiatives, may be important factors in understanding the success of a non-formal environmental education initiative.

It might be assumed that families with pro-environmental attitudes and behaviors will tend to raise children with those same values. However, this

assumption does not appear to be playing a large role in program design. Furthermore, this same logic does not suggest what effect those values might have on program success. The learning that takes place at an environmental education initiative is connected to learning taking place in the home, the classroom, the playground, the TV, etc. It is suggested that the learning experiences in the home before, during, and after the intervention are factors associated with any potential for change. Thus, while two students' beliefs before the intervention may be nearly the same, the family and home experiences before the intervention will affect the magnitude of the change after the intervention. This also suggests that while a student with pro-environmental beliefs before a program is likely to have pro-environmental beliefs after the program, the magnitude of any change will differ depending on family and home learning. Furthermore, these factors may play a role in stabilizing environmental beliefs or in assisting students in understanding their beliefs.

By investigating the family and home factors associated with program effectiveness it will be possible to identify factors correlated with potential initiative success as well as estimate the magnitude of these effects relative to the effects of changing programs and curricula. This research assumes the possibility that distinct strands of activity, teaching, and experience in the home or with the family have an effect on environmental beliefs and can be used as predictors of a student's potential to be influenced by and retain a pro-environmental message. The assumption is based in part on the growing body of research on significant life experiences reported by

individuals who are active in environmental issues as responsible for their environmental sensitivity (Tanner 1980; Chawla 1998)

PURPSE OF STUDY

The purpose of this study is to identify and describe factors associated with the development and retention of environmentally responsible knowledge, attitudes, and behaviors in children. The factors primarily in question in this research are those factors influencing the child in the home and family before, during, and after a program rather than those factors associated with a specific intervention.

This study will assess the pro-environmental knowledge, attitudes, and behaviors (or beliefs) of students before and after a non-formal EE program and attempt to identify patterns in the home teaching and family exploration of the environment before and after the program. One principle assumption of this research is that learning is a life-long process and thus, the learning and experiences in the home and family before, during, and after a non-formal EE program will influence the success of the program itself (Knapp 1972; Orion and Hofstein 1994; Falk and Dierking 2002).

Several studies have attempted to describe formative experiences thought to have influenced the pro-environmental behavior of environmental activists (Chawla 1998). While this body of research has used a retrospective approach to gathering data about specific individuals thought to represent an ideal, it is used here to describe the significant life experiences presently influencing learning behavior. Significant life experience ideas and theory are used here in connection with life long learning

theories to attempt to describe how these past, present, and future experience will influence educational initiatives.

This study will attempt to identify and describe factors or patterns of family and home activity as a tool for EE improvement both in the home and at the non-formal institution. These factors will then be used to model the implications of these factors on EE and its goals to encourage pro-environmental beliefs.

OVERVIEW OF DESIGN

This research will attempt to determine family and home life factors associated with acquisition and retention of pro-environmental beliefs of 3rd-8th grade students attending a week long day camp at a children's science museum (The Science Factory) in Eugene, OR. Students attending camps focused on environmental education will serve as experimental groups while others having no objective to address this focus will serve as controls for the attitude/behavior assessment. Students will be assessed using an attitude and behavior scale before, after, and six weeks after the camp. Students will also be interviewed during the camp to explore family and home life factors contributing to their development and retention of pro-environmental beliefs. Summer camp classes generally range in size from 5 to 14 students per class who attend by family or individual choice. The relatively small class sizes, field components, and potential overnights allow for close interaction between the instructor and students. The researcher serves as the instructor for three of the experimental groups.

Therefore, this research engages in two dependent studies. The first is a quantitative study using questionnaires to determine pro-environmental beliefs and family and home life factors. The second is a qualitative study of environmental beliefs and family and home life factors utilizing interviews with students. The combined studies will be used to explain and model some portion of the selective effectiveness of an EE program between students through a description of the family and home life factors affecting the student before, during, and after the program.

LIMITS AND BOUNDARIES

The students who will be engaged in this assessment all live in or near Eugene, Oregon. The site and courses for study were chosen for convenience. Furthermore, these students participate by choice or family choice and are therefore, a unique population. As such, the inferences of this study cannot be extended beyond the students involved. Furthermore, the researcher serves as the instructor at the center and must therefore admit a bias in the study. Despite the inherit limits to the inferences that can be drawn, in-depth analysis of factors contributing to pro-environmental beliefs appear lacking in the literature. Most data has been collected through written attitude surveys and are free of rich data collected through interview and observation.

The focus of this research is not to assess the quality of the EE program, the instructor's effectiveness, or non-formal EE in general; but rather, it is an assessment of external factors contributing to the effective potential of the program. Although data will be collected on the effect of the program, it is not meant as an absolute

measurement of effectiveness or outcome. Its intent is to serve to determine the degree to which any individual is being affected relative to the others in the population. This data can serve as a variable against which to compare trends in family and home teaching and activity.

Any factors identified as associated with the ability of a program to alter environmental beliefs are not meant necessarily to imply causal factors. It is not the intent of this research, for example, to prove that talking about the environment at home is the cause of success in the non-formal program to alter behavior. Rather, it is the intent of this research to identify any such factors and recommend them as one of many possible pathways toward change.

The family and home are only one subset of many sets of external factors that may play a role indirectly in influencing program potential. However, it was necessary to limit the scope of the research questions to reduce the length of interviews and types of questions asked. Furthermore, it has already been demonstrated that altering the program itself can affect program outcome (Leeming, Dwyer et al. 1993). This research will not explore factors related to the initiative itself, although they are recognized as extremely important.

Students in this study will be assessed for environmental beliefs before, after, and six weeks after a non-formal EE initiative. Thus, any affect can only be said to persist after six weeks. Given additional time, it would be important to re-test after additional time has lapsed. Most studies have not included any follow up tests to assess the ability of students to retain post-test beliefs (Crater and Mears 1981;

Shepard and Speelman 1986; Armstrong and Impara 1991). It is hoped that a six week delay will provide evidence of selective persistence among students.

This small case study will suggest factors that may be examined in more depth with larger and or more diverse populations in later studies. One important strength of the study is the degree to which the researcher and students interact and the students can be observed. This approach can produce rich and valid data regarding beliefs and the personal and environmental factors associated with them that could not be understood in a larger study.

Research and research considerations have been restricted to non-formal EE initiatives. Although any family and home factors found associated with EE effectiveness are likely important considerations in formal education, this research does not focus on this form of education. The style and intended outcomes in non-formal education are often different than in formal education and may be influenced by a different set of factors. In addition, this non-formal setting is also potentially free-choice. In a setting where learning and participation are motivated by external rather than internal factors, the factors identified here may play more or less of a role.

DEFINITION OF TERMS

"**Environmental Education (EE)** is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solutions." (Stapp 1969). It was later defined internationally by UNESCO-UNEP as "develop(ing) a world population that is aware of, and concerned about, the

environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones." (Barry 1976) The researcher sees these two definitions as consistent, still widely agreed upon as appropriate definitions, and appropriate for this research.

Home and Family Factors are the personal and environmental factors designed or utilized by the individual or individuals responsible for the development of the child. It includes the relationships and interactions both within and without the home with those who are responsible for development and the environments designed for development alone or with others. These factors might be broken down into the following categories:

1. Interactions with parents or guardians
2. The environments designed or utilized by parents or guardians
3. The experiences provided by parents or guardians

This definition has been self-defined to place limits on the types of questions and factors explored in this research and is based on personal experience and previous attempts to identify such factors (Tanner 1980; Chawla 1998; Eagles and Demare 1999).

Pro-environmental beliefs are the understandings, attitudes, and behaviors of an individual that lend themselves to meeting the objectives of EE as outlined by UNESCO- UNEP (Barry 1976; UNESCO/UNEP 1978). A student meeting these objectives and standards might be summarized as being:

1. Aware of the total environment and its problems
2. Knowledgeable of these problems
3. Possessing strong feelings, concerns, and motivation to protect and improve the environment.
4. Skilled in solving environmental problems
5. Able to evaluate environmental measures
6. Participating in solving these problems

For the purposes of this research, the specific beliefs necessary to reach the above objectives are derived from the K-12 EE Standards (National Project for Excellence in EE 1999) based on national and international agreements. Individuals meeting the above objectives and standards will be said to have a more pro-environmental belief than those who are not. The measurement of these beliefs is meant only to imply the degree to which an individual is meeting the goals, objectives, and standards of EE and is not a reflection of any other standard.

Knowledge, attitudes, and behaviors are considered both individually as well as parts of a connected pro-environmental belief. The cognitive, affective, and behavioral dimensions are considered as distinct yet inseparable.

Free-Choice Learning is the most common form of learning and is directed by a person's own particular needs and interests. Learning that takes place based on internal motivation is considered free-choice. Learning from television, internet, museums, books, and newspapers are all considered parts of the free-choice learning

sector. The summer camp setting used here may be a free-choice learning initiative if students attend by choice (Falk and Dierking 2002).

Non-formal education is any form of education that takes place outside of the formal school, K-Graduate. Non-formal education includes museums, aquariums, nature centers, zoos, etc. and is often distinguished from informal education which includes television, radio, internet, etc. Most non-formal education is also free-choice in that the experience and learning takes place because of internal motivation. A children's science museum and its programs are a form of non-formal education.

SIGNIFICANCE

Understanding the effectiveness of environmental education initiatives is important as a method for addressing environmental concerns. Given the current interest in using environmental education to address environmental issues (1990; National Environmental Education Advisory Council 1996), it is important to know whether these initiatives are effective and what factors contribute to their effectiveness. In addition to the overall environmental concerns of failing at EE there are financial and time investments of concern. These programs are owned and operated as private industries, non-profit organizations, government initiatives, and university extensions and operate at a considerable investment to stakeholders. In order to ensure that the financial and personal investment is reaching intended objectives, appropriate assessment is essential.

Evaluation of environmental education is underdeveloped and under-researched (National Environmental Education Advisory Council 1996). While

important steps are being taken in the development of effective programs, it is also important to determine the factors necessary in development of the individual student. This research assumes that among other factors EE is tied to a prepared and teachable student, an effective intervention (or series of interventions), and an environment suitable to retain the message. This study will assist in the development of research to explore the first and last of these steps.

Any findings that suggest family and home factors are associated with the success of a non-formal EE initiative imply that EE will need to consider methods to extend curricula beyond the intervention. Curricula may need to include a time of preparation for parents and students as well as follow up activities or suggestions that will take place in the home. One of the important implications of this research is informing the connectivity of non-formal initiative learning and learning in the home. Further implications may exist for the need to connect formal and non-formal settings (Milson 1990) and the home to both in order to develop EE that is long-term and sustainable.

Environmental Education is an important and widely used tool for dealing with environmental problems in general (Stapp 1969; National Environmental Education Advisory Council 1996). Developing a citizenship that is aware of and knowledgeable about environmental problems, have the skills to address these problems, and motivated to work toward this goal is essential to a sustainable future (Barry 1976; UNESCO/UNEP 1978). Understanding those factors that contribute to an effective environmental education will assist in the realization of this important goal.

CHAPTER 2

BACKGROUND

"If one listens carefully, it may even be possible to hear the Creation groan every year in late May when another batch of smart, degree-holding, but ecologically illiterate, Homo sapiens who are eager to succeed are launched into the biosphere." ---David Orr (Orr 1994, p.5)

OVERVIEW

The primary objective of this research is to explain some portion of the selective effectiveness of non-formal EE programs through factors related to the home and family experiences before, during, and after a program. These factors will then be utilized in the development of a typology that will be used to explain the potential an EE program has to foster pro-environmental beliefs with a given individual. This objective is based on several basic assumptions that will be addressed below in a review of related literature. Principle assumptions that will be addressed below include:

1. Environmental education is a distinct yet interdisciplinary approach to solving environmental problems. Thus, research to improve the quality of EE directly addresses a world-wide concern surrounding environmental issues.
2. EE infrastructure present in the U.S. is capable of addressing pro-environmental beliefs and seeks to do so.

3. EE programs are selectively effective. If EE programs are not universally effective at fostering pro-environmental beliefs, then understanding what factors relate to effectiveness is essential in improving programs.
4. EE programs are selectively effective not only between programs but also within programs. Individuals participating in a program are not receiving a similar treatment due to external factors affecting learning potential.
5. Factors unrelated to the program itself may be related to a programs potential to foster pro-environmental beliefs.
6. Pro-environmental beliefs and those factors interacting with the development of these beliefs can be modeled and described as a means to program improvement.
7. Learning at any particular moment in time is dependent on past learning and activities and will be retained differentially depending on learning and activities after that moment. Learning is a lifelong process.
8. There is reason to assume that factors related to family and home learning may be responsible for explaining some portion of the selective success in non-formal EE programs.

The above assumptions will be justified through a review of literature or research in relevant fields. The review will begin with the purpose of EE, its history, and its objectives. The present state of EE, modes and methods in EE, and standards in EE will then be reviewed as a means for defining accepted learning outcomes. Next, a review of evaluations to determine program effectiveness will be explored for

selective success at fostering and retaining pro-environmental beliefs. Factors shown or suggested as related to a program's ability to foster and retain pro-environmental beliefs will then be explored. Research on significant life experiences influencing pro-environmental belief and life long learning theories will also be reviewed. Finally, models suggesting how family and home factors might contribute to overall pro-environmental beliefs will be reviewed. A review of literature in all of the above areas will provide the necessary evidence to support research and methodological choices in this investigation.

WHAT IS ENVIRONMENTAL EDUCATION (EE) AND WHERE DID IT COME FROM?

HISTORY OF EE

While the term environmental education did not get its start until the 1960's, the foundations upon which environmental education is built have been evolving for centuries (Swan 1975). Malcom Swan commented that environmental degradation has always been happening and therefore, environmental education, albeit not in its present form, may have been practiced throughout that time (Stapp 1974; Swan 1975). The environmental education movement as it is described here likely began after the second world war, but the climate necessary for its birth is the result of an indefinite series of changes in paradigm in environmental thinking and education.

Clay Schoenfeld first used the phrase environmental education in his 1968 book Environmental Education and the University. Schoenfeld went on to establish the Journal of Environmental Education the following year (North American Association of Environmental Education 2004). William Stapp defined the concept in

its first edition as, "...aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution." (Stapp 1969, p.30) A year later the first Earth Day served to firmly establish the phrase and provide the momentum that launched environmental education as an established discipline (Stapp 1974).

Environmental Education as it was defined by Stapp has a history of governmental, intergovernmental, and non-governmental involvement. In 1970 President Richard Nixon signed the first Environmental Education Act which established the first Office of Environmental Education, a National Advisory Council for EE, and established a grant program (1970). However, the Office and programs were eliminated in the 1980's. In 1971 The National Association for Environmental Education (now the North American Association for Environmental Education (NAAEE)) was founded as a professional association (North American Association of Environmental Education 2004). In 1972 the United Nations held a Conference on Human Environment in Stockholm, Sweden that called for environmental education as a means to address the environmental issues worldwide (North American Association of Environmental Education 2004). The United Nations Educational, Scientific, and Cultural Organization (UNESCO) responded with a conference on EE in 1975 in Belgrade, Yugoslavia (Barry 1976).

Belgrade Charter

The Belgrade Charter outlined the basic structure of EE from an international perspective and has influenced more recent attempts to establish EE learning standards. The Belgrade Charter stated that the goal of EE is,

> "to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones." (Barry 1976, p.2)

The objectives of EE were defined at the Belgrade Charter and include:

1. **Awareness** of environmental problems
2. **Knowledge** of problems and humanity's role
3. **Attitudes** that promote strong feelings of protection and motivation to solve problems.
4. **Skills** necessary to solve problems.
5. **Evaluation ability** to help evaluate environmental measures and programs
6. **Participation** in appropriate action to solve these problems. (Barry 1976)

Tbilisi Declaration

In 1977 UNESCO-UNEP held a follow-up Intergovernmental Conference on Environmental Education in Tbilisi, Republic of Georgia. At Tbilisi, the goals, objectives, and guiding principles of environmental education were laid out. The Conference produced a Declaration on environmental education and provided 41 recommendations to UNESCO and member states. In Recommendation 1 the Conference suggests that,

> "Environmental education should aim at creating awareness, behavioral attitudes and values directed toward preserving the biosphere, improving the quality of life everywhere as well as safeguarding ethical values and the cultural and natural heritage including: holy places,

> historical landmarks, works of art, monuments and sites, human and natural environment, including fauna and flora and human settlements." (UNESCO/UNEP 1978, p.2)

The goals and categories of environmental education are clearly outlined in recommendation 6 of the report. The goals of environmental education are:

a. to foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;
b. to provide every person with opportunities to acquire the knowledge, values, attitudes, commitments and skills needed to protect and improve the environment;
c. to create new patterns of behavior of individuals, groups and society as a whole towards the environment. (UNESCO/UNEP 1978, p.3)

The categories of environmental education are described as: awareness, knowledge, attitudes, skills, and participation. These categories, objectives, and goals are utilized in the EE standards documents described below.

Beyond Tbilisi and Belgrade

In response to unclear direction and failure to achieve the goals set out in the Belgrade Charter and Tbilisi Conference, Hungerford, Peyton, and Wilke published "Goals for Curriculum Development in Environmental Education" in the Journal of EE in 1980 (Hungerford, Peyton et al. 1980). The publication developed a framework for developing EE curricula that included four levels based on Tbilisi: Ecological foundations, Conceptual Awareness-Issues and Values, Investigation and Evaluation, and Environmental Action Skills-Training and Application (Hungerford, Peyton et al. 1980). This framework can be found in the standards documents and in much of EE planning today.

Hungerford and Peyton defined EE, myths about EE, and methods in EE in Teaching Environmental Education (Hungerford and Peyton 1976). Their model of EE suggests that there are many interdependent concepts and disciplines responsible for and a part of EE. They suggest that EE is an interdisciplinary relationship between problem solving, social science, math, value clarification, science, and language arts (Hungerford and Peyton 1976).

Other reports and conferences outlining and defining EE are also available, although those cited above are among the most commonly accepted and utilized. A few of these conferences and reports include: the Snowmass Conference, the St. Louis International Regional Conference on EE, "Policies and Practices," The First National Congress for EE Futures, The Brundtland Report of the World Commission on Environment and Development, United Nations Conference Rio de Janeiro Chapter 36 Agenda 21 on EE, and others. Those specifically mentioned above were important in the conceptual framework of the "Guidelines for Excellence" standards project (National Project for Excellence in EE 1999) and this research.

CURRENT STATE OF U.S. ENVIRONMENTAL EDUCATION

The legislation that currently defines the state of environmental education in the United States became law in 1990 (1990). The National Environmental Education Act (NEEA) of 1990 reauthorized an Office of Environmental Education that would now be an office of the Environmental Protection Agency. It established an environmental education and training program to be directed by an organization selected by the Office. The law established grants, scholarships, fellowships, and

awards. It also established a National Advisory Council and the National Environmental Education and Training Foundation (1990).

The Office of Environmental Education has thus far selected three programs to administer its environmental education and training program: the University of Michigan, the North American Association for Environmental Education (NAAEE), and now the Environmental Education and Training Partnership (EETAP) at the University of Wisconsin Stevens Point (North American Association of Environmental Education 2004). All three of these administering agencies continue to play a vital role in the administration of environmental education and training.

The National Environmental Education and Training Foundation (NEETF) along with the Environmental Education and Training Partnership (EETAP) serve as umbrella organizations to administer funding to many other partner organizations concerned with environmental education. These organizations include institutions of higher education and other non-profit organizations.

The National Advisory Council on Environmental Education established by the Act in 1990 serves as the primary advisor to the U.S on matters of environmental education. The Council consists of 11 members chosen by the Office of Environmental Education to represent classroom teachers, industry, senior Americans, universities, non profit organizations, and State departments of education and natural resources. (1990)

Advisory Council Report 1996

In December of 1996 the Council published a report assessing the implications of the National Environmental Education Act of 1990 as well as reporting on the condition of EE in the U.S. The Council found that EE is critical and relevant to all Americans and essential to the U.S. It further concluded that the U.S. is currently failing at several levels to provide a nation wide environmental education (National Environmental Education Advisory Council 1996). The report defined environmental education and the categories of EE based on the Tbilisi Declaration. Among the relevant contributions of this report is the statement, "...because environmental education is not viewed as a national priority, universal guidelines do not exist to assure quality program development and implementation, and it is not often well integrated into state and local education reform efforts." (p.ii) The reports following plea is also relevant,

> "Environmental education needs increased support, participation, collaboration and coordination from all stakeholders---including federal agencies; state, local, and tribal governments; educators and education organizations; schools and their boards and administrators; colleges and universities; foundations; nonprofit organizations; individual citizens and community groups; and the private sector." (National Environmental Education Advisory Council 1996, p.ii)

Reauthorization of NEEA

In 1995 the National Environmental Education Act required reauthorization but was not acted upon by the House. The Act cleared the Senate with unanimous consent in 2000. The House held hearings before a Subcommittee on Early Childhood

on the need for reauthorization. At this time the Act has not been reauthorized but continues to serve to provide funding and function as it was established. The House Subcommittee intends to rename the Act the John H. Chafee Environmental Education Act in honor of Senator Chafee who was active in environmental causes. No further action has been taken on reauthorization at this time and the current presidential administration does not support the action.

U.S ENVIRONMENTAL EDUCATION STANDARDS

With assistance from EETAP, the NAAEE continues work on the National Project for Excellence in Environmental Education (NPEEE) which it initiated in 1993. The Project is designed to identify and provide examples of high quality environmental education in practice. (National Project for Excellence in EE 1999) The project currently has published standards for quality environmental education materials, standards for K-12 learning, and guidelines for teacher preparation of environmental educators, as well as a review and comment on EE materials available. The Project has now finished but not yet published a standards document for non-formal EE (National Project for Excellence in EE 2004).

The National Project for Excellence in Environmental Education is not the only attempt to develop standards nor is it necessarily agreed upon by all individuals. Others have also developed criteria for evaluating EE materials, curricula, and programs (Niedermeyer 1992) and for establishing content standards (Roth 1970). Waals and Van Der Leij suggest that standards are not appropriate at all and that EE

must be catered to the situation or community on which it is focused (Wals and van der Leij 1997).

Guidelines for Learning (K-12)

The "Guidelines for Learning (K-12)" were prepared in 1999 in response to the Advisory Council's request for standards a well as the national "Goals 2000" process (National Project for Excellence in EE 1999). Lemons reported the need for these content standards in "Bioscience" in 1994 (Lemons 1994). The purpose of the guidelines is to serve to articulate the essential knowledge and skills for environmental literacy. The Guidelines provide content standards for the completion of 4^{th}, 8^{th}, and 12^{th} grade (National Project for Excellence in EE 1999) and appear to be the only national standards for environmental education in the U.S. Dr. Deborah Simmons of Northern Illinois University and coordinator of the project suggests that while these standards are not yet definitive, they are the only standards available in the U.S (Simmons 2004).

The guidelines are constructed based on the categories and objectives outlined in the Tbilisi Declaration as well as more recent educational frameworks. The guidelines include four primary strands or objectives for environmental education based on the Tbilisi categories. These strands are:

1. Questioning and analysis skills
2. Knowledge of environmental processes and systems
3. Skills for Understanding and Addressing Environmental Issues
4. Personal and civic responsibility

Each of the above strands are subdivided into specific sub-strands and then broken down even further into specific content areas that are necessary to address environmental literacy. For each content area, specific evidence is provided that a student of that grade level has met the standard as outlined (National Project for Excellence in EE 1999).

Like other standards in use in the U.S., the Guidelines for Excellence in EE are compiled by a professional association, in this case, the North American Association of Environmental Education (NAAEE). The work is further supported by the Office of Environmental Education, and is based on the work of the United Nations.

Non-formal Environmental Education Programs: Guidelines for Excellence

A series of standards have also been developed for evaluating non-formal EE. These standards are meant to be useful to the large diversity of program types and program goals. It is meant as a means to determine the quality of a program, and whether it is meeting the EE goal of environmental literacy. These standards include the following six key characteristics of an effective EE program (National Project for Excellence in EE 2004).

1. **Needs Assessment**: The program is designed to address identified environmental, educational, and community needs
2. **Organizational Needs and Capacities**: The program meets the mission, goals, and purpose of the any parent organization.
3. **Program Scope and Structure**: The program has well defined goals and objectives and states how the program will contribute to the development of environmental literacy.
4. **Program Delivery and Resources**: The program ensures that a well-trained staff, facility, and materials are available to meet their goals.
5. **Program Quality and Appropriateness**: The program is built on a foundation of quality materials and planning.

6. Evaluation: The program defines and measures intended outcomes to ensure accountability and improve current programs. (National Project for Excellence in EE 2004)

The quality of all six of these guidelines is tied to the ability of a program to produce an environment where some given belief can be acquired and retained.

In addition to these EE standards documents, the National Science Education Standards (NSES) include many of the EE objectives (Brown 2001). Brown reports that NSES standards could be used to engage EE in the classroom. However, he recognizes that the NSES does not address issue analysis or problem solving (Brown 2001).

HISTORICAL SUMMARY

This history of EE serves to demonstrate some of the strengths and weaknesses of the discipline and the niche it fills today. The recent development of EE standards and national coordination of curriculum development through the NEEA have helped to define the discipline. EE is a relatively new distinct discipline and is likely to soon play a larger role in both formal and non-formal education. Currently, many argue that EE is not present in curricula or teaching as it should be (Ramsey, Hungerford et al. 1992; Smith-Sebasto 1998). New research in EE will serve to better define the field, coordinate its efforts, and meet its objectives.

THE APPEARANCE OF ENVIRONMENTAL EDUCATION TODAY

MODES AND METHODS IN EE

Several modes and methods are utilized by environmental educators and EE programs. EE programs take place as part of the standard curriculum in the formal

school setting, as residential camps, day camps, field trips, museums, zoos, aquariums, nature walks, wilderness camps, and in many other creative venues. Each of these locations, by nature of the environment, utilizes distinct modes and methods. In addition to the venue or environment, EE programs may specifically address nature awareness, action skills, investigation, experiential learning, lecturing, labs, case studies, exploration, or a set of these and other methods for teaching EE. Many EE programs are choosing to focus their attention on a single learning approach or theory outlined in a particular text or developed by a specific organization (Payne 1981; Van Matre 1990; Eagles and Demare 1999). While it is unlikely that there is a single best approach to EE, the inconsistent results of evaluations to measure the ability of a program to affect environmental knowledge, attitudes, and behaviors, suggests that not all of these modes and methods are effective or are equally effective (Dettmann-Easler 1999).

In the eyes of many educators, evaluators, and advisory councils, EE is failing at meeting its objectives (Hungerford and Volk 1990; National Environmental Education Advisory Council 1996; Salmon 2000). Perhaps as a result, criticism of a particular style or method is common. One of the common criticisms focuses on teaching EE in the classroom setting. Many have argued and shown that teaching outdoors is more effective at meeting EE objectives (Crompton and Sellar 1981; Dettmann-Easler 1999). This argument is explored more fully below.

In addition, many educators have suggested that EE focuses on awareness without introducing the tools and skills necessary to solve environmental problems

(Ramsey, Hungerford et al. 1981; Jordan, Hungerford et al. 1987; Mordock and Krasny 2001). In this view, students may be uncovering environmental issues, but cannot act on these issues because they lack the skills necessary to do so. Ramsey suggests the use of issue investigation and action training specifically as tools to alter environmental behavior (Ramsey 1993). Others suggest that students should learn problem solving, and that they are currently not receiving the training necessary to critically analyze and solve complex environmental problems (Childress 1978; Mordock and Krasny 2001). In a review of formal EE curricula, Childress found that problem solving and developing action skills were the least cited objectives of EE (Childress 1978).

The evaluations reviewed below suggest that there may be much more involved in a successful program than simply where EE takes place and what is taught. Considerable research has attempted to outline the specific characteristics of programs and educators that relate to introducing pro-environmental beliefs.

One of the many variables considered relevant in program success is length of program (Shepard and Speelman 1986; Gillett, Thomas et al. 1991; Bogner 1998). Bogner showed that both a 1 and 5 day EE program fostered knowledge in children, but only the 5 day program fostered attitude change. Shepard showed that a five day residential camp was having more of an influence on students than a three day camp (Shepard and Speelman 1986). Age has also been viewed as an important factor and has been reviewed (Wilson 1996). Wilson suggested that early childhood years are a crucial point for introducing EE (Wilson 1996).

FORMAL VS. NON-FORMAL EE

Environmental education is taught in both the formal and non-formal environment. In many cases this division can be extended to suggest that EE is taught both indoors and outdoors. In either case, the environment in which EE is introduced is clearly important (Simmons 1998). Unfortunately EE has not been included into the formal K-12 curriculum to the extent of other content areas (Ramsey, Hungerford et al. 1992). One clear criticism of formal classroom instruction is the degree to which the learning is removed from the subject matter. Evidence suggests that classrooms may not be as conducive to fostering environmental beliefs as outdoor settings (Crompton and Sellar 1981; Dettmann-Easler 1999). La Pierre asserts in an issue of "National Parks" that EE taking place on the television and in the classroom will not connect students to the land as they should be (La Pierre 1992). Simmons suggests that formal school teachers need adequate training in the use of outdoor settings in order to understand their value and reduce perceived risks (Simmons 1998).

Despite this documented criticism, formal EE programs have demonstrated both altered knowledge and attitudes after indoor programs (Aird and Tomera 1977; Crater and Mears 1981; Leeming, Porter et al. 1997; Bradley, Waliczek et al. 1999) In some cases this change has been shown to persist as long as two years after the intervention (Jaus 1984). Zelezny even suggests that the classroom setting is more effective than a non-formal setting for changing behaviors (Zelezny 1999). In addition formal education has focused on the use of the schoolyard and outdoor classrooms as effective tools in EE (Cronin-Jones 2000). Cronin-Jones found that students receiving

10 hours of ecology instruction in the school grounds had more pro-environmental beliefs than those receiving the same instruction in the classroom.

Formal settings are often more conducive to presenting long term EE programs and many are planned to last an entire school year with much success (Solkov-Brecher; Leeming, Porter et al. 1997). In addition, novel environments, often experienced in non-formal and outdoor formal settings, could reduce the potential for learning if students are not adequately prepared (Martin, Falk et al. 1981; Orion and Hofstein 1994; Tunnicliffe and Laterveer-de Beer 2002). Thus, there is also reason to question the relative effectiveness of non-formal environments.

Although arguments over whether EE should best be introduced in the formal vs. nonformal setting are prevalent, discussions about how they might compliment each other are also available. In either case it is clear that not all formal programs (Armstrong and Impara 1991) or non-formal programs (Leeming, Dwyer et al. 1993) are effective at fostering pro-environmental beliefs. One meta-review of research comparing the relative effectiveness of formal vs. non-formal EE suggest that neither form is universally effective at any outcome evaluated. Of the 34 evaluations reviewed, 17 were characterized as formal. Of these 9 reported only positive effects on altering beliefs; another three reported mixed results. The 17 non-formal programs reviewed present only 4 having all positive effects while another 3 present mixed effects (Leeming, Dwyer et al. 1993).

REVIEW OF PROGRAM EVALUATIONS

COGNITIVE EFFECTS OF EE

The measured outcomes of EE programs vary depending on the centers objectives or researchers objectives. In many cases the objective of the program may be simply to provide a fun and healthy experience for children. However, in many cases the programs are designed as learning experiences. The measured outcome of these programs may include cognition. Written or oral assessments of student knowledge about the environment, nature, action skills, ecology, issues, etc. are given before and after programs as a measure of effectiveness. Many of the instruments utilized are not analyzed for their reliability or validity and many more are not described in the research at all (Crompton and Sellar 1981). In addition, it is difficult to understand whether the program itself is the cause of the knowledge gain.

Despite the many limitations, research suggests that some EE programs do result in students with greater knowledge of some of the EE standard content areas. A study of what parts or portions of the content standards are taught in any given program and how that might influence attitude and behavior would be useful, but at present the results of these studies are presented notwithstanding their limitations.

Positive Effects

Several studies have shown positive effects on knowledge after an EE program (Aird and Tomera 1977; Lisowski and Disinger 1991; Keiffer 1992; Cronin-Jones 2000; Culen and Mony 2003). Cronin-Jones showed that students participating in a 10 day EE course on ecology did improve scores both in an indoor setting and in a

schoolyard setting. Students participating in the schoolyard sample scored higher than those indoors (Cronin-Jones 2000). The modes and methods utilized in these EE programs differ and suggest that a wide range of programs may be capable of fostering knowledge in EE domains.

Shephard explored the ability of residential camps to affect knowledge and found that both three and five day camps were effective at fostering environmental knowledge (Shepard and Speelman 1986).

Lisowski showed that ecological concepts were fostered after a 7 week field program with children. Knowledge scores remained stable after a four-week delayed test (Lisowski and Disinger 1991).

Null Effects

In addition, many studies have found that EE programs have no effect on knowledge of selected content after a program (Armstrong and Impara 1991; Leeming, Porter et al. 1997). Failure to demonstrate cognitive gains after an EE program does not necessarily indicate program failure if the program does not intend to address cognition. However, as the models of pro-environmental beliefs below demonstrate, knowledge may be an important factor in predicting attitudes and behaviors as well. It is also necessary to question whether programs are failing to address cognition or simply failing to address those questions present on the assessment.

AFFECTIVE EFFECTS OF EE

The EE content standards and the goals and objectives of EE are not only cognitive (UNESCO/UNEP 1978; National Project for Excellence in EE 1999). Much of the intent of EE and in some cases the purpose of an EE program is to address affective elements of development. Attitude toward the environment has long been considered essential in the development of pro-environmental behaviors (Stapp 1969). Although this thesis is under question (Wicker 1969; Wicker 1971; Culen and Mony 2003), and will be discussed further later, attitudes are certainly a component of the overall pro-environmental beliefs of any individual.

Although addressing attitude change is one of the primary objectives of EE, it is not as well understood as cognitive development (Wicker 1969). Educational research has primarily focused on fostering knowledge in students and has not focused on affective elements of belief (Knapp 1972). For this reason, and others, understanding and measuring attitudes in children is complex. In many cases attitudes are measured through self-reporting instruments and are unable to discriminate between what a student feels and what that student claims she feels (Moyer 1977). In addition, attitudes in children are dynamic. A written instrument or survey may only be able to capture a child's attitudes at any one moment and may not be predictive of what that student may feel at a later time. Few studies examine the attitudes of students at time intervals after a program is completed (Cronin-Jones 2000). Those that have examined whether these attitudes are retained rarely demonstrate retention.

However a few studies have demonstrated retention after significant periods (Jaus 1984; Dettmann-Easler 1999).

Despite the difficulties in measuring attitudes, many researchers have engineered creative ways to measure attitudes and predict the affective change of an EE program. Others are subject to the criticism described above, but may at least represent some measure, albeit biased, of a students attitudes after a program.

Positive Effects

A variety of formal and nonformal programs report attitude changes after a programs completion (Christy 1982; Dresner and Gill 1994; Leeming, Porter et al. 1997; Bradley, Waliczek et al. 1999; Dettmann-Easler 1999; Cronin-Jones 2000). Christy found that while environmental attitudes improved in all groups, those attending more remote sites had more pro-environmental attitudes than those who stayed in a base camp (Christy 1982). Cronin-Jones found an environmental attitude change after only 10 hours of school yard ecology instruction. As mentioned above, Jaus found that a 2 hour course changed attitude and was retained after two years (Jaus 1984). These programs vary in length from hours to weeks and represent a variety of approaches and environments for learning.

Null Effects

Other programs report no change in attitude after a program or report no net change after a time-delayed test (Kostka 1976; Shepard and Speelman 1986; Armstrong and Impara 1991; Gillett, Thomas et al. 1991; Reid and Sa'di 1997). Reid and Sa'di suggest that EE curricula needs reform in order to address affective change

(Reid and Sa'di 1997). In addition, many studies show that while attitudes toward specific EE content areas does change, other areas are unaffected (Carlson and Baumgartner 1974; Kostka 1976). Kostka found that 6-7 hours of nature camp EE had no effect on pro-environmental attitude overall but only affected specific attitudes directly addressed. Carlson found that a natural resource camp for boys did change specific attitudes, but did not change environmental attitudes overall. These findings suggest that programs that do have an effect on attitude, may only be affecting some specific domain within the field of EE.

Shepard and Speelman found that although both three and five day camps were affecting knowledge, neither were capable of affecting attitude (Shepard and Speelman 1986).

BEHAVIORAL EFFECTS OF EE

Many environmental educators argue that the primary objective of EE should be to change behavior (Stapp 1969). While EE may address knowledge and attitudes, these educators argue that they are addressed only as factors that ultimately influence individual behavior. While this position may not be held by all, if the intent of EE is to address environmental issues, as many including the National Advisory Council believe, a knowledge of and feeling toward environmental issues is not enough.

Although many believe that changing environmental behaviors is an important objective, behavior is rarely measured as an intended outcome (Simmons 1991), although the measurement of behavior is emerging as a trend. When behavior is measured it is often measured by asking students whether they have intent to act or

whether they have acted in a specific way. Measuring behavior through actual observation of behavior is rarely attempted due to obvious difficulties, although this measurement is certainly the most valid (Wicker 1971).

As with measuring knowledge and attitudes, measuring behavior over time after a student has participated in a program is rare. A long term study attempting to measure whether individuals who attend a specific EE program are making pro-environmental choices in their behavior would be illuminating. Some research has been done on interviewing or assessing the past experiences of individuals thought to already have strong pro-environmental beliefs (Tanner 1980). This research is discussed under factors affecting pro-environmental beliefs.

One sociological review of EE suggests that programs and evaluations need to evaluate whether the modes and methods utilized are capable of altering behavior. Social behavior models and typologies might assist in the development of EE programs with goals to alter behavior (Cook and Berrenberg 1981). In a survey of EE programs, Simmons showed that while many programs considered behavior change an objective, they were unwilling to address environmental action strategies and skills (Simmons 1991).

Positive Effects

Some evaluations have attempted to demonstrate that behaviors do change after the completion of an EE program (Aird and Tomera 1977; Ramsey, Hungerford et al. 1981; Jordan, Hungerford et al. 1987; Adams 1993; Ramsey 1993). Jordan and Hungerford's 1987 study and Ramsey and Hungerford's 1981 study both compared

students who received only a program that emphasized awareness with a similar program that emphasized awareness and action skills. They found that those receiving a knowledge of action skills did change behavior (Ramsey, Hungerford et al. 1981; Jordan, Hungerford et al. 1987). It is important to realize that most of these measurements measure intent to act rather than actual behavior. Those that do address actual behavior, ask students to self-report behavior. In order to demonstrate that a program does effect how a child behaves, many of these studies have employed a time-delayed measurement where they then asked the student, parent, or both what behaviors have changed since the program (Jordan, Hungerford et al. 1987; Lisowski and Disinger 1991). These measurements of behavior are likely dependent on factors not directly related to the program itself. Many of these factors are those factors this research is attempting to identify.

Null Effects

Other evaluations demonstrate that programs have no effect on behavior. If the measurement is a measure of self-reported or parent-reported behavior after some time lapse, then it cannot be determined whether the program failed to change behavior or whether factors unrelated to the program are influencing behavior. A study that measures student's intents to act directly after a program and then compares that intent to actual behavior would be an interesting tool to identifying what factors relate to a student acting on their intent. While many EE programs report changes in overt environmental behaviors, understanding what factors influenced behavior is still an important question (Cook and Berrenberg 1981).

KNOWLEDGE, ATTITUDE, BEHAVIOR INTERACTIONS

The nature of the relationship between knowledge, attitude, and behavior is often explored in EE evaluation. It is often an assumption of research that fostering knowledge of the environment will then lead to attitude and or behavior change (Simmons 1991; Reid 2000; Thompson and Mintzes 2002). This simplistic model has been criticized by many but has been shown to be true in some instances (Ramsey and Rickson 1977). Several studies have even shown a statistical correlation between one or more of these domains (Bradley, Waliczek et al. 1999; Thompson and Mintzes 2002).

Other evaluations have shown that while a program may be effective at changing one of the above domains, it is not effective at changing others. In many cases, knowledge changes, but attitude does not change (Keiffer 1992; Tung, Huang et al. 2002; Culen and Mony 2003). Tung and Huang found that two of the three programs they evaluated did change knowledge but none had any effect on attitude, behavior, self efficacy, environmental sensitivity, or responsibility (Tung, Huang et al. 2002). Attitudes have been shown to be adequate predictors of behaviors when measured appropriately (Newhouse 1990). Culen and Mony found that while 4H camps were fostering knowledge, they were not influencing several factors thought to be predictors of pro-environmental behavior including issue awareness, action skills, and evaluation techniques (Culen and Mony 2003). These attempts to correlate knowledge and attitude have shown little or no relation in these studies (Keiffer 1992).

In one study conducted by Bickman, a university environment was manipulated to include a site where litter had been scattered on a walkway beside a trash can. An observer recorded whether passers by would respond to the trash. Just beyond the site, individuals were asked whether they felt they had a personal responsibility to remove litter. The study found that 94% of those individuals who had passed by without acting responded that they felt they were personally responsible for picking up litter (Bickman 1972). Thus, there is reason to question whether verbal attitude commitment relates to behavior.

Young interviewed respondents by phone to determine the degree to which knowledge about wilderness correlated with attitude about wilderness. He found that knowledge was more closely related to attitude than age, income, education, or residence. He suggests that knowledge about wilderness leads to more positive attitudes toward wilderness (Young 1980). He does not appear to have explored the possibility that positive attitudes toward wilderness lead to increased knowledge about wilderness.

Wicker reports on relationship between environmental attitudes and environmental behaviors using the model proposed by Fishbein. Wicker comments that attitude cannot predict behavior alone but is also tied to normative beliefs and motivations to comply with norms. There are also a series of personal and situational factors that are important in understanding behavior from attitude (Wicker 1969). Wicker has also reported the need to focus on behaviors rather than attitudes which he proposes can be done by asking about attitudes toward a specific action, inquiring

about multiple attitudes involved in acting, or observing behavior directly (Wicker 1971).

Ramsey and Rickson suggest that there is a non-linear relationship between knowledge and attitude. Ramsey and Rickson's study suggests that knowledge moderates attitudes and different contents serve to moderate in different ways. A study of trade offs served to moderate attitudes toward environment (Ramsey and Rickson 1977).

OTHER EFFEECTS OF EE

In addition to influencing a student's knowledge, attitudes, and behaviors in respect to EE standards, many researchers have attempted to identify other effects of programs. These outcomes may relate to feelings of self-worth, social interaction, locus of control, trust, team-work, or physical and mental health (Gillett, Thomas et al. 1991). Many of these outcomes are beyond the scope of this research. However, outcomes and research that were reported in literature related to knowledge, attitudes, and behavior are reported here. In addition, research that reports on the effect of a program on those interacting with the student are included here. These intergenerational studies attempt to show the affects of an EE program on those who the student will influence.

One of the effects of EE at the childhood level may be to stabilize beliefs. Ballantyne reports that 12 hour course utilizing structured controversy in EE was able to assist students in understanding their perspectives and the perspectives of others. They were better able to formulate their views and identify inconsistencies.

(Ballantyne and Bain 1995) Ballantyne also reports on the ability of two formal school programs to change attitudes, behaviors, and engage students in intergenerational discussions about environment in the home. (Ballantyne, Fien et al. 2001). He has also demonstrated the effectiveness of engaging in conversation with parents as a means to behavior change in the home. (Ballantyne, Fien et al. 2001). Leeming showed that a year long school course affected both student and parent attitudes as well as parent behavior (Leeming, Porter et al. 1997). Knapp described the intent of EE as clarifying values. Knapp saw EE as helping students understand and define the values they have (Knapp 1972).

Kapyla evaluated an EE course for teacher trainers in Finland and found that the course effected the personal commitment and responsibility the trainers felt toward the environment. The research suggests that this feeling was then conveyed to teachers in EE pre-service training (Kapyla and Wahlstrom 2000).

One study intending to look at the effects of a residential camp on attitudes toward wildlife found that the six camps researched all produced attitude scores that differed from each other implying that different programs indeed produce different effects (Dettmann-Easler 1999). In addition, Gillett found that six day wilderness experiences had an effect on individual self-concept in 12^{th} graders (Gillett, Thomas et al. 1991).

THEORETICAL FRAMEWORK

SELECTIVE SUCCESS AMONG STUDENTS

One purpose of this research is to demonstrate that a program has selective success among students. Assuming that all students participate to the same degree in a program, then selective success suggests that factors un-related to the program are influencing the potential for a program to meet its objectives. This thesis does not appear to have been explored in the research in any detail. However, several researchers have made comments in discussion about the possibility of selective success (Kostka 1976). Kostka found that not all students were affected equally in a large study of nature camps. Those students whose pro-environmental beliefs were shown to be the lowest on a pre-test also showed the least amount of change. Students who had higher pre-test scores also showed the greatest amount of net change. Kostka also found a small correlation between previous nature experience and overall change in attitude (Kostka 1976).

Leeming described a distinct difference in attitude change based on student interest. Students who professed little interest in the EE experience did not differ from a control group in post-test attitudes while those reporting high interest in the beginning did have significant attitude changes (Leeming, Porter et al. 1997). The difference in program effect between those who were interested vs. those who were not suggests the importance of identifying what fostered the interest. Leeming also showed that younger students changed more than older students (Leeming, Porter et al. 1997)

The work of Tanner in determining significant life experiences related to pro-environmental beliefs described below, also suggests that non-formal programs may be selectively effective. Only one of the nine significant factors described by Tanner specifically addresses factors associated with an educational initiative. The third most cited factor determining belief was an individuals parents (Tanner 1980). Other factors including outdoors, books, and solitude may also directly relate to the family and home life of an individual. Tanner's findings suggest that the differential life experiences within a classroom will manifest themselves as different environmental beliefs. It can then be inferred that these different beliefs may also play a role in the selective effectiveness of programs to address beliefs.

Potential evidence of selective success is often removed through testing of means and statistical analyses that assumes the student population is a single test subject. Although this approach is widely used in educational assessment, it may be inappropriate to assume that the individuals in a course all come from the same population. They may come from distinct populations of which factors unrelated to the intervention will play a role in their acceptance and retention of pro-environmental beliefs.

FACTORS THAT INFLUENCE PRO-ENVIRONMENTAL BELIEFS

There are many factors that are thought to, or have been shown to directly or indirectly influence pro-environmental beliefs (Sia, Hungerford et al. 1985; Sivek and Hungerford 1990; Chawla 1998). The presence of these factors is thought to relate to an individual's pro-environmental belief. Much of this research has been designed to

predict behavior specifically and uses knowledge and attitudes as possible predictors of behavior (Sivek and Hungerford 1990). However, other factors have been cited as related to beliefs in general. In addition, a growing body of research on significant life experiences that influence pro-environmental beliefs reveal trends in self-perceived factors that influence belief.

In a study conducted by Eagles and Demare on the pro-environmental attitudes of students before and after an outdoor EE program, pro-environmental attitudes were found linked to several variables. Attitudes were found to be highly correlated with talking about the environment at home, reading environmental books and magazines, and watching environmentally related media. However, these attitudes were not found to be correlated with family camping, summer camp experience, or talking about the environment in the classroom (Eagles and Demare 1999). Eagles and Demare investigated these significant life experiences within the context of a pre-post analysis of a program's effects; other significant life experience research is explored below.

In a study on curbside recycling, attitudes as well as subjective norms were found to be influential factors correlated with activity (Ewing 2001) Hwang suggests that environmental behavior is influenced primarily by attitude and locus of control (Hwang, Kim et al. 2000). Iwata looked at what attitudes are most closely correlated with pro-environmental behavior. Iwata suggests that of the attitudes observed attitudes toward the behavior itself and attitudes toward careful shopping best predicted behavior. Behavior was not found to be linked to attitudes toward anti-materialism or self-sufficiency (Iwata 2001).

In a later study, Iwata used coping strategies as possible predictors of pro-environmental behavior. In this case self-deception and ability to sacrifice were found to best explain behavior, although Iwata states that coping strategies were not good predictors (Iwata 2002).

In a study of predictors of environmental knowledge, Lisowski showed only previous knowledge to be a predictor of knowledge score. Gender, grade-level, background in science, extracurricular activities, travel, and outdoor experience were not found correlated with knowledge score (Lisowski and Disinger 1991).

Ma and Bateson suggest that attitude toward science can be used as a predictor of attitude toward environment based on a correlation established in one study (Ma and Bateson 1993).

Outdoor activity is also considered a factor related to pro-environmental behavior. In one study students participating in outdoor activities not only had a greater desire to participate in outdoor activities in the future but also showed a more empathetic attitude toward nature than those who did not (Palmberg and Kuru 2000).

The relative connections between factors influencing all or a part of the pro-environmental belief system were analyzed by Hamilton in his 1983 thesis. Hamilton established connections between knowledge and locus of control, importance and locus of control, knowledge and importance, and personal responsibility and knowledge (Hamilton 1983). Hamilton's thesis demonstrates the connectivity of factors involved in the development of pro-environmental beliefs.

Factors shown to be related to an individuals pro-environmental behavior include locus of control, feelings of responsibility, understandings of issues and action strategies, and positive attitudes (Newhouse 1990). These factors found to be related to behavior are consistent with the models for predicting behavior designed by Hines (Hines, Hungerford et al. 1986) and Hungerford (Hungerford and Volk 1990) as well as those factors found by Sivek and Hungerford (Sivek and Hungerford 1990). One earlier study tested nine factors for their role in predicting behavior. Those found related were, level of environmental sensitivity, perceived knowledge of action strategies, perceived skill using the strategies, sex role classification, individual locus of control, group locus of control, and attitude toward pollution. The first three factors were the most related. The one factor not related was belief in technology. These factors still only account for 43-57% of total variance (Sia, Hungerford et al. 1985). These reoccurring factors used in predicting environmental behavior may be useful factors but still do not explain total variance in the way an individual behaves.

One final factor potentially important is offered by Clifford Knapp. Knapp suggests that the potential of an experience to serve as a learning device depends on reflection. Knapp suggests that educational activities are not accompanied by adequate reflection. Reflection could serve to clarify and solidify beliefs (Knapp 1992).

SIGNIFICANT LIFE EXPERIENCES

The significant life experience (SLE) research attempts to examine what types of educational factors are influential in the development of pro-environmental beliefs.

Palmer and Suggate opened their 1996 paper with, "If a fundamental aim of environmental education is to help children learn about and care for the environment, then those responsible for this subject area must know the types of learning experiences that help to produce active and informed minds." (Palmer and Suggate 1996, p.2) The work attempts to ask individuals with proven commitment to the environment to reflect on what experiences influenced their beliefs.

Tanner began the work on significant life experiences that influence an individuals pro-environmental beliefs in 1980 (Tanner 1980). In a study that examined the lives of individuals known to have pro-environmental beliefs and actively engage in pro-environmental behaviors, Tanner developed a list of significant life experiences common among respondents. His list was broken into nine categories based on open-ended response:

1. Outdoors
2. Habitat
3. Parents
4. Teachers
5. Books
6. Adults other than parents
7. Habitat alteration
8. Solitude
9. Miscellaneous

Each of these nine factors was described by some respondent as having a role in the development of their pro-environmental beliefs. These factors are listed in the order in which they appear in frequency among respondents (Tanner 1980). Tanners work in determining significant life experiences suggests what is happening outside of the non-formal EE program is important. Tanner also suggests that individuals who

reported outdoors and habitat as being important mentioned that these experiences happened on a regular basis, if not daily (Tanner 1980).

In a review of further research in significant life experiences in 1998, Chawla reviews all available lists created of significant life experiences reported as influencing pro-environmental beliefs. Chawla reports on seven lists of influences. In all seven cases exposure to outdoor or natural areas was mentioned most frequently by respondents. In many cases, this exposure was reported to have taken place in youth. In addition to outdoor or natural areas, family and or parents were reported as influential in every case and in most cases nearly as frequently as outdoor and natural areas (Chawla 1998). In Chawla's own study, 77% of all respondents reported that family was an important influence on commitment to environmental protection (Chawla 1998; Chawla 1999). The lists in general seem consistent with the one Tanner reported above. Other areas reported frequently include education, vocation, and organizations (Chawla 1998).

In addition to the report of outdoors and family as significant life experiences, Chawla reports a correlation between the two. Respondents who reported outdoor places as significant also reported family as significant and traced the family interaction to the teaching of the value of natural things while exploring the outdoors. Chawla suggests that outdoor experiences need to be combined with a positive role model, and further suggests that this role model is often a family member and most often a parent (Chawla 1999). This observation was made forty years earlier by Rachel Carson in The Sense of Wonder (Carson 1956).

Palmer and Suggate commented on the overwhelming response of family as a significant life experience. In this study, the family is expanded to include not only the family of a youth but also the affect of having children on environmental beliefs (Palmer and Suggate 1996).

Chawla has suggested that significant life experiences specifically affect our environmental sensitivity. Environmental sensitivity is one component of environmental beliefs and was described by Hungerford and Volk as one of the entry level variables associated with environmental behavior.

The significant life experiences literature has been the subject of a growing debate and has recently been the subject of two special issues of Environmental Education Research (Gough 1999). Primarily the debate over this research can be broken into two categories: who should be the subjects of significant life experiences research and what do the activities reported by respondents actually mean?

Tanner wrote a commentary on the first of these subjects in 1998. His paper suggests that most of the individuals chosen to participate in these studies have not been appropriate subjects. Tanner suggests that research that has asked environmental educators and other populations interested in environmental quality is not appropriate because these subjects are not going to "save the earth". Tanner suggests that it is only informed, responsible, environmental activists who will do so (Tanner 1998). While Tanner's argument is rather specific, he brings into question whether the subjects of these studies are the models whose significant life experiences should be created in others.

The second debate focuses on what SLE research actually explores. Are the experiences described by respondents as significant responsible for their pro-environmental beliefs, or are they a reflection of what past experiences are likely to be recalled as significant by those who have pro-environmental beliefs? In a review of SLE debate, Gough suggests that the view taken by SLE researchers is not one that must necessarily be taken. In addition he points to how similar experiences are mediated differently be different individuals. Therefore, it may be necessary to not only understand the outward experience but also the inward experience (Gough 1999).

The way in which significant life experiences are used in the present research may avoid the above criticisms. The research being conducted here is not retrospective nor does it seek a population of a specific sort, but rather asks questions of the present to those who may or may not have pro-environmental beliefs. The significant life experiences research is used here to suggest that childhood may be a significant time in the development of pro-environmental beliefs and that outdoor and family experiences may be important factors in the development of these beliefs. Whether these assumptions are valid will be tested through the research itself.

LIFELONG LEARNING FRAMEWORK

One of the basic assumptions underlying this research is that what we learn is based on what we have already learned or experienced. John Falk and Lynn Dierking suggest that learning is not the storage of information, but rather, a life-long process. Learning is unique to that individual and is based on previous and present experiences. They suggest that learning is a product of physical context, personal context and

sociocultural context over time (Falk and Dierking 2002)(See Figure 1). The first part of this suggestion is not distinctly novel, but the last, that it is a process that takes place over time, is indeed. Falk and Dierking summarized the learning process as follows:

> "People make meaning through a constant process of relating past experiences to the present, connecting what is happening in the present to what has happened in the past.... Learning is a dialogue between the individual and his or her social/cultural and physical environment; learning is a contextually driven effort to make meaning in order to survive and prosper in the world" (Falk 2001, p.13)

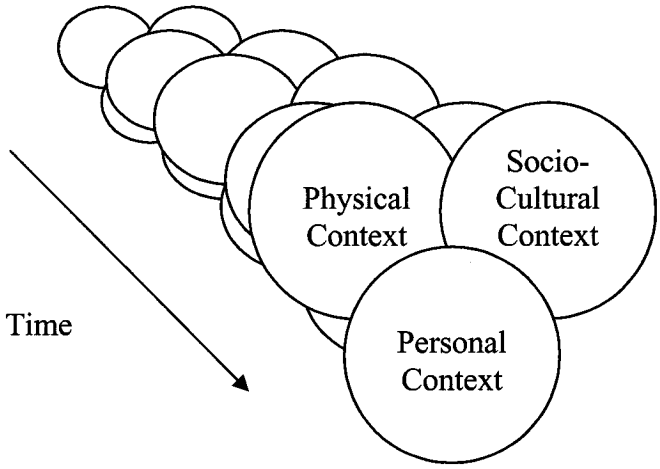


Figure 1

Contextual Model of Learning described by John Falk and Lynn Dierking
(Falk and Dierking 2002, p.37)

Lundmark suggests that we should be asking what a program contributes to what we know, feel, and understand rather than what a program itself accomplishes. A program is one part in the series of lifelong learning (Lundmark 2002).

CONCEPTUAL MODELS FOR UNDERSTANDING

Several models in social psychology can be utilized to understand the nature of the interactions between knowledge, attitudes, and behaviors and those factors that influence all three. Environmental beliefs have been modeled specifically based on several of these social psychology models by Hines and others. These models suggest, that while distinct, domains build on and in the case of Bandura's model, reinforce each other (Bandura 1977) (See Figure 2). Although many of these models were designed to predict behavior specifically, other aspects of an individual's belief are included as aspects of behavior and lead a model describing pro-environmental beliefs inclusively.

Ajzen and Fishbein proposed a model for understanding behavior that has been used by Hines and Hungerford (Hines, Hungerford et al. 1986) to predict environmental behavior specifically. The model suggests that behavior is driven by intent alone. Therefore, if an individual has an intent to act in a certain way then they will act in that way based on the theory of reasoned action (Ajzen and Fishbein 1980). Hungerford and Hines add a set of situational factors that will determine whether intent will lead to behavior (Hines, Hungerford et al. 1986). The intentions are based on attitude toward the behavior, subjective norms, and the relative importance of each of the previous. The attitudes toward the behavior and the subjective norms are based on beliefs that are made up of many components. In this model of behavior, attitude is specific to the action rather than to the idea (Ajzen and Fishbein 1980). This suggests that asking an individual whether they feel carpooling is a good idea is not a predictor

of whether an individual will carpool, but asking an individual how they feel about themselves carpooling would predict behavior. Ajzen and Fishbein also suggest in the development of this model that predicting behavior can be understood without understanding the factors that produce the behavior, but it is not possible to change behavior without understanding the factors that produce the behavior (Ajzen and Fishbein 1980).

Bandura suggests in his model of reciprocal determinism that behavior is based on the interaction between behavior, person, and environment. These interactions are reciprocal; however, the relative importance of each is situational. In Bandura's model, the person includes the factors associated with an individual's development that are important in determining behavior and include knowledge and attitude. However, unlike the model proposed by Azjen and Fishbein, behavior is also dependent on environmental factors or what some authors have described as "other factors". An individual's personal beliefs and behaviors are dependent on the situation or environment that the individual and behavior is placed in (Bandura 1977).

One aspect of Bandura's model that is unique is the idea that behavior is not only dependent on other factors but those factors are also dependent on behavior. Bandura suggests that behavior or action influences both the person and the environment (Bandura 1977)(See Figure 2).

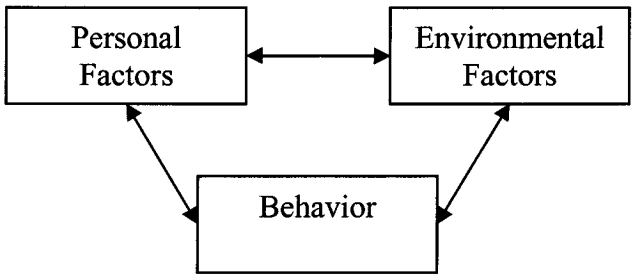


Figure 2

Bandura's Model of Reciprocal Determinism (Bandura 1977)

Hines has developed a model for understanding pro-environmental behaviors that is based on the work of Ajzen and Fishbein (See Figure 3). In a review of EE research, Hines describes a model for predicting behavior that is based on several factors. Hines suggests that an individual's intent to act and situational factors predict behavior. An individual's intent to act is based on personality factors, knowledge of issues, knowledge of actions, and skills. That individuals personality factors relating to environmental behavior are attitudes, locus of control, and feelings of responsibility (Hines, Hungerford et al. 1986). Figure 3 is a replication of the model proposed by Hines et al. Unlike Bandura's model, Hines' model is unidirectional, however its specificity to pro-environmental beliefs is helpful in understanding factors related to influencing beliefs. A model of where family and home factors may fit into Hines' model is included in Chapter 5 of this work.

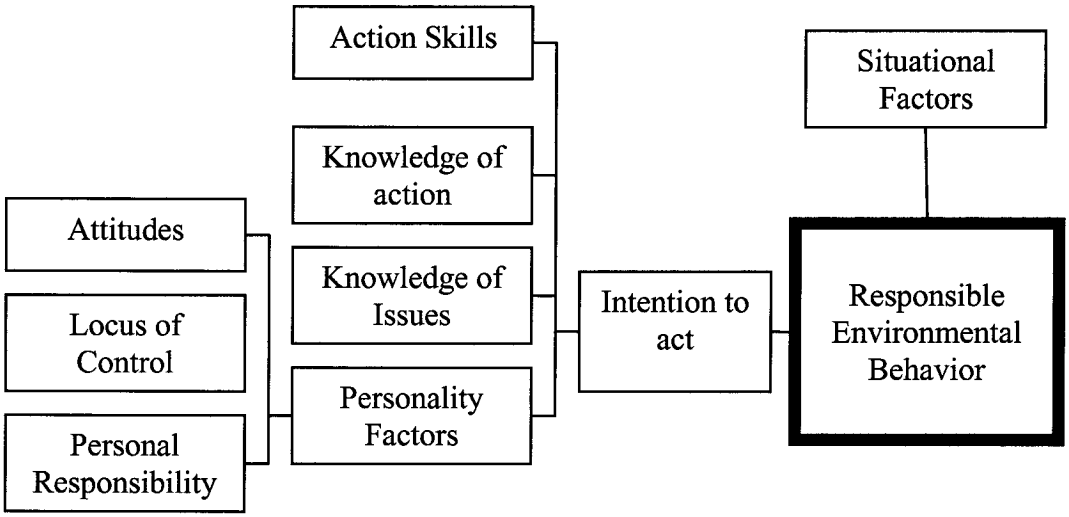


Figure 3

Proposed model for responsible environmental behavior
(Hines, Hungerford et al. 1986)

The model proposed by Hines was used by Hsu to try and model self-reported environmental behavior. Hsu found that the best predictors of self-reported behavior were perceived knowledge of environmental action strategies, intent to act, area of residence, and perceived skill in using action strategies (Hsu and Roth 1998). Hsu's model is consistent with the work of Hines and begins to explore other factors that may influence both the intent to act and situational factors.

Hungerford proposed a model similar to Hines that places the variables defined by Hines into three categories: entry-level, ownership variables, and empowerment

variables. Entry level variables include knowledge about various components of the behavior as well as knowledge. Ownership variables include in-depth knowledge of issues and feelings of personal investment. Empowerment variables include a knowledge of skills and actions that can be taken, a locus of control, and intent to act (Hungerford and Volk 1990). Unlike the model proposed by Hines, this model is free of situational factors.

The model on which this research is based is proposed in Chapter 3 and is based on the models described above. Bandura's model of reciprocal determinism is considered exceptional based on its assumption that the person, environment, and behavior are interactive rather than strictly linear.

OPPOSITION AND CRITICISM

Environmental education is not without opposition and or criticism (Adler 1993; Sommerfeld 1996; Pope 1997). This opposition comes from within and without the environmental community. There has been a large debate as to whether EE is an appropriate discipline for the public school. It has been argued that education should not play a role in advocacy, and that EE does just that (Adler 1993; Sommerfeld 1996). Others have argued that all education advocates for some theory or practice, and EE simply follows that same trend (Knapp 1972). Pope wrote that many considered EE to be "junk science" (Pope 1997).

Adler, a policy analyst for the Competitive Enterprise Corporation, asserts that EE is grossly misinforming children about environmental issues (Adler 1993). He states that EE takes away from other important topics such as history and science and

leads children to blindly follow environmental causes. He reports on the development of the Corporation's own parents guide for teaching EE (Adler 1993).

Opposition from within the environmental, and even from within the EE community itself, claims that EE is not effective or not appropriate. It has been argued that the materials used in EE are not scientifically accurate or that EE fails to equip students with the necessary tools to address environmental problems. Gigliotti suggests programs focus on recognition of issues but don't focus on the actions required to solve the issues, especially those requiring self sacrifice (Gigliotti 1990).

Loughland and Reid have shown that students view the environment as an object rather than a relationship. They claim that this conception of environment demonstrates the failure of EE to connect humanity to ecology and calls for EE to include individual experiences in its teachings (Loughland and Reid 2002). Loughland has shown that only one in seven children view environment as a relationship. Knowledge about the environment has no effect on this conception in the high school and has a negative impact on the conception in primary school (Loughland, Reid et al. 2003).

The international community criticizes U.S. EE for attempting to standardize content and objectives rather than allowing the environment or community problems to determine the direction of EE (Wals and van der Leij 1997). Others claim that EE has done little to change the underlying beliefs of individuals involved (Gigliotti 1990).

Rockland and the National EE Advisory Council both point out that EE has not adequately addressed all sectors of the socio-economic scale equally. Both under-privileged and under-represented groups are not being targeted by EE (Rockland 1995; National Environmental Education Advisory Council 1996).

The George C. Marshall Institute was employed to form the Independent Commission on EE. The commission's report included a list of ten findings, many of which were direct criticisms of current practice. They also prepared a list of nine recommendations for EE. One of the major themes of the commission's report was the finding that EE materials and texts often have serious flaws. Among recommendations prepared by the commission were the ideas that EE should place its primary emphasis on the acquisition of knowledge and EE materials should include more substantive content in the sciences (Salmon 2000). This focus on content and knowledge differs from many other environmental educators focus on attitude and behavior change.

CLOSING

This concludes a review of environmental education and the literature pertinent to an understanding of EE effectiveness. The information presented here is exhaustive and is meant to justify both the need for the research being conducted and the decisions made during the research. Although the literature reviewed has been helpful, it is apparent that work in the field of EE and specifically work in addressing factors associated with environmental belief formation is uncommon.

The research experiment that follows was designed to contribute to and inform existing models for understanding EE and environmental beliefs. The research focuses on factors contributing to environmental belief and their implications for EE. Based on the review of literature it appears justified to focus this research on the role of formative family and outdoor experiences and their interaction. Findings in this research are meant to contribute to the volume of literature reviewed, but additionally meant to assist the work of hands-on environmental educators. It is hoped that a more thorough understanding of factors related to environmental beliefs will assist educators in their attempt to develop programs to meet the goals and objectives of environmental education.

CHAPTER 3

MATERIALS AND METHODS

"It defines no right or wrong, assigns no obligation, calls for no sacrifice, implies no change in the current philosophy of values. Just how far will such education take us?"
---Aldo Leopold (Leopold 1953)

PURPOSE OF STUDY

The purpose of this study is to identify and describe factors associated with the development and retention of environmentally responsible knowledge, attitudes, and behaviors in children. The factors primarily in question in this research are those factors influencing the child in the home and family before, during, and after an EE program rather than those factors associated with an intervention itself. This study will assess the pro-environmental knowledge, attitudes, and behaviors (or beliefs) of students before and after a non-formal EE experience and attempt to identify patterns in the home teaching and family exploration of the environment before and after the program.

It is this researcher's assumption that select activities or discussions with parents and family members before, during, and after a non-formal program will influence that student's environmental beliefs and that program's ability to foster and retain environmental beliefs. If factors outside the intervention itself are important in determining the potential success of a non-formal program, then it will be essential to understand the background of students in predicting a program's outcome. Identification and description of these factors also provides the opportunity to engage

in programs and curricula designed to create those factors in the family and home that will be necessary as preparation for a program and responsible for retention of program effects.

DESCRIPTION OF STUDY AND STUDY DESIGN

Students attending a summer day camp at the Science Factory, a children's science museum, served as test subjects in this study. All consenting 3rd-8th grade students attending the summer camp program participated in the study. Camps under investigation included camps specifically designed to address aspects of environmental education and others with no intent to address environmental education as a discipline or any of its components. The study employed a pre-post-delayed post design with quantitative measures for data collection as well as a qualitative study of the students enrolled in environmental education camps to determine family and home factors present in individual students. Pro-environmental belief scores determined on the quantitative instrument were compared with trends in family and home factors found present in the qualitative study. Data on pro-environmental beliefs (knowledge, attitudes, and behaviors) were collected through a written questionnaire while data on family and home teaching and activities were collected through written questionnaire and personal interview. Only students participating in the experimental groups or environmental education camps were further studied through personal interview. The research then consists of two dependent studies; the first employs an experimental design to determine pro-environmental beliefs (pre-post-delayed post), and a second employs an in-depth observational study of factors related to those beliefs.

In addition to the above two original studies to address this research a third study was organized as desired by the host facility. The original written instrument comprised of family/home life questions and environmental belief questions was modified to include a set of questions meant to evaluate attitude toward science, demographics, general attitude about subject matter, and attitude toward camp (desired outcomes of the Science Factory). These questions were written by the Science Factory and modified to fit the format of the written instrument.

Many of the students in this study did not participate in a camp designed to address environmental content or meet EE objectives. Students attending a camp that included objectives that matched one or more EE objectives were used to measure correlations between specific family and home factors and the acquisition and retention of pro-environmental beliefs. All evaluations, including those given to students not attending a camp designed to address EE content, were used to compare relative pro-environmental beliefs and family/home factors and will be used by the Science Factory in an evaluation of effectiveness in meeting intended outcomes

SELECTION OF STUDY SITE AND STUDENTS

The study site for this research was selected by convenience in access and location. Furthermore, the program fit the need of the study in that it offered courses in EE in a non-formal setting to children. The program also offers non-formal programs that are not designed to address EE and could thus be used as a control. Many studies attempting to evaluate the impact of a program on children have utilized quantitative tools which are often criticized as invalid (Moyer 1977). In order to

produce a study that could evaluate students in-depth through interaction, interview, and exercises and could attempt to identify factors contributing to beliefs, it was found necessary to select a study site where the researcher could closely interact with students. The researcher serves as the summer camp instructor for many of the Science Factory camps including the experimental groups in this study.

Eugene, Oregon

The Science Factory is located in Eugene, Oregon, a town of more than 140,000 people. Eugene is the second largest city in Oregon and covers approximately 41.5 square miles. Eugene has a high percentage of professionals, and one third of the population has completed four or more years of college. Eugene is also the home of four institutions of higher education including the University of Oregon (City of Eugene 2004; City of Eugene 2004).

Eugene has a specific environmental policy that promotes a sustainable future. Eugene publishes its environmental responsibilities as to (Dietz, Kalof et al. 2002; City of Eugene 2004):

1. Support a stable, diverse and equitable economy
2. Protect the quality of air, water, land and other natural resources
3. Conserve native vegetation, fish, wildlife habitat, and other ecosystems
4. Minimize human impacts on local, regional, and worldwide ecosystems

Furthermore Eugene often advertises itself as a bicycle friendly community and one of the nations most livable communities.

Science Factory and Students

The Science Factory is a children's science museum with an objective to inspire interest toward science in children. The mission of the Science Factory is to "...engage, excite, and inspire children and those who work with children to explore science, technology, and humanity." They offer year round programs for individuals and school groups and operate a ten week summer camp program from late June through August. Camps are offered on a variety of topics in three age categories. Students participating in the programs enroll in camps from one of these three categories. Course content and activities vary and have included a focus on natural sciences, ecology, and conservation as well as various other topics. Students participate in both indoor and outdoor settings depending on instructor desire. Students attend camp for five consecutive days for either 3 or 7 hours per day depending on age. Those attending the 6^{th}-8^{th} grade camps may participate in an overnight in addition to their regularly scheduled camp times. The Science Factory is only one of many summer camp programs in the Eugene area. Many other programs in Eugene are designed to address environmental education exclusively.

On the first day of camp, all students and parents attending camp were given a letter from the Science Factory explaining the research as well as a formal informed consent document. Any students or parents who chose not to allow participation in this study were not asked to fill out the instrument. Students who did not participate in filling out the instrument took part in an alternate activity. Students in EE camps who did not choose to participate in this study did not fill out instruments and were not

assigned a time to meet with the researcher for an interview, nor were they contacted in the delayed post portion of the study.

Courses under study

Five courses were chosen based on convenience and content to serve as experimental groups in the pro-environmental belief study. The students from three of these courses served as subjects for a qualitative study of factors associated with beliefs. All other courses engaged in the summer camp program received the instrument portion of the assessment as part of a broader study of factors and as a control for comparison. Class sizes generally range in size from 2 to 15 individuals. The researcher had no previous knowledge of the students participating in these courses before selection. The name and objectives of the experimental courses are given here:

1. Blue Planet: A course for 6^{th}-8^{th} grade students designed to introduce marine ecosystems, natural resource issues, and marine conservation. Course included an overnight and two days of ocean exploration. (Interviewed)
2. Photo Safari: An outdoor photography course for 6^{th}-8^{th} grade students designed to introduce photography, observation skills, and the sense of wonder. The course was directed at the need to preserve and restore beauty and wilderness. This course included field trips. (Interviewed)
3. Wild Edibles: A course in plants, vegetables, cooking, and gardening for 3^{rd}-5^{th} grade students. This course was designed to teach students where food

comes from, how the land and its conservation affects what we eat, and the nature of sustainability. This course included various field trips. (Interviewed)

4. Mural Madness: An art course designed in part to assist in painting the interior of the Science Factory. The students studied the life and work of David Douglas, a regionally important naturalist and botanist. The course introduced environmental themes and ideas through art.
5. Future Power: An engineering course designed to study and develop alternative energy. The course focused both on the design of alternative energy but also on the need for alternative energy. Students were introduced to environmental problems and were invited to offer solutions.

OUTLINE OF METHODS

Study 1

All consenting students participating in three different EE day camp programs at the Science Factory were interviewed during the EE program. Interviews were directed at determining prior and current involvement in learning and activities in the home related to the learning of pro-environmental beliefs. The interview took place between the student and researcher and focused on previous and current experiences. A second follow up interview was intended but not conducted due to a lack of support for the project by students and parents.

Study 2

All consenting 3rd-8th grade students attending the summer day camp at the Science Factory participated in a pre-post-delayed post study of pro-environmental

beliefs, family and home life factors thought to relate to those beliefs, and overall attitudes toward science and the Science Factory experience. Students participating in a course with an objective to address one or more EE objectives were used in a study to compare course effects against family and home life factors. Students who did not participate in a course to address EE objectives were analyzed for correlations between environmental beliefs and family and home life factors.

The following is an outline of the study as it was conducted including the nature of each assessment and to what population each instrument was given. Both of the above studies are represented in the outline of assessments described below.

Experimental Group (EE Camps)

1. Pre-test of environmental beliefs, family and home factors, and intended program outcomes.
2. Student personal interviews regarding family and home environmental activities and learning.
3. Post-test of environmental beliefs, family and home factors during course, and intended program outcomes.
4. Delayed-test of environmental beliefs, family and home factors since course, and intended program outcomes.

Control Group (All Camps)

1. Pre-test of environmental beliefs, family and home factors, and intended program outcomes.

2. Post-test of environmental beliefs, family and home factors during course, and intended program outcomes.
3. Delayed-test of environmental beliefs, family and home factors since course, and intended program outcomes.

ASSESSMENT TECHNIQUES

Written Instrument

The written instrument was administered on three occasions, modified slightly on each occasion to collect relevant data. The instrument consisted of four smaller instruments each attempting to access unique information. Specific details about how the sections were constructed can be found below. The four sets of questions are divided as follows:

1. Demographics
2. Overall attitudes toward science and program
3. Family and home activities and teaching
4. Environmental attitude and knowledge scale

Modifications to the instrument were made only to the family and home activities and teaching section and overall attitudes section of the instrument. The modifications were made only to specify a new time frame for the activities. The pre-test asked about activities taking place before the camp, the post-test asked about activities taking place during the camp, and the delayed post-test asked about activities since the camp. The modifications were intended to collect data about three relevant

time periods in preparing students for the camp, reinforcing the camp, and providing an environment for retention.

The pre-tests were given on the beginning of the first day of camp and the post-test were given at the end of the last day of camp. The delayed post-test were mailed to the students home 6 weeks after program completion with a self-addressed stamped envelope to the Science Factory.

The complete text of each of these instruments can be found in the Appendix. Text size and formatting have been modified to fit the size restrictions of this document. The instruments delivered to students contained larger text and more generous spacing.

Demographics

Previous studies have supported the claim that demographic information is not a good predictor of pro-environmental beliefs (Dietz, Kalof et al. 2002). Furthermore, it is not the intent of this study to investigate the effect of demographics on pro-environmental beliefs. The demographics section of this study was included to identify students for comparison with pre-post-delayed post tests, identify the age of the individual, and learn whether the individual has previous experience with the Science Factory. Previous research has suggested that age plays a role in environmental belief and will be reviewed here (Wilson 1996). Questions about previous experience with the Science Factory were intended to investigate whether students with repetitive exposure to a novel environment or who have participated in a course several times will differ from those who have not. These prior experiences,

like the prior experiences under principle investigation, may play a role in program potential.

Overall attitudes toward science and program

Questions in this section of the instrument are primarily intended to identify whether the Science Factory is meeting its intended goals. Inclusion of these variables is based on the request of the facility to gain additional needed information from this research. Questions in this section of the assessment were intended to be used only as supplementary information although they were identified as important to this work in later analyses. The questions in this section of the instrument were designed to meet the specific needs of the Science Factory and are not based on any previous assessments.

Family and home activities and teaching

This section of the written instrument was intended to compliment the in-depth interviews taking place in this research. Questions for this section of the instrument were written by the researcher and are based on the experience of previous studies to identify factors associated with pro-environmental beliefs. Questions are derived from the formative experiences work suggested in Chawla's review of SLR research and from a similar study conducted by Eagles and Demare (Chawla 1998; Eagles and Demare 1999). Eagles and Demare found that environmental attitudes were highly correlated with talking about the environment and home, reading environmental books and magazines, and watching environmentally related media (Eagles and Demare 1999). Palmberg and Kuru found that outdoor activity was related to pro-

environmental behavior (Palmberg and Kuru 2000). In Chawla's review of SLR research he found that exposure to outdoor or natural areas was mentioned in every case as was family and parents. He also reported a correlation between the two noting the teaching of the value of natural things while exploring the outdoors as important (Chawla 1998). Tanner found that books, adults other than parents, and solitude were also important factors in determining environmental beliefs (Tanner 1980). The fourteen specific questions asked in this section can be found in the Appendix.

It is hoped that trends in the written instrument will correspond with those trends identified in the personal interviews to add to the power of a model of these factors. This section asked students only to report experiences or report the degree to which experiences occur. These questions were not intended to specifically address a domain, and it is not assumed that these questions are addressing a specific family and home factor domain although this assumption is reviewed. The personal interview work taking place as part in this research will inform any later attempts to use a quantitative instrument to identify family and home factors related to pro-environmental beliefs.

Environmental Beliefs Section

The first three sub-sets of questions in this section are based on the Children's Environmental Knowledge and Attitude Scale (Leeming and Dwyer 1995). The scale was developed for measuring the knowledge and attitudes of children in grades 1-7. The instrument was chosen based on its broad age range as well as its excellent reliability and tested validity. The instrument measures several categories of attitude

including verbal commitment, actual commitment (report behavior), and affect. Both the attitude section and knowledge section focus on questions from six dependent domains: animals, energy, pollution, recycling, water, and general issues (Leeming and Dwyer 1995). The questions addressed also relate well to the content areas presented in the Guidelines for Excellence standards documents (National Project for Excellence in EE 1999).

The CHEAKS was not used in its entirety for several reasons including readability, length of instrument, and intent of instrument. The knowledge section of this scale was removed in this research to limit the scope of the study and to shorten the length of the instrument. Furthermore, questions were removed and modified with author's permission based on a pilot of the instrument with 3^{rd}-8^{th} grade educators, administrators, and students. In the original instrument two questions from each subject domains were asked in each of the verbal commitment, actual commitment, and affect sections. As a result of the apparent need to shorten the instrument, only four questions were selected from each category containing 12 questions. Questions were selected from all subject domains based on perceived reading level.

The last three sub-sets on this section are based on Sia's 1984 dissertation instrument in identifying factors associated with environmental behavior and the model proposed by Hines et al. (Sia 1984; Hines, Hungerford et al. 1986). The sub-scales include two questions relating to a student's feelings of responsibility toward the environment, two questions relating to individual and group locus of control, and three questions about perceived knowledge of environmental issues and action skills.

Hungerford, Hines, and Volk proposed models for describing environmental behavior based on a series of factors. In Hines' model those factors found to be responsible for behavior are attitudes, locus of control, feelings of responsibility, and knowledge of actions, issues, and skills (Hines, Hungerford et al. 1986). Hsu used the model proposed by Hines to predict reported environmental behavior and found knowledge of action strategies, intent to act, area of residence and perceived skill in using action strategies as the best predictors of environmentally responsible behavior (Hsu and Roth 1998). Hungerford and Volk use the factors identified above by Hines in their model in which variables are divided into entry level, ownership, and empowerment variables. Those questions used in this analysis represent variables from all three categories (Hungerford and Volk 1990).

Interviews

Interviews were conducted with all consenting individuals in each of the experimental classes during the course of the camp. Interviews contained a series of open-ended questions that were presented in an informal interview process. Those family and home factors related to pro-environmental beliefs are largely unknown. Thus, an informal format that allows the researcher to explore factors that may be voiced increases the information rich nature of the interview process (Henerson, Morris et al. 1978). The specific questions asked in the interviews can be found in the Appendix and specifically ask students to qualify the formative experiences the written instrument asked them to quantify.

PILOT STUDY

A short pilot study was conducted on both the written instrument and the interview questions. The written instrument was given to and reviewed with five third grade students, five educators from grades 3-5, and one elementary school administrator. Several changes in formatting were made to the test including larger text, spacing between questions, and the inclusion of choices where choices had not previously been given. In addition, several words appearing in the original instrument were found to be consistently inappropriate for the audience and were replaced with synonyms.

One change requiring mention was the removal of the word *environment* from the written instrument completely. It was found that the word was not understood by third graders and was thought to be beyond the understanding of 3rd-5th graders by educators. The word was reluctantly replaced with the word *nature*. Although these words are certainly not synonymous and carry distinct and different connotations, the change was thought to be necessary and adequate at this age level. The words *environment* and *nature* were both used in interviews after thorough definition. Students' difficulty with understanding environment has been previously noted and researched in great detail. Loughland and Reid have shown that only one in seven children view the environment as a relationship and that education has a negative impact on that conception in primary school (Loughland and Reid 2002; Loughland, Reid et al. 2003).

In addition to changes made to the format of the written instrument, small changes were made to the format of the interview questions. Although the questions were written as open ended questions, many of the students consistently responded with one word or less than a sentence in response. After practice with this age range it was found that a dialogue with the student while subtly introducing the questions of interest produced a better response.

MODIFICATIONS TO METHODS

As would be expected in any research employing the assistance and cooperation of others, this research underwent continual modification throughout the research period. A brief discussion of these modifications is given here. A more thorough look at the implications of the modifications will be discussed in Chapter 5.

Originally two courses were designed to serve as experimental groups in this study. These courses along with all other courses designed for the Science Factory were published online and sent throughout Eugene. Enrollment in all courses and especially courses focusing on natural science was considerably low. One of the courses designed for this research was dropped by the facility due to lack of enrollment. In response, other courses taught by this researcher were chosen as hosts for the interview portion of this research. Thus, the students in three courses were interviewed as opposed to the original two in part due to cancelled classes and low enrollments.

To the surprise of this researcher it was found that a considerable portion of the students being interviewed came from unique family settings that would make

contacting them in the future very difficult. In addition, it was found as a surprise again that students recalled or were willing to share almost no interaction with their parents/guardians as it related to outdoor activity or environmental teachings. In fact, many students could not recall any positive interaction with parents/guardians. Although initial interviews were extremely useful in understanding the responses seen on the written instrument, it was decided that follow-up interviews would be unnecessary and potentially too great a burden on students and parents/guardians.

PSYCHOLOGICAL AND EDUCATIONAL MODELS

The data collected is based on the principle assumptions of two models. The first is a model of learning that suggests that what we learn is a product of personal, social, and environmental factors over time. The second is a model of pro-environmental beliefs and its distinct components. Using these two models derived from the work of others, two further models will be designed for further understanding. The first of these new models will suggest a typology of family and home factors that contribute to different levels of program potential and environmental beliefs. The second will use these modeled types to suggest where these factors fit in the above model of pro-environmental belief.

The Contextual Model of Learning

The existing model for learning was developed by Falk and Dierking and is described as The Contextual Model of Learning and is presented in Figure 1 of Chapter 2. Learning is dependent on personal context, physical context, and sociocultural context. Learning is further dependent on previous learning and contexts

and will be influenced by future learning and contexts (Falk and Dierking 2002). Therefore, learning at a non-formal EE center is dependent on previous learning and contexts and will be influenced by the learning and contexts that exist after the program is over. An understanding of the learning and context for learning a student brings to a program and the learning and contexts they will return to after completion will assist in understanding selective effectiveness and can aid in attempts to improve programs.

Model of Pro-environmental Belief

Based on the models proposed in previous research on responsible environmental behavior (See Figure 3), and Bandura's model of reciprocal determinism (See Figure 2)(Bandura 1977), a new model is proposed for understanding environmental beliefs in general. Bandura suggested that behavior influences and was influenced by the person and by the environment (Bandura 1977). Hines et al. described the two factors influencing behavior as intentions to act and situational factors. Hines et al. also suggests that the intent to act is based on attitudes, knowledge, responsibility, and locus of control (Hines, Hungerford et al. 1986). Combining these two models produces a model for understanding beliefs that is reciprocal as Bandura suggested and specific to environmental beliefs as Hines showed. Thus, the model proposed by Hines et al. is thought to be more informative when connections are thought of as reciprocal rather than unidirectional. The model proposed in Figure 11 of Chapter 5 is based on this assumption.

EXPECTED OUTCOMES

Several outcomes of this study are expected based on the literature reviewed. Primarily, it is expected that a series of life experiences specific to the home and family will be found to reoccur among those students with the highest pro-environmental beliefs and those who demonstrate the greatest change in belief after the summer camp. It is not expected that only students with these experiences will demonstrate pro-environmental beliefs, but rather that a visible trend will exist to support the claim that these experiences are playing a role in belief formation and the ability of a program to help foster and retain those beliefs.

In addition, the scores on the environmental belief instrument are expected to go up in the experimental courses but not uniformly throughout the class population. It is not certain whether or not the mean score for the class will change or remain the same, however it is expected that some students will experience a change and that this difference can be partially explained when including family and home life data.

OUTLINE OF RESEARCH QUESTIONS

The following is a general list of questions that this research has been designed to address and that have been referred to throughout this research:

1) Are any of the factors explored in this research as requested by the Science Factory (age, gender, grade, attitude toward camp, attitude toward science, perceived knowledge, etc). related to a students overall environmental belief, change in environmental belief, or any of its components?

2) Do any or all of the family variables correlate with a students environmental belief , change in belief, or any of its components?
3) Are the components of environmental belief used here (verbal commitment, actual commitment, affective dimensions, responsibility, locus of control, or perceived knowledge) related in any way and can they be said to be addressing a similar domain?
4) Are the numerous family variables asked about in this research related in any way and can they be said to be addressing a single domain?
5) Do environmental beliefs change over the period of a five day course?
6) Do environmental beliefs change over the period of a five day course for specific and potentially predictable individuals?
7) Are there any observable changes in environmental belief among students after six weeks?
8) What can be said about the relative relationship of the family variables before the initiative, during the initiative, and after the initiative, with environmental belief, change in environmental belief, or any of its components?
9) Are the family and home life factor scores valid when compared to personal interviews with individual students?
10) What added information can be gained about how family and outdoor experiences have affected students from interviews?

The questions involved in this research are provided here in list form rather than as a hypothesis because of the exploratory nature of the study. Although there were a set

of hypotheses on which this research was designed, the research allowed an investigation of other questions to which this researcher did not feel prepared to suggest an answer.

PRESENTATION OF DATA

The data collected in this study will be presented in several ways. Those family and home life factors found consistently present among individuals with pro-environmental beliefs or those who experience a change in belief will be presented as a typology. The typology will suggest types of family and home life experiences and how they influence belief and program potential to foster and retain beliefs.

These experiences or factors found present will then be incorporated into the models designed by Hines (Hines, Hungerford et al. 1986) and others to produce a more content rich model of how pro-environmental beliefs are formed. This model will necessarily need to be expanded by the research of others, as not all aspects of belief or how they are formed are explored in this study.

Finally, data collected through the pre-post-delayed post experimental study on beliefs will be analyzed statistically and presented as a tool in suggesting whether the EE programs at the Science Factory do change pro-environmental beliefs, what kinds of beliefs, and whether those beliefs are retained. Whether this change is uniform or selective based on course or individual will also be explored.

ANALYSIS OF DATA

The data collected from the written instrument, from personal interviews, and from observation were analyzed according to the outline of research questions

presented above. Many of the research questions were answered or addressed through statistical analysis while others were addressed by means of qualitative comparison. The research questions and the manner in which they were addressed are listed below.

Questions 1,2,8

Both questions one and two ask whether or not there are any relationships between questions asked about demographics, general attitudes, family and outdoor experience and environmental beliefs. These questions were addressed in several ways. First, a correlation matrix was constructed to test for correlation using Pearson's correlation coefficient. Statistically meaningful correlations were then identified and described. In addition, a multiple regression analysis was conducted on environmental beliefs as a function of all of the above factors. Question eight is addressed by analyzing whether the family factors asked on each iteration of the instrument relate differently to environmental beliefs. Thus, multiple sets of correlations and regressions will be conducted. Those factors found to meaningfully predict or explain an individuals environmental belief were then identified and explained. Finally, considerable commentary is given to how the interview questions and observations contribute to or conflict with data gathered from the written instrument. This information rich discussion is intended to demonstrate the validity of the written instrument as well as describe in greater detail any relationships identified.

Questions 3,4

Questions three and four are questions of relationship as well as questions of the reliability of the instrument given. The degree to which the family variable

questions are related and the degree to which the environmental belief questions are related is explored both through a item-total item correlation as well as through a test of internal consistency utilizing Cronbach's alpha. Questions found to have poor reliability are identified.

Questions 5,6,7

Questions five, six, and seven are all questions of comparison. Each of these comparisons are made using paired t-tests. When the total population of students is under consideration paired t-tests are conducted among the total population. When the question of interest involves students from a particular subset of the population then a descriptive factor is given to the population and the comparison is made among populations. In several cases an analysis of variance (ANOVA) may have served as a more appropriate measurement based on unequal population sizes. However, the results from both the t-test and a one-way ANOVA produce identical responses as to probability or significance. T-tests have been used to suggest mean differences, however it is recognized that these estimated means may be viewed critically. In either case the results are meant to suggest whether some factor is affecting change and not meant to specifically quantify any difference.

Question 9,10

Answers to questions nine and ten were explored through a comparison and description of responses to interview questions. A thorough description of the responses given is provided in Chapter 4 and implications are discussed in Chapter 5. In addition, where information gathered in this analysis pertains to any of the previous

questions, that information is provided alongside the analysis of the written instrument for that particular question.

Overall results

Although the outline of research questions and the answers to those research questions are of considerable interest. The way in which the answers to those questions can be used to inform environmental education is of primary concern. A thorough description of how these results might be interpreted and the ways in which these results might contribute to existing models for understanding environmental beliefs and environmental education is given in Chapter 5.

The chapter that follows describes the results of a large number of analyses meant to address the ten questions of interest described above. Results of the analyses have been provided in table form when appropriate, but in many cases the nature of the results are not suitable for quantitative description. The lengthy discussions of interview responses and observations are meant to be and are necessarily pertinent to complete understanding of the information gathered in this research.

CHAPTER 4

RESULTS

> "Scientific facts are essential. But a scientist who has lost a sense of wonder, or scientists who try to teach facts without feeling, will not find their work transformed into the wisdom and knowledge that the times so urgently require." ---Kathleen Moore (Moore 2004, p.16)

This research investigates the importance of family and home experiences pertaining to environment on the development and retention of environmental beliefs. Information on this relationship has been collected largely in four ways. The first has been the review of research reporting on factors associated with environmental beliefs and reporting specifically on the notion that family and outdoor experiences may be of importance in understanding beliefs. The second source of information on this relationship has been data collected from a written instrument administered to 3rd-8th grade students in a pre, post, delayed-post fashion. This instrument, as described in the previous chapter, attempted to access information from a variety of dependent domains and contained four parts: demographics, overall program attitudes, family and home life factors, and environmental beliefs. The third source of information is derived from personal interviews conducted with students concerning the experiences and events in their lives that have introduced them to their surroundings and environmental issues. The fourth and final source of information is simply the observation of and interaction with students attending camps at the Science Factory. This last source of information, albeit biased, should not be undervalued. In addition to these four sources of information, the ways in which these four sources of

information have proven to support or challenge each other is also of importance and will be reviewed here. Data supporting conclusions drawn from one source of data will be compared with data from other sources in order to demonstrate the validity of inferences that may be drawn.

The results of this research are reported by both the method by which the data was collected and by the research question of interest. This chapter will first outline a brief portion of the literature reviewed as a source for answers to the questions of interest. After this review, the data from the written instrument will be outlined by research question. When appropriate, information from both interviews and observations will accompany these results. After the results from the written instrument a more thorough description will be given of the interview responses and then of observations made while conducting this research and serving as an instructor at the host facility. A description of how these results inform existing models for understanding environmental beliefs and environmental education is given in Chapter 5.

LITERATURE REVIEW REVISITED

In the opening paragraphs of Chapter 2 a series of principle assumptions were outlined and were then addressed systematically throughout the literature review. These principle assumptions, when documented, become evidence of the relationship under question and are the results of a careful research initiative employing an exhaustive review of literature reporting on factors relating to environmental beliefs and the effectiveness of environmental education. While each of these assumptions

were addressed in the review, the results of that review as pertaining to the principle thesis of this research are documented here.

It is pertinent to the usefulness of this line of research to demonstrate the selective effectiveness of EE initiatives. In a review of the effectiveness of non-formal and formal EE initiatives to address goals of fostering knowledge, attitude change, and behavior change it was found that initiatives are indeed selectively effective. Positive, negative, and null effects on intended objectives are documented in the research (Leeming, Dwyer et al. 1993). Furthermore, the National Advisory Committee has reported on this same issue (National Environmental Education Advisory Council 1996). The results of this review suggest that understanding factors associated with environmental belief and the fostering of environmental beliefs is of use.

In addition to the selective effectiveness throughout EE initiatives, the effectiveness of an initiative within a class population was also explored. While this question does not appear to have been reviewed to any great extent in the literature, several observations and notes on this possibility have been documented (Kostka 1976).

This selective effectiveness within the population of students attending an EE initiative can be understood, in part, by reviewing the models proposed for predicting environmental behavior (Hines, Hungerford et al. 1986; Hungerford and Volk 1990; Hsu and Roth 1998). Many of these models for understanding environmental behavior

suggest the potential for situational factors to influence environmental behavior, and thus contribute to environmental beliefs.

A description of these situational or external variables does not yet exist, but it has been suggested by the significant life experiences research that these variables include the degree to which a person has become introduced to outdoor settings, the family, and a relationship between these variables in childhood or inclusively a term sometimes referred to as environmental sensitivity in the research.

Therefore, the results of the literature review suggest that two interacting factors involving an individual's family and an individual's time spent outdoors are related to an individual's overall environmental beliefs and that these factors may affect an educational initiative's success. While this assumption is supported by common sense, it does not appear to play a large role in the development of EE initiatives or in the delegation of funds to increase public awareness of environmental issues. The proof and then realization of this relationship would likely alter the manner in which EE initiatives are designed and potentially the target audience for these initiatives.

WRITTEN INSTRUMENT OVERVIEW

The written instrument was administered in full or in part to 218 consenting students. The written instrument required approximately ten minutes to complete. However, a few students required as long as 20 minutes to complete the instrument. Observation would suggest that these students required additional time because of thoughtful response rather than difficulty in reading. The instrument was given in part

as the result of student absence or as the result of the instructor failing to administer some portion of the test. In addition, the delayed-post test was administered by mail and therefore had a lower response rate than those previous instruments administered in the classroom. A description of the results of this instrument, how data was handled, and the reliability and validity of this instrument are described below.

Missing or invalid data

Before addressing the results of this instrument it is necessary to first describe how the data was handled during the analysis. There were errors in both how the instrument was administered and in how it was filled out. Instrument data was removed from the overall data set for a series of reasons related to these errors. In most cases instruments were removed from the data set as a result of being administered repetitively to the same individual. This occurred often and is the result of students enrolling in more than one class during the summer without the instructor's knowledge. Only the first instrument filled out by a student was used in the final data set. In addition, seven instruments were found to have the same number circled on every question in multiple parts of the test. All tests having the same number circled on every question in multiple parts of the instrument were removed. These students were presumed to have filled in the test without reading it. Observation of students and instructor comment support this inference. In addition, a number of tests were removed for being incomplete. All tests with more than three missing data points were removed. In many cases this included students who had skipped a page or more of the instrument or had failed to finish the instrument. Instruments containing three

or fewer missing data points were assigned the mean response for that question and used in analysis. After removal of all instruments for above reasons the data appeared both normally distributed about environmental belief scores and free from severe outliers.

Outliers persisting in the data were all examined to identify any reason for removal. No evidence was found that the outliers were from a distinct population. A visual analysis of outliers appearing in data sets suggests they will have little or no effect on results. In all cases, the removal of outliers had no effect on the acceptance or rejection of a null hypothesis when analyzed without outliers. These outliers do affect the mean score, but are included in all analyses as there is no evidence to warrant their removal.

After removing data for the above reasons complete data sets were analyzed. The number of responses in each data set is presented in Table 1.

Table 1

Number of complete data sets of each iteration of the written instrument

114	Complete Pre-tests
79	Complete Post-tests
64	Complete Pre/Post Sets
34	Complete Delayed-tests

All four data sets are used in this research. The data set used in any analysis is based on the question of interest. All questions of comparison between pre-test and post-test utilize the 64 complete combined sets. However, because of the greater number of individuals in the other data sets, the larger data sets are used when a

comparison was unnecessary and the question of interest pertains only to a single test, either pre-test, post-test, or delayed post-test. Little attention will be given to the delayed-post test because of its size. The sample size of 34 contained only seven individuals enrolled in EE courses and makes quantitative comparison difficult. The data is reviewed and reported where appropriate, but should be viewed only as suggestive as the size makes inference questionable. When a comparison is needed to demonstrate effect of program, the pre-tests are compared to post-tests. In the event that the delayed post-test is used in any analysis it is specifically stated.

DESCRIPTIVE STATISTICS

Demographics and Overall Attitudes

The first section of data collected from the instrument included demographics as well as overall attitudes toward the program. Descriptive statistics for this section of the instrument are given here as they have the potential to benefit the Science Factory in development. Descriptive statistics for other sections of the written instrument are not given here, but are analyzed in greater depth in later analyses. The data for demographic and overall attitudes is summarized in Table 2 for three sets of data. The first part of the table represents the data summarized from all pre-tests collected, the second summarizes data from all post-tests, and the third summarizes the sample that completed both. Any evidence of change in overall attitude is reviewed after the presentation of data in this section.

The grade indicated by Table 2 is the grade in which the student expected to be enrolled the following year. The exposure value is a summary of three questions

relating to prior experience with the Science Factory or questions (1,2,3). The high and low scores indicate the range of possible responses. Under the motivation section, responses are divided by whether the student was self motivated to attend, motivated by an external pressure (parent requirement), or for both reasons. A (P) indicates the score originates from the post-test. A copy of the questions asked can be found in the Appendix.

Table 2

Demographic and Overall attitude means from each iteration of the written instrument

Pre-Test Data

Gender	**Age**	**Grade**	**Exposure**	**Motivation**
71 Male	Mean: 9.8	Mean: 4.9	Mean: 0.79	Self: 70
42 Female	High: 13	High: 8	High: 3	Other: 7
	Low: 7	Low: 2	Low: 0	Both: 34
Knowledge	**Excitement**	**Science**	**Future**	
Mean: 3.0	Mean: 4.2	Mean: 4.1	Mean: 3.8	
High: 5	High: 5	High: 5	High: 5	
Low: 1	Low: 1	Low: 1	Low: 1	

Data from Post-Test

Gender	**Age**	**Grade**	**Exposure**	**Motivation**
49 Male	Mean: 9.6	Mean: 4.7	Mean: 0.83	Self: 51
29 Female	High: 13	High: 8	High: 3	Other: 5
	Low: 7	Low: 2	Low: 0	Both: 21
Knowledge	**Excitement**	**Science**	**Future**	**Sharing**
Mean: 4.0	Mean: 4.2	Mean: 4.1	Mean: 4.0	Mean: 3.7
High: 5	High: 5	High: 5	High: 5	High: 5
Low: 1	Low: 1	Low: 1	Low: 1	Low: 1
Fun				
Mean: 4.5				
High: 5				
Low: 1				

Table 2 (Continued)

Data from Set containing Pre and Post-Test

Gender	**Age**	**Grade**	**Exposure**	**Motivation**
41 Male	Mean: 9.6	Mean: 4.6	Mean: 0.85	Self: 39
24 Female	High: 13	High: 8	High: 3	Other: 3
	Low: 7	Low: 2	Low: 0	Both: 20
Knowledge	**Excitement**	**Science**	**Future**	**P. Motivation**
Mean: 3.0	Mean: 4.2	Mean: 4.3	Mean: 3.9	Self: 41
High: 5	High: 5	High: 5	High: 5	Other: 4
Low: 1	Low: 1	Low: 1	Low: 1	Both: 19
P. Knowledge	**P. Excitement**	**P. Science**	**P. Future**	**P. Sharing**
Mean: 4.1	Mean: 4.2	Mean: 4.1	Mean: 4.1	Mean: 3.7
High: 5	High: 5	High: 5	High: 5	High: 5
Low: 1	Low: 1	Low: 1	Low: 1	Low: 1
P. Fun				
Mean: 4.5				
High: 5				
Low: 1				

In order to better understand the overall success of the Science Factory at meeting its objectives, several of the variables above are listed as percentage values. The score for (P.Sharing) refers to question 10 on the instrument which asked whether the student talked about the things they learned with family or friends. Twenty three percent of all students strongly agreed that they talked about the information while another 48% agreed at such. The score for (Fun) refers to question 11 on the instrument which simply asked whether the students had a good time at camp. Sixty

three percent of the students strongly agreed with the statement while another 30% agreed.

INSTRUMENT RELIABILITY (QUESTIONS 3,4)

The reliability of the written instrument was analyzed by looking at the item-total item correlation within questions addressing a similar domain and the Cronbach's alpha for these sets of data. The family and home life factor portion of the instrument is reviewed first. After a review of the family data a review is given of the environmental beliefs section of the instrument. Neither the demographics nor overall attitudes section were analyzed as no questions were thought to address a similar domain and are not used extensively in any analysis.

Family and home life Factors

Of primary interest in this evaluation is the relationship or correlation between items on the family and home factors subset of questions on the written instrument and whether these 14 questions access a distinct domain. Cronbach's alpha was calculated for each iteration of the test and found to be high in each case. Alpha for pre-test was found to be .905, for the post-test it was found to be .896 and for the delayed post-test it was found to be .902 (See Table 3).

Table 3

Cronbach's Alpha calculations for each iteration of the family and home factors section of the written instrument

Reliability Statistics (Pre-Test)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N
.905	.903	14

Reliability Statistics (Post-Test)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N
.896	.896	14

Reliability Statistics (Delayed Post-Tests)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N
.902	.906	14

In addition to the overall alpha on this subset of questions, an item-total item correlation matrix and the alpha if the item were deleted were calculated for each of the fourteen questions and are presented in Table 4. All questions were found to be correlated with all other questions despite the range of questions asked in this section. One question, question thirteen on the post-test was found to decrease overall alpha. However, the change in alpha was small and later analysis did not warrant the removal of this item for any apparent reason. It is important to note that these fourteen questions were not necessarily thought to be correlated and are not necessarily correlated in demonstrating that any one of the actions are correlated with environmental beliefs. For example, time spent outdoors alone was found correlated

with whether a student enjoys spending time outdoors with family. It may have been that solitude and the desire for solitude are solely responsible for environmental belief formation. Then these experiences may not have been found correlated and they would not have both been found correlated with environmental beliefs. However, because this analysis and others performed later suggest a strong correlation between these 14 factors, they are used as a whole when needed to refer to the degree to which the family and home has introduced nature and environment. This factor is referred to as the family index in this research.

Table 4

Item-Total Item Correlation and Chronbach's Alpha if item Deleted for Family and home factor section of each iteration of the written instrument

Item-Total Statistics (Pre-Test)

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Fam1	38.63	118.220	.656	.556	.896
Fam2	37.32	122.206	.506	.373	.902
Fam3	38.50	115.487	.698	.686	.894
Fam4	38.76	116.848	.642	.544	.897
Fam5	38.38	113.399	.652	.522	.896
Fam6	39.01	121.481	.530	.383	.901
Fam7	38.74	123.526	.428	.368	.905
Fam8	38.47	116.852	.643	.548	.897
Fam9	37.60	119.963	.551	.535	.900
Fam10	38.79	114.146	.710	.619	.894
Fam11	37.05	125.577	.440	.462	.904
Fam12	37.83	115.860	.718	.703	.894
Fam13	37.02	123.960	.475	.525	.903
Fam14	38.13	114.009	.768	.730	.891

Table 4 (Continued)

Item-Total Statistics (Post-Test)

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Fam1	33.90	120.253	.713	.652	.883
Fam2	32.74	121.814	.559	.467	.890
Fam3	34.20	121.084	.682	.651	.885
Fam4	34.03	122.385	.604	.612	.888
Fam5	33.45	118.024	.668	.551	.885
Fam6	34.23	125.980	.466	.548	.894
Fam7	34.30	124.359	.663	.698	.886
Fam8	34.02	121.274	.715	.604	.884
Fam9	33.29	125.644	.430	.475	.897
Fam10	34.11	119.121	.727	.713	.883
Fam11	31.88	129.997	.438	.492	.894
Fam12	32.69	123.105	.661	.793	.886
Fam13	31.84	135.672	.229	.355	.901
Fam14	33.04	121.638	.623	.750	.887

Item-Total Statistics (Delayed Post-Test)

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Fam1	37.40	98.659	.612	.659	.894
Fam2	36.58	98.669	.697	.761	.891
Fam3	38.12	98.529	.708	.684	.891
Fam4	38.00	100.500	.464	.607	.901
Fam5	37.76	98.554	.525	.565	.899
Fam6	37.88	103.076	.489	.642	.899
Fam7	37.76	97.924	.588	.658	.896
Fam8	37.97	98.951	.638	.715	.893
Fam9	36.79	98.520	.529	.774	.899
Fam10	37.79	95.764	.734	.759	.889
Fam11	35.88	101.463	.590	.644	.896
Fam12	36.40	99.732	.675	.901	.892
Fam13	35.85	105.423	.564	.649	.898
Fam14	36.64	97.348	.665	.895	.892

Environmental Beliefs

The items on the environmental belief section of the written instrument have been taken from a series of instruments as well as written independently based on research conducted on factors relating to environmental beliefs. A clear defense of the items chosen in this portion of the instrument can be found in both Chapters 2 and 3. The environmental beliefs section was divided into six parts: verbal commitment, actual commitment, affect, responsibility, locus of control, and perceived knowledge. The results presented in Table 5 are from a series of analyses that assumed all of these items were addressing a single environmental belief score. The cronbach's alpha for all iterations of this instrument were high (pre-test, .931)(post-test, .939)(delayed post-test, .903).

Table 5

Cronbach's alpha calculations for environmental beliefs section of each iteration of the written instrument

Reliability Statistics (Pre-Test)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N
.931	.930	19

Reliability Statistics (Post-Test)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N
.939	.940	19

Reliability Statistics (Delayed Post-Test)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N
.903	.907	19

In addition to the overall alpha for the environmental beliefs section, a test of the item-total item correlation appears below in Table 6 along with the alpha if any individual item were deleted. The results suggest that all items are highly correlated and would adversely affect the internal consistency of the instrument if deleted.

Table 6

Item-Total Item Correlation and Cronbach's alpha if item deleted for environmental belief section for each iteration of the written instrument

Item-Total Statistics (Pre-Test)

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
V1	122.15	1182.220	.480	.348	.931
V2	120.91	1186.380	.497	.387	.930
V3	120.99	1133.137	.766	.702	.924
V4	120.65	1172.457	.574	.507	.928
A1	122.29	1132.552	.703	.631	.925
A2	119.36	1238.814	.286	.303	.933
A3	119.68	1236.008	.342	.493	.932
A4	121.81	1165.736	.630	.619	.927
AF1	121.82	1130.212	.761	.659	.924
AF2	120.63	1158.113	.690	.570	.926
AF3	119.68	1192.729	.615	.540	.928
AF4	120.95	1152.077	.678	.614	.926
C1	121.71	1139.235	.738	.616	.925
C2	120.44	1149.711	.743	.714	.925
R1	122.38	1149.956	.693	.872	.926
R2	122.18	1149.289	.693	.887	.926
K1	120.10	1190.521	.547	.529	.929
K2	120.62	1153.275	.713	.747	.925
K3	120.44	1172.079	.602	.698	.928

Table 6 (Continued)

Item-Total Statistics (Post-Test)

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
V1	124.63	1301.009	.574	.584	.937
V2	123.55	1306.023	.550	.585	.938
V3	123.76	1272.164	.735	.705	.934
V4	123.12	1329.912	.546	.521	.938
A1	125.49	1286.857	.603	.544	.937
A2	123.08	1306.476	.519	.576	.938
A3	122.94	1305.993	.696	.603	.935
A4	124.64	1272.401	.749	.672	.934
AF1	123.77	1282.518	.691	.670	.935
AF2	123.23	1284.419	.769	.708	.934
AF3	122.66	1334.022	.533	.570	.938
AF4	123.76	1284.264	.691	.680	.935
C1	125.17	1266.883	.694	.578	.935
C2	123.40	1274.978	.754	.716	.934
R1	125.33	1253.965	.752	.840	.934
R2	125.21	1253.301	.730	.799	.934
K1	122.75	1331.439	.594	.632	.937
K2	123.09	1306.220	.650	.669	.936
K3	123.17	1330.199	.514	.639	.938

Table 6 (Continued)

Item-Total Statistics (Delayed Post-Tests)

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
V1	135.59	762.546	.394	.608	.902
V2	134.97	740.272	.606	.765	.896
V3	135.50	715.463	.709	.819	.893
V4	135.15	723.940	.726	.741	.893
A1	136.67	706.451	.736	.874	.892
A2	134.94	755.139	.361	.606	.904
A3	135.17	714.506	.693	.826	.893
A4	136.97	712.452	.631	.678	.895
AF1	136.00	762.284	.390	.800	.902
AF2	135.56	775.366	.262	.812	.907
AF3	133.85	780.420	.585	.847	.899
AF4	135.06	744.170	.599	.858	.896
C1	136.59	699.459	.707	.820	.892
C2	134.79	750.330	.519	.858	.898
R1	136.76	726.911	.578	.882	.897
R2	136.23	729.939	.645	.918	.895
K1	134.32	774.578	.421	.794	.901
K2	133.88	789.488	.481	.586	.901
K3	134.38	774.158	.505	.847	.899

Although all of these items are apparently correlated and are reasonably addressing a single factor, a factor labeled environmental belief here, it is important that there are six distinct divisions in questions. The data in Table 7 are from a series of tests as to whether the items within each section of the environmental belief instrument are internally consistent. First, a series of Chronbach's alphas for each division of data are given. In each case, alpha is high and supports the claim that the data is internally consistent.

Table 7

Cronbach's Alpha for each of the six sections of the environmental belief section

Alpha on Pre-Test

Section	Cronbach's Alpha	Cronbach's alpha based on standardized items	N of items
Verbal	.717	.719	4
Actual	.671	.681	4
Affect	.830	.834	4
Control	.814	.815	2
Responsibility	.961	.961	2
Knowledge	.849	.848	3

Alpha on Post-Test

Section	Cronbach's Alpha	Cronbach's alpha based on standardized items	N of items
Verbal	.793	.793	4
Actual	.751	.764	4
Affect	.817	.817	4
Control	.715	.719	2
Responsibility	.924	.925	2
Knowledge	.835	.837	3

Alpha on Delayed Post-Test

Section	Cronbach's Alpha	Cronbach's alpha based on standardized items	N of items
Verbal	.766	.767	4
Actual	.747	.751	4
Affect	.684	.727	4
Control	.720	.735	2
Responsibility	.909	.913	2
Knowledge	.797	.808	3

Table 8 gives the item-total item correlation between items addressing a specific component of the belief instrument and the alpha on that section of the data if the item were deleted. Although the data are represented in a single table, the analysis looked at each portion of the instrument separately where items on the verbal section, for example, are analyzed against only other verbal items. Although correlation values and alphas are lower in this analysis, as would be expected with fewer total items in comparison, the values are still high and suggest internal consistency within each component of this instrument.

Table 8

Item-Total Item correlation and Cronbach's alpha if item deleted for each section of the environmental beliefs section

Alpha on Pre-Test

Item	Corrected Item-Total Correlation	Cronbach's Alpha if item Deleted
V1	.417	.710
V2	.485	.667
V3	.640	.571
V4	.489	.665
A1	.407	.649
A2	.339	.671
A3	.524	.571
A4	.579	.512
AF1	.678	.778
AF2	.701	.765
AF3	.636	.800
AF4	.637	.796
C1	.688	NA
C2	.688	NA
R1	.924	NA
R2	.924	NA
K1	.641	.857
K2	.797	.709
K3	.719	.787

Table 8 (Continued)

Alpha on Post-Test

Item	Corrected Item-Total Correlation	Cronbach's Alpha if item Deleted
V1	.618	.735
V2	.592	.749
V3	.679	.703
V4	.534	.775
A1	.419	.769
A2	.487	.730
A3	.658	.648
A4	.675	.621
AF1	.623	.778
AF2	.765	.711
AF3	.507	.825
AF4	.672	.753
C1	.561	NA
C2	.561	NA
R1	.860	NA
R2	.860	NA
K1	.682	.789
K2	.737	.729
K3	.678	.791

Table 8 (Continued)

Delayed Post-Test

Item	Corrected Item-Total Correlation	Cronbach's Alpha if item Deleted
V1	.433	.779
V2	.500	.744
V3	.638	.669
V4	.712	.632
A1	.590	.662
A2	.474	.727
A3	.626	.643
A4	.488	.720
AF1	.533	.572
AF2	.438	.656
AF3	.574	.620
AF4	.457	.624
C1	.581	NA
C2	.581	NA
R1	.840	NA
R2	.840	NA
K1	.710	.668
K2	.588	.801
K3	.697	.663

As one further indication of the relationship between the six components of the environmental belief scale, an analysis was conducted on the internal consistency of the instrument where the sum of responses from each component were compared for correlation (See Table 9). In this analysis the data was assumed to originate from six items rather than the 19 written items where the six responses are the sum of responses from each section. A high correlation and internal consistency was found between items when evaluated in this way (See Table 9)(See Table 10). As a result of the high

correlation within and between questions on each subset of the belief section, an overall environmental belief score is used in this research that is formed as the sum of the scores on each of the six subsets of the environmental belief instrument. This score is referred to as overall environmental belief and contains the six components already spoken of.

Table 9

Cronbach's alpha for environmental belief section of written instrument where sum of each of six components is used

Reliability Statistics (Pre-Test)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.892	.900	6

Reliability Statistics (Post-Test)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.904	.912	6

Reliability Statistics (Delayed Post-Test)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.836	.843	6

Table 10

Item-total item correlation and Cronbach's alpha if item deleted for environmental beliefs section where sum of each of six components is used

Pre-Test

Item	Corrected Item-Total Correlation	Cronbach's Alpha if item Deleted
Verbal	.766	.865
Actual	.680	.878
Affect	.817	.856
Control	.793	.870
Responsibility	.663	.882
Knowledge	.654	.881

Post-Test

Item	Corrected Item-Total Correlation	Cronbach's Alpha if item Deleted
Verbal	.718	.893
Actual	.829	.872
Affect	.812	.875
Control	.815	.885
Responsibility	.736	.889
Knowledge	.623	.902

Delayed Post-Test

Item	Corrected Item-Total Correlation	Cronbach's Alpha if item Deleted
Verbal	.759	.776
Actual	.765	.779
Affect	.513	.829
Control	.676	.804
Responsibility	.582	.817
Knowledge	.488	.834

Instrument validity

The validity of the written instrument can be addressed in several ways. First, items for the instrument were selected based on an extensive review of literature in this field. In every case, the item selected was either taken from an instrument that had already been used extensively, or supported by a direct claim in the research regarding the factors responsible for or related to environmental beliefs. The selection of these items was discussed in Chapter 3. All questions used in the environmental belief portion of the written instrument additionally conformed to the National EE standards documents and the concept of EE as outlined by UNESCO. Thus, there is evidence of the instrument's content validity on the family factors and environmental beliefs section of the instrument.

In addition, the personal interviews conducted as part of this research allow for a qualitative review of instrument questions and a measurement of construct validity. Although a series of concerns emerged in this comparison, it was apparent that those students describing poor involvement with family and friends in interviews also scored lower on the family factors portion of the written instrument. Additional interviewing would be necessary or additional measurements would be necessary to further establish the written instrument's construct validity

Finally, five school teachers and one elementary school administrator were asked to review the instruments before they were given. After modifying format, text size, and the wording of several questions, these reviewers felt the instrument could be read and understood by the age level of interest. While this does not guarantee that the

instrument is measuring the concept under question, it does suggest that the respondents are likely responding to the questions being asked rather than responding to a misconception of what the question means.

Ultimately, predictive validity would provide the most convincing evidence that an instrument is measuring what it is said to measure. However, predictive validity is difficult to measure in this research for several reasons. First, it is difficult to know what a student actually believes and nearly as difficult to know how they behave. Students are not under long term observation and the researcher did not have direct access to the students after their camp. Predictive validity of this instrument may be established through long-term observational studies looking at the beliefs and actions of students involved in the study.

As already mentioned, several concerns emerged when the written instrument responses were compared to interview responses. Comments are made here about how the interview process proved to validate or invalidate the instrument. First, it is apparent that the fourteen questions chosen to address family and home life factors are indeed viewed by the students as learning experiences about the environment. When asked to describe the conversations and activities the student engages in, most descriptions matched those items listed on the instrument itself. The most frequently mentioned activity was spending time outdoors with friends. This item and others related to it appeared on the instrument.

The interviews and observations do suggest a reason to question how each student interpreted the words "family" and "parents". Many of the students involved

in this research came from unique family settings that may have made answering questions about activities or teaching with family or parents difficult. This observation is reviewed in detail later in this document. One further potential problem exists in a student's interpretation of nature and environment. One of the questions asked on the instrument addressed whether students talk about nature with their parents. In interviews, this question was asked again and students were invited to explain the content of these conversations. The content related by these students ranged from ways to protect the environment to who should be the next U.S. President or when and how to feed the hummingbirds outside. This wide range of conversations regarded as conversations about the environment suggests the interpretation of the results may be complex.

One concern with the instrument was the degree to which students would honestly answer questions about their environmental beliefs and actions. The results of the instrument and the conversations held with students indicate students are being honest about beliefs. It was assumed that scores on written instruments and the comments made in the interviews would be highly pro-environmental and perhaps even misleading. However, students in the interviews did not seem concerned about what ought to be said or with what is considered an "acceptable" environmental belief. In addition, environmental belief scores on the instrument were highly variable and rarely as high as was expected.

The validation of the current instrument depends in large measure on its further use as a tool to measure prior formative experiences and environmental beliefs. In this

study the content validity based on questions asked from well recognized instruments and the question's relation to the national EE standards is considered acceptable. In addition construct validity was evaluated as a consequence of comparison to interview response. Further validation would be useful.

PROGRAM EFFECTS (QUESTIONS 5,6,7)

A large portion of the literature reviewed in this research has been devoted to understanding the effect of a program or intervention on its participants. In many cases these reviews are meant as program evaluations, or as evidence that a program is meeting its intended objectives. The effect of a program on an individual is hard to quantify and may not necessarily be immediately evident. However, in this research, an attempt has been made to measure the degree to which a person's environmental beliefs change over a period of a five day course. This measurement, which is the intended objective of a large number of environmental education initiatives, has a considerable history and was reviewed in Chapter 2. It has been shown that attitudes and behaviors may change over a period as short as that being evaluated here. As mentioned earlier, it is not the intended objective of the Science Factory to change environmental beliefs, but rather to excite, engage, and inspire students and teachers. However, it was the intent of a subset of the Science Factory's classes to address environmental beliefs. Both the total population of student's attending summer camp and those attending only a camp aimed at affecting environmental beliefs are reviewed here.

Overall Attitudes Differences

The first portion of the instrument was devoted to understanding overall attitudes toward the camp experience. Several questions in this section of the instrument were asked on both the pre and post-tests in order to evaluate whether the program had any effect on the items asked. Differences in this section, while perhaps of little significance to the work being conducted here, are relevant to the needs of the Science Factory. Table 11 summarizes the results of several paired t-tests to identify whether the change in mean response on any of the above questions differed meaningfully over the five day period.

Table 11

Test for mean differences in overall attitudes between pre-test and post-test

Variable	Knowledge	Excitement	Science	Future
Estimated Change	1.108	-0.0277	-0.1977	0.1953
P value	<0.00001	0.8379	0.0396	0.1778
95% CI	0.813 – 1.402	-0.297 – -0.242	-0.386 - -0.010	-0.091 – 0.482
	Significant	Not Significant	Significant	Not Significant

The above table suggests that two of the above variables did change significantly from pre-test to post-test. The first suggests that student's perceive they have a greater knowledge of the subject matter after the camp. This is an expected and anticipated result of any educational initiative. The second, however, suggests that students enjoy learning science less at the end of the five day camp. This is an

unexpected result of the initiative and will be explored further. Both of these changes will be discussed in Chapter 5.

Family and Home Life Factors

The family and home life factors portion of the written instrument differed in each iteration. The pre-test asked questions pertaining to the time period before the camp, the post-test asked only about the time period during the camp, and the delayed post-test asked only about the six weeks since camp. The change in time period makes any comparison between iterations meaningless. Although, it is not necessarily supposed that the camp experience has no effect on the family and home life of a student. This supposition is explored below. A comparison of the family and home life factors of students in EE courses vs. Non EE courses is given in Table 12 and displayed graphically in Figure 4. Before the program there was no statistically meaningful difference between the family and home life factors between EE students and non EE students. After the program, or at the post-test iteration and at the delayed post iteration, a statistically meaningful difference at the 95% level exists between treatment groups.

Table 12

Test for mean differences between EE vs. non EE scores on family factors section of the written instrument

Comparison	N EE, Non EE	Mean EE, Non EE	Mean Difference	P value	SE	95% CI
EE vs. Non EE Pre-Test Family factors	30, 83	42.84, 40.47	2.362	.343	2.480	-2.553 – 7.276
EE vs. Non EE Post-Test Family factors	20, 58	41.56, 34.05	7.513	.014*	2.991	1.556 – 13.470
EE vs. Non EE Delayed-Post Family Factors	7, 27	47.57, 38.37	9.198	.039*	4.269	.502 – 17.893

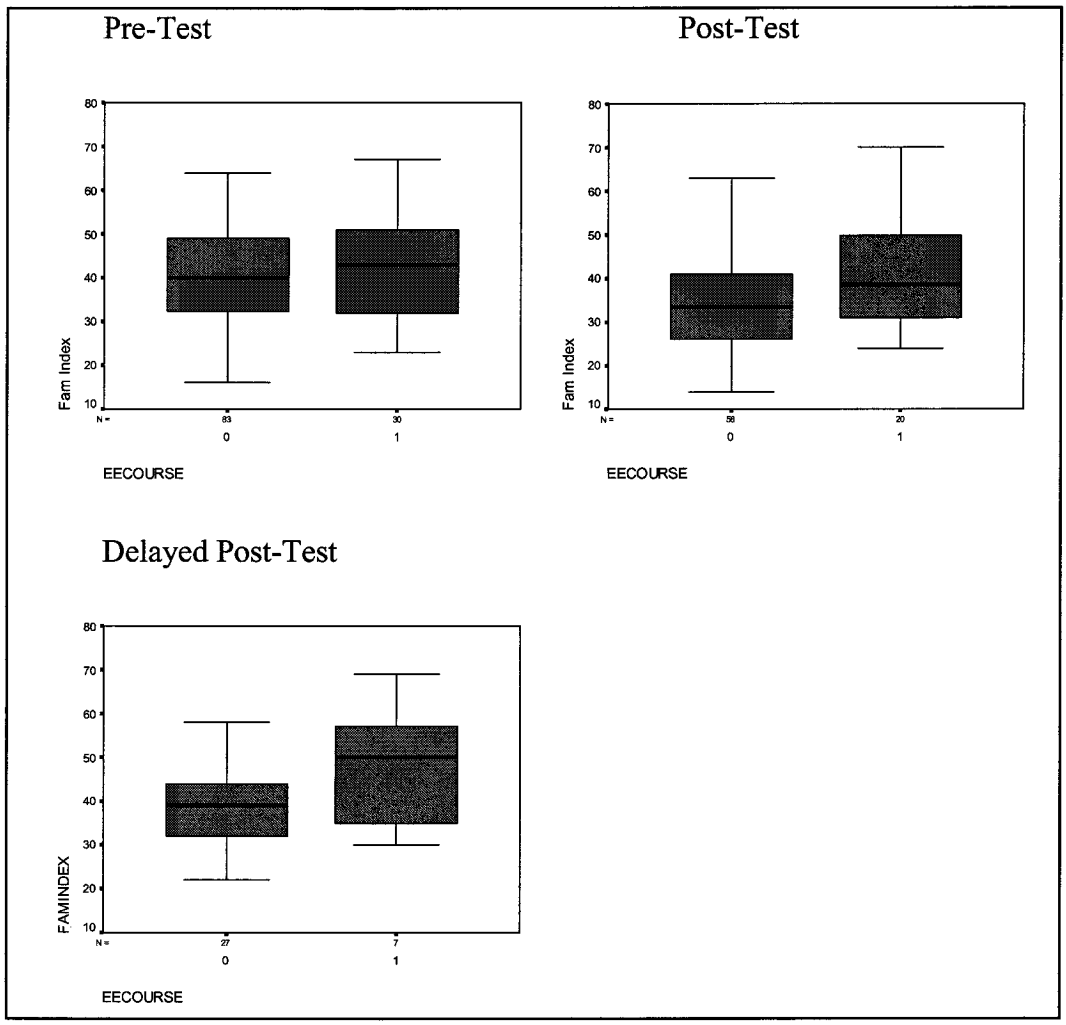


Figure 4

Box plots showing mean difference in EE (1) vs. non EE (0)
family factors scores on written instrument

Environmental Beliefs

The environmental beliefs section of the written instrument is of the greatest concern in this set of analyses. Any mean change in environmental beliefs over the

five day period and existing after six weeks might be said to reflect on an effective environmental program if it was the intent of the program to alter these beliefs. A series of analyses are conducted on the environmental belief results from all three tests and presented here.

Table 13 and Figure 5 show the results of a series of independent samples t-tests where environmental belief scores are compared between students who participated in an EE course and those who participated in a Non EE course. In the pre-test sample, the mean environmental belief score was not found to differ between treatments ($p = .196$). However, the scores found on the post-test, the delayed post-test, and those found when comparing the change in environmental belief were found to differ meaningfully at the 95% level between students who took an EE course and those who did not. ($p= .031$ and $p=.035$). The difference in population sizes between comparisons is a result of the data set used and uses the largest population of instruments available to test for the mean.

Table 13

Test for mean differences between EE vs. non EE students environmental belief scores on written instrument

Comparison	N	Mean	Mean Difference	P-Value	SE	95% CI
Pre-Test Comparison of EE vs. Non EE courses	83 Non EE 30 EE	125.07 135.01	9.937	.196	7.645	-5.213 – 25.087
Post-Test comparison of EE vs. Non EE courses	58 Non EE 20 EE	125.31 146.38	21.072	.031*	9.594	1.965 – 40.179
Comparison of Change in Att. On EE vs. Non EE courses	49 Non EE 16 EE	-4.25 6.19	10.441	.035*	4.840	.768 – 20.113
Delayed Post-Test comparison of EE vs. Non EE courses	27 Non EE 7 EE	136.78 166.56	29.785	.012*	11.192	6.988 – 52.582

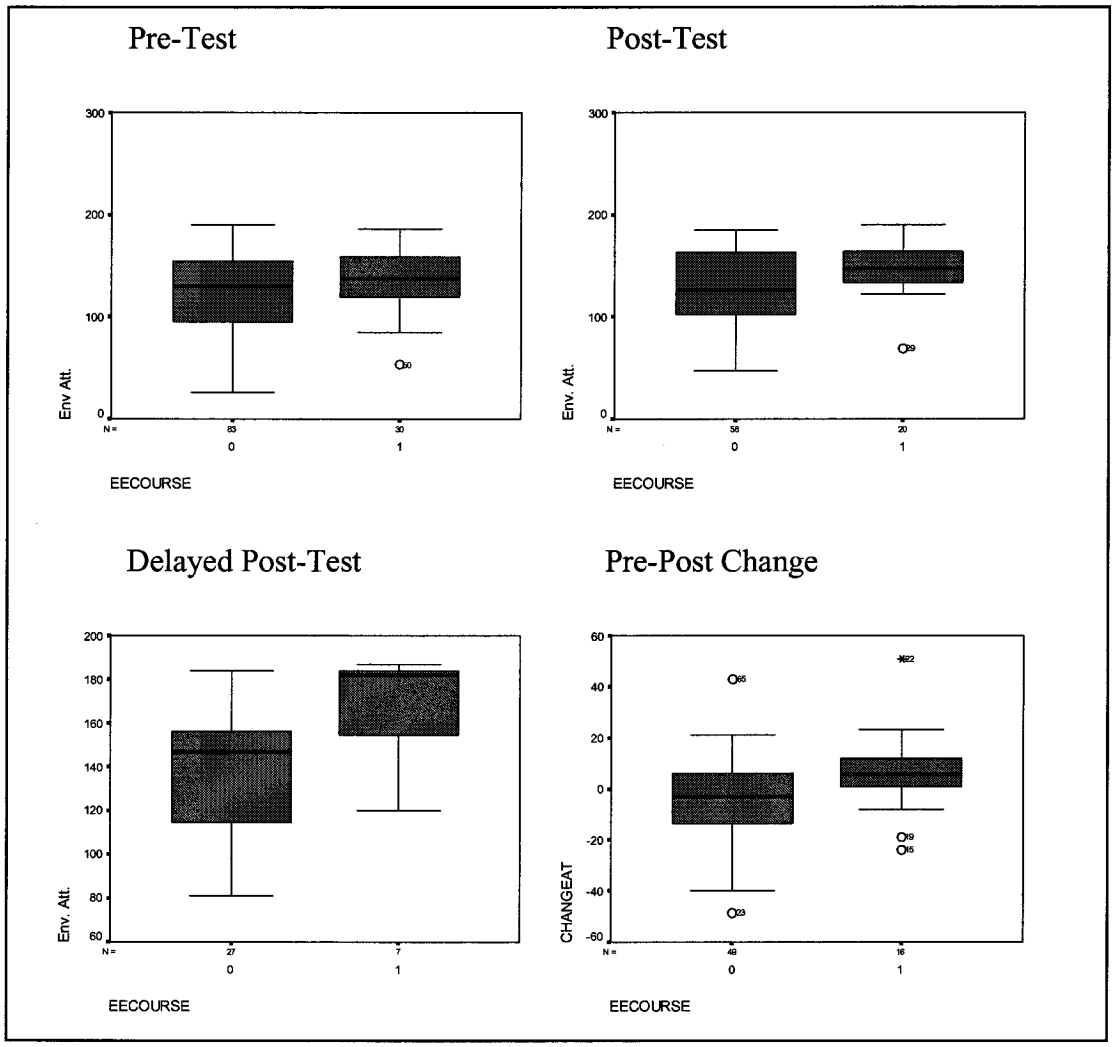


Figure 5

Box plots showing mean differences between EE (1) vs. non EE (0) scores on the environmental belief section of the written instrument

In the comparison of change in environmental beliefs between EE and Non EE students, the mean change for non EE students was found to be negative. The mean change for EE students was slightly positive. The decrease in environmental beliefs

over the five day period will be discussed in Chapter 5. While there appears to be a meaningful difference between the change in environmental beliefs between these two groups, neither represent an overall change in belief. Table 14 and Figure 6 show the results of two paired t-tests to explore whether the beliefs of EE students and Non EE students change over the length of the program. In neither case is there a meaningful change in the belief score at the 95% level. It is significant to note that the negative change in belief score for the non EE students approaches the 95% significance level. As mentioned before, this decrease in belief will be discussed in Chapter 5.

Table 14

Test for mean difference between pre-post test environmental belief scores for EE and non EE students

Comparison of Pre vs. Post test belief score for EE students	16 EE	136.31 Pre 142.50 Post	6.188	.167	4.262	-2.898 – 15.273
Comparison of Pre vs. Post test belief score for non EE students	49 Non EE	130.60 Pre 126.35 Post	-4.253	.082	2.391	-9.060 - .554

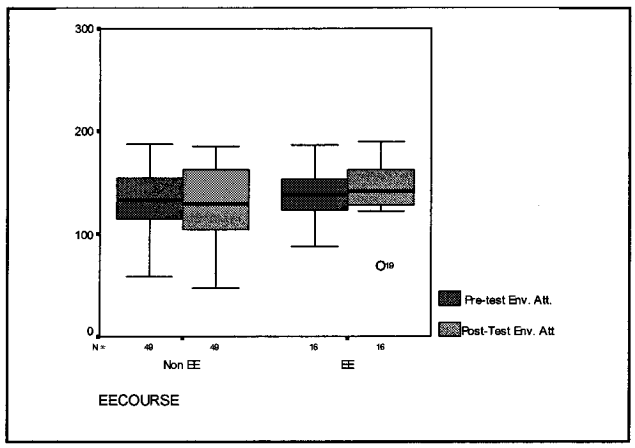


Figure 6

Paired box plot of the mean difference between pre-post test environmental belief scores for EE and non EE students

The above two tables indicate that post-test environmental belief scores are higher for EE students than for non EE students and that the change in environmental belief is greater for these EE students. This is consistent with what one would expect from an educational initiative designed to effect these beliefs. However, the tables also indicate that there is not a statistically meaningful increase in overall environmental belief for either group. This finding is consistent with the findings of many other studies on the effectiveness of environmental education programs and suggests that the courses are not significantly altering environmental beliefs.

In addition to the overall environmental belief, the components of that environmental belief are also reported here. The results of these independent and paired t-tests are presented here based on the claims made in Chapter 2 that some forms of educational initiatives are effective at altering one or more of these

components and not others. Whether any one of these components changes over five days is considered important.

Table 15 presents the data from a series of 12 independent sample t-tests where six are applied to the pre-test and another six are applied to the post-test. In two cases the post-test score differs meaningfully at the 95% level between EE students and Non EE students. The factors on which this difference can be found are the actual commitment section and the environmental responsibility section. It is also true that in every case in both the pre and post administration, the EE students' belief scores are higher, even if not statistically different. The finding that these differences exist both before and after the program will be explored in Chapter 5.

Table 15

Test for mean differences between EE vs. non EE student scores on each division in the environment beliefs section of the written instrument

Comparison between EE students and Non EE students	N	Mean	Mean Difference	P value	SE	95% CI
Verbal Pre	30,83	27.87, 25.51	2.361	.211	1.877	-1.358 – 6.079
Verbal Post	20,58	31.05, 26.64	4.407	.063	2.332	-0.237 – 9.051
Actual Pre	30,83	28.93, 27.28	1.656	.320	1.656	-1.626 – 4.938
Actual Post	20,58	30.70, 25.29	5.407	.019*	2.262	0.901 – 9.912
Affect Pre	30,83	29.60, 27.09	2.508	.195	1.923	-1.303 – 6.319
Affect Post	20,58	32.55, 28.33	4.224	.065	2.255	-0.266 – 8.714
Control Pre	30, 83	14.08, 12.98	1.097	.330	1.120	-1.123 – 3.316
Control post	20,58	14.60, 12.25	2.352	.091	1.376	-0.388 – 5.092
Resp. Pre	30, 83	11.30, 10.70	.603	.625	1.230	-1.834 – 3.040
Resp. Post	20,58	13.73, 9.90	3.828	.019*	1.594	0.654 – 7.003
Knowledge Pre	30,83	23.23, 21.52	1.713	.266	1.532	-1.322 – 4.748
Know. Post	20,58	23.75, 22.90	0.853	.621	1.717	-2.567 - 4.274

In Table 15 only the differences between groups were analyzed. In Table 16 the differences within group but between iterations of the instrument are explored. This data suggests where any changes in environmental beliefs have been found. Among EE students there were no factors on which environmental beliefs increased meaningfully at the 95% level. In one case, the case of verbal commitment this difference does approach 95% significance. In the case of the non EE students, three factors were found to decrease meaningfully. The mean actual commitment, locus of control, and environmental responsibility all decreased meaningfully over the five day period.

Table 16

Test for mean differences in each section of environmental belief section from pre-post test for EE and non EE students

Comparison	N	Mean Pre,Post	Mean Difference	P value	SE	95% CI
EE Verbal	16	27.88 - 30.63	2.750	.053	1.312	-.046 – 5.546
EE Actual	16	30.25 – 30.44	.188	.818	.802	-1.522 – 1.897
EE Affect	16	29.25 – 31.63	2.375	.098	1.347	-.497 – 5.247
EE Control	16	13.56 – 13.56	.000	1.000	.842	-1.794 – 1.794
EE Resp.	16	12.19 – 13.13	.938	.392	1.063	-1.327 – 3.202
EE Knowledge	16	23.19 – 23.13	-.063	.952	1.014	-2.225 – 2.100
Non EE Verbal	49	26.65 – 26.85	.193	.827	.876	-1.569 – 1.954
Non EE Actual	49	26.87 – 25.76	-1.116	.040*	.528	-2.177 – -.055
Non EE Affect	49	28.80 – 28.14	-.657	.434	.832	-2.329 – 1.016
Non EE Control	49	13.71 – 12.23	-1.485	.020*	.618	-2.728 – -.243
Non EE Resp.	49	11.44 – 10.15	-1.289	.006*	.449	-2.193 - -.386
Non EE Knowledge	49	23.12 – 23.22	.102	.902	.824	-1.554 – 1.758

RELATIONSHIP WITH ENVIRONMETNAL BELIEFS (QUESTIONS 1,2,8)

The primary questions of interest in this research involve whether a relationship exists between specific formative experiences in the home and the environmental beliefs of children. Question one asks whether any of the questions about overall attitudes or demographics can be found to be related to environmental

belief or with a change in environmental belief. Question two asks whether this relationship can be found between family and home life factors and environmental beliefs. Finally, question eight questions which set of family factors; those before the initiative, during the initiative, or after the initiative, are most related to the environmental beliefs in question.

Correlation

Table 17 is a Pearson's correlation matrix of overall attitudes, demographics and family factors against environmental beliefs appearing on the pre-test. Each of the six sections of the environmental belief instrument are identified below along with an overall environmental belief score found as the sum of all six components. Where a correlation is found to be significant at the .001 level, it is marked with a **. Where a correlation is found to be significant at the .05 level, it is marked with a *. Only correlations against environmental belief and its components are given here. In the event that additional correlations are relevant and significant, they are reported later.

Table 17

Pearson Correlations between all factors asked on Pre-test and aspects of environmental belief

		Verbal	Actual	Affect	Control	Responsibility	Knowledge	Env Belief
Age	Pearson Correlation	-.198(*)	-0.123	-.328(**)	-0.126	-0.177	-0.148	-.234(*)
	Sig. (2-tailed)	0.036	0.195	0	0.185	0.061	0.118	0.013
	N	113	113	113	113	113	113	113
grade	Pearson Correlation	-.233(*)	-0.121	-.386(**)	-0.159	-.208(*)	-0.177	-.272(**)
	Sig. (2-tailed)	0.013	0.201	0	0.092	0.027	0.06	0.004
	N	113	113	113	113	113	113	113
Exposure	Pearson Correlation	-.233(*)	-0.153	-0.114	-0.094	0.022	0.024	-0.124
	Sig. (2-tailed)	0.013	0.105	0.231	0.323	0.815	0.798	0.19
	N	113	113	113	113	113	113	113
Knowledge	Pearson Correlation	-0.002	0.114	-0.059	0.008	0.148	-0.005	0.033
	Sig. (2-tailed)	0.98	0.228	0.538	0.935	0.117	0.959	0.727
	N	113	113	113	113	113	113	113
#7	Pearson Correlation	.270(**)	.263(**)	.327(**)	.414(**)	.302(**)	.296(**)	.374(**)
	Sig. (2-tailed)	0.004	0.005	0	0	0.001	0.001	0
	N	113	113	113	113	113	113	113
#8	Pearson Correlation	.370(**)	.309(**)	.419(**)	.467(**)	.306(**)	.310(**)	.442(**)
	Sig. (2-tailed)	0	0.001	0	0	0.001	0.001	0
	N	113	113	113	113	113	113	113
#9	Pearson Correlation	0.18	.213(*)	.278(**)	.218(*)	.300(**)	.335(**)	.307(**)
	Sig. (2-tailed)	0.057	0.024	0.003	0.02	0.001	0	0.001
	N	113	113	113	113	113	113	113
Fam1	Pearson Correlation	.398(**)	.387(**)	.412(**)	.410(**)	.404(**)	.426(**)	.495(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113
Fam2	Pearson Correlation	.294(**)	.355(**)	.278(**)	.290(**)	.244(**)	.247(**)	.350(**)
	Sig. (2-tailed)	0.002	0	0.003	0.002	0.009	0.008	0
	N	113	113	113	113	113	113	113

Table 17 (Continued)

Fam3	Pearson Correlation	.437(**)	.534(**)	.461(**)	.424(**)	.430(**)	.482(**)	.565(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113
Fam4	Pearson Correlation	.438(**)	.518(**)	.466(**)	.461(**)	.382(**)	.361(**)	.537(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113
Fam5	Pearson Correlation	.557(**)	.518(**)	.428(**)	.449(**)	.426(**)	.393(**)	.568(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113
Fam6	Pearson Correlation	.313(**)	.278(**)	.367(**)	.321(**)	.303(**)	.320(**)	.389(**)
	Sig. (2-tailed)	0.001	0.003	0	0.001	0.001	0.001	0
	N	112	112	112	112	112	112	112
Fam7	Pearson Correlation	.283(**)	.447(**)	.356(**)	.281(**)	0.145	.347(**)	.389(**)
	Sig. (2-tailed)	0.002	0	0	0.003	0.125	0	0
	N	113	113	113	113	113	113	113
Fam8	Pearson Correlation	.543(**)	.531(**)	.557(**)	.492(**)	.405(**)	.498(**)	.624(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113
Fam9	Pearson Correlation	.379(**)	.285(**)	.423(**)	.335(**)	.290(**)	.383(**)	.433(**)
	Sig. (2-tailed)	0	0.002	0	0	0.002	0	0
	N	113	113	113	113	113	113	113
Fam10	Pearson Correlation	.542(**)	.440(**)	.535(**)	.522(**)	.506(**)	.433(**)	.606(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113
Fam11	Pearson Correlation	.372(**)	.326(**)	.334(**)	.447(**)	.332(**)	.344(**)	.433(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113
Fam12	Pearson Correlation	.600(**)	.514(**)	.599(**)	.597(**)	.424(**)	.506(**)	.665(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113

Table 17 (Continued)

Fam13	Pearson Correlation	.455(**)	.309(**)	.457(**)	.415(**)	.286(**)	.335(**)	.467(**)
	Sig. (2-tailed)	0	0.001	0	0	0.002	0	0
	N	113	113	113	113	113	113	113
Fam14	Pearson Correlation	.578(**)	.568(**)	.582(**)	.587(**)	.490(**)	.555(**)	.686(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113
Fam Index	Pearson Correlation	.669(**)	.652(**)	.675(**)	.650(**)	.550(**)	.605(**)	.779(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	113	113	113	113	113	113	113
Sex2	Pearson Correlation	-.297(**)	-.284(**)	-.362(**)	-.245(**)	-0.157	-0.176	-.321(**)
	Sig. (2-tailed)	0.001	0.002	0	0.009	0.098	0.062	0.001
	N	113	113	113	113	113	113	113
motivation	Pearson Correlation	.227(*)	.268(**)	.280(**)	.354(**)	.292(**)	.224(*)	.326(**)
	Sig. (2-tailed)	0.016	0.004	0.003	0	0.002	0.018	0
	N	111	111	111	111	111	111	111

A large number of significant Pearson Correlations can be found in the above table. A discussion of these correlations begins here. First, it is noted that there is a negative correlation between environmental beliefs and age or grade level. This correlation suggests that as age and or grade level increases, environmental belief decreases. This result has been found in previous research (Wilson 1996) and is outlined briefly in Chapter 2. Gender was also found to be correlated with environmental beliefs and some of its components. The negative correlation above indicates that females had a higher environmental beliefs than males (assigned male=1, female=0 for means of numeric comparison).

In addition, Questions 4,7,8,9 on the written instrument were all found highly correlated with environmental beliefs. Question 4 asks students why students have come to camp, question 7 asks whether the student is excited about the subject, question 8 asks whether the student enjoys learning about science, and question 9 asks whether the student wish to go to camps like this one in the future. The findings suggest that overall attitude toward the program, or perhaps an overall positive attitude is correlated with the environmental beliefs. However, it is important to note that perceived knowledge of the subject and past exposure with the Science Factory were not correlated.

The 14 family and home life factors asked on the written instrument were all found to be highly correlated with environmental belief and all of its components. The high correlation between all questions about environmental experiences and teaching in the home and the environmental beliefs of the students are discussed in detail in the next chapter.

The correlations discussed thus far have been restricted to correlations on the pre-test iteration of the written instrument. Table 18 will display the results of the same correlations but found on the post-test iteration of the instrument.

Table 18

Pearson Correlations between all factors asked on the post-test and aspects of environmental belief

		Affect	Actual	Verbal	Control	Responsibility	Knowledge	Env. Belief
Age	Pearson Correlation	0.009	0.054	-0.017	-0.066	0.009	0.062	0.014
	Sig. (2-tailed)	0.938	0.64	0.879	0.567	0.94	0.589	0.906
	N	78	78	78	78	78	78	78
grade	Pearson Correlation	0.013	0.056	-0.036	-0.059	-0.003	0.054	0.008
	Sig. (2-tailed)	0.913	0.628	0.753	0.606	0.981	0.636	0.945
	N	78	78	78	78	78	78	78
Exposure	Pearson Correlation	-0.056	-0.127	-0.084	-0.006	0.046	-0.019	-0.06
	Sig. (2-tailed)	0.623	0.269	0.462	0.958	0.687	0.872	0.602
	N	78	78	78	78	78	78	78
Knowledge	Pearson Correlation	0.109	.226(*)	0.158	0.136	0.111	0.171	0.184
	Sig. (2-tailed)	0.344	0.046	0.168	0.234	0.334	0.135	0.106
	N	78	78	78	78	78	78	78
#7	Pearson Correlation	.293(**)	.364(**)	.300(**)	.250(*)	0.189	.275(*)	.342(**)
	Sig. (2-tailed)	0.009	0.001	0.008	0.027	0.097	0.015	0.002
	N	78	78	78	78	78	78	78
#8	Pearson Correlation	.347(**)	.458(**)	.441(**)	.434(**)	.329(**)	.306(**)	.467(**)
	Sig. (2-tailed)	0.002	0	0	0	0.003	0.007	0
	N	77	77	77	77	77	77	77
#9	Pearson Correlation	.374(**)	.508(**)	.485(**)	.360(**)	.367(**)	.401(**)	.506(**)
	Sig. (2-tailed)	0.001	0	0	0.001	0.001	0	0
	N	77	77	77	77	77	77	77

Table 18 (Continued)

#10	Pearson Correlation	.351(**)	.446(**)	.374(**)	.431(**)	.405(**)	.442(**)	.483(**)
	Sig. (2-tailed)	0.002	0	0.001	0	0	0	0
	N	78	78	78	78	78	78	78
#11	Pearson Correlation	.326(**)	.369(**)	.330(**)	.302(**)	.230(*)	.331(**)	.382(**)
	Sig. (2-tailed)	0.004	0.001	0.003	0.007	0.043	0.003	0.001
	N	78	78	78	78	78	78	78
Fam1	Pearson Correlation	.384(**)	.487(**)	.418(**)	.457(**)	.429(**)	.321(**)	.498(**)
	Sig. (2-tailed)	0.001	0	0	0	0	0.004	0
	N	78	78	78	78	78	78	78
Fam2	Pearson Correlation	.250(*)	0.215	.395(**)	.349(**)	.270(*)	0.09	.315(**)
	Sig. (2-tailed)	0.027	0.059	0	0.002	0.017	0.431	0.005
	N	78	78	78	78	78	78	78
Fam3	Pearson Correlation	.321(**)	.426(**)	.378(**)	.285(*)	.387(**)	0.216	.409(**)
	Sig. (2-tailed)	0.004	0	0.001	0.011	0	0.057	0
	N	78	78	78	78	78	78	78
Fam4	Pearson Correlation	0.205	.363(**)	.361(**)	.369(**)	.297(**)	0.207	.359(**)
	Sig. (2-tailed)	0.072	0.001	0.001	0.001	0.008	0.069	0.001
	N	78	78	78	78	78	78	78
Fam5	Pearson Correlation	.375(**)	.413(**)	.462(**)	.449(**)	.445(**)	0.221	.473(**)
	Sig. (2-tailed)	0.001	0	0	0	0	0.052	0
	N	78	78	78	78	78	78	78

Table 18 (Continued)

Fam6	Pearson Correlation	0.107	0.202	.237(*)	.250(*)	.317(**)	0.087	.234(*)
	Sig. (2-tailed)	0.35	0.076	0.036	0.027	0.005	0.451	0.04
	N	78	78	78	78	78	78	78
Fam7	Pearson Correlation	.296(**)	.388(**)	.385(**)	.370(**)	.409(**)	.232(*)	.415(**)
	Sig. (2-tailed)	0.008	0	0.001	0.001	0	0.041	0
	N	78	78	78	78	78	78	78
Fam8	Pearson Correlation	.324(**)	.497(**)	.512(**)	.413(**)	.386(**)	.345(**)	.500(**)
	Sig. (2-tailed)	0.004	0	0	0	0	0.002	0
	N	78	78	78	78	78	78	78
Fam9	Pearson Correlation	0.087	0.087	0.189	.273(*)	0.201	0.065	0.17
	Sig. (2-tailed)	0.451	0.45	0.097	0.016	0.078	0.574	0.137
	N	78	78	78	78	78	78	78
Fam10	Pearson Correlation	.320(**)	.437(**)	.381(**)	.404(**)	.517(**)	.255(*)	.458(**)
	Sig. (2-tailed)	0.004	0	0.001	0	0	0.024	0
	N	78	78	78	78	78	78	78
Fam11	Pearson Correlation	.502(**)	.472(**)	.459(**)	.448(**)	.452(**)	0.213	.516(**)
	Sig. (2-tailed)	0	0	0	0	0	0.061	0
	N	78	78	78	78	78	78	78
Fam12	Pearson Correlation	.539(**)	.591(**)	.504(**)	.523(**)	.580(**)	.475(**)	.641(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	78	78	78	78	78	78	78
Fam13	Pearson Correlation	.237(*)	0.202	.299(**)	.303(**)	.234(*)	-0.033	.251(*)
	Sig. (2-tailed)	0.037	0.077	0.008	0.007	0.039	0.774	0.026
	N	78	78	78	78	78	78	78

Table 18 (Continued)

Fam14	Pearson Correlation	.601(**)	.596(**)	.496(**)	.536(**)	.590(**)	.466(**)	.657(**)
	Sig. (2-tailed)	0	0	0	0	0	0	0
	N	78	78	78	78	78	78	78
Fam Index	Pearson Correlation	.488(**)	.579(**)	.593(**)	.590(**)	.598(**)	.343(**)	.637(**)
	Sig. (2-tailed)	0	0	0	0	0	0.002	0
	N	78	78	78	78	78	78	78
motivation	Pearson Correlation	.512(**)	.325(**)	.322(**)	.484(**)	.330(**)	.400(**)	.465(**)
	Sig. (2-tailed)	0	0.004	0.004	0	0.003	0	0
	N	77	77	77	77	77	77	77
Gender	Pearson Correlation	-0.221	-.239(*)	-0.168	-0.195	-0.16	-0.116	-.223(*)
	Sig. (2-tailed)	0.052	0.035	0.141	0.086	0.161	0.311	0.049
	N	78	78	78	78	78	78	78

Post-Test correlations reveal the same trends found in the pre-test iteration of the instrument. Age and grade level were still found to be negatively correlated with environmental beliefs, although this time, this correlation is not found statistically significant. Questions 4,7,8,9 are all found to be correlated with environmental belief and its components as are questions 10 and 11. Question ten asks whether the student talked to his or her parents about what was learned and question eleven asks whether the student had a good time at camp that week.

Again family factors were found to be correlated with environmental beliefs and its components. In this iteration, family question 9, which asked whether the

student spent time outdoors with friends and neighbors was not found correlated with overall environmental belief. In addition, several of the factors were not found correlated with one or more component of environmental belief. Despite the lack of correlation in rare cases, nearly all correlations, and in all of the overall family factors and environmental beliefs comparisons, the correlation was found to be highly correlated at the 0.01 level.

One further set of correlations is essential in understanding the degree to which the formative factors in the home involving environmental experiences and teaching have an effect on the degree to which a program is able to inform environmental beliefs. Correlations among factors and the mean change in environmental belief score and its components were reviewed for students who attended an environmental education course. The correlation matrix is given here in Table 19 although it produced few positive correlations. All correlations found between factors and the change in environmental belief are described here in text.

Table 19

Pearson Correlations for all factors asked on pre/post tests and aspects of environmental belief change

		Belief	Verbal	Actual	Affect	Control	Responsibility	Knowledge
Age	Pearson Correlation	-0.029	0.096	-0.212	0.159	-0.231	0.105	-0.206
	Sig. (2-tailed)	0.916	0.722	0.43	0.557	0.389	0.698	0.443
	N	16	16	16	16	16	16	16
grade	Pearson Correlation	-0.036	0.082	-0.231	0.153	-0.249	0.104	-0.18
	Sig. (2-tailed)	0.894	0.763	0.389	0.573	0.352	0.701	0.504
	N	16	16	16	16	16	16	16
Exposure	Pearson Correlation	0.328	0.386	0.285	0.195	0.439	-0.224	0.264
	Sig. (2-tailed)	0.215	0.14	0.285	0.469	0.089	0.403	0.323
	N	16	16	16	16	16	16	16
Knowledge	Pearson Correlation	.516(*)	0.317	.587(*)	.603(*)	0.487	-0.365	0.47
	Sig. (2-tailed)	0.041	0.232	0.017	0.013	0.055	0.165	0.066
	N	16	16	16	16	16	16	16
#7	Pearson Correlation	0.407	0.36	0.3	0.248	0.349	0.232	0.146
	Sig. (2-tailed)	0.118	0.171	0.259	0.355	0.185	0.387	0.588
	N	16	16	16	16	16	16	16
#8	Pearson Correlation	0.104	0.064	0.246	-0.026	0.036	0.409	-0.266
	Sig. (2-tailed)	0.702	0.813	0.359	0.925	0.894	0.116	0.319
	N	16	16	16	16	16	16	16
#9	Pearson Correlation	.693(**)	.564(*)	0.195	.628(**)	0.365	.524(*)	0.342
	Sig. (2-tailed)	0.003	0.023	0.469	0.009	0.164	0.037	0.195
	N	16	16	16	16	16	16	16
Fam1	Pearson Correlation	-0.195	-0.164	-0.313	-0.101	-0.268	0.066	-0.07
	Sig. (2-tailed)	0.47	0.544	0.237	0.71	0.315	0.809	0.796
	N	16	16	16	16	16	16	16
Fam2	Pearson Correlation	-0.38	-0.224	-0.258	-0.243	-0.123	-0.227	-0.442
	Sig. (2-tailed)	0.146	0.405	0.335	0.364	0.65	0.397	0.086
	N	16	16	16	16	16	16	16

Table 19 (Continued)

Fam3	Pearson Correlation	-0.029	-0.093	0.03	-0.036	-0.159	0.184	-0.036
	Sig. (2-tailed)	0.916	0.732	0.911	0.894	0.555	0.496	0.894
	N	16	16	16	16	16	16	16
Fam4	Pearson Correlation	-0.11	-0.153	-0.257	-0.039	-0.296	0.125	0.104
	Sig. (2-tailed)	0.685	0.572	0.337	0.887	0.266	0.644	0.701
	N	16	16	16	16	16	16	16
Fam5	Pearson Correlation	-0.063	-0.041	-0.037	0.041	-0.226	0.041	-0.094
	Sig. (2-tailed)	0.816	0.88	0.893	0.88	0.4	0.88	0.728
	N	16	16	16	16	16	16	16
Fam6	Pearson Correlation	0.012	-0.208	0.014	0.073	-0.227	0.208	0.18
	Sig. (2-tailed)	0.966	0.438	0.959	0.788	0.398	0.439	0.504
	N	16	16	16	16	16	16	16
Fam7	Pearson Correlation	-0.137	-0.157	-0.312	-0.178	0	0.496	-0.407
	Sig. (2-tailed)	0.614	0.561	0.239	0.509	1	0.051	0.118
	N	16	16	16	16	16	16	16
Fam8	Pearson Correlation	-0.305	-0.321	-0.429	-0.34	-0.201	0.294	-0.217
	Sig. (2-tailed)	0.251	0.226	0.097	0.197	0.455	0.269	0.419
	N	16	16	16	16	16	16	16
Fam9	Pearson Correlation	-0.34	-0.171	-0.471	-0.274	-0.492	-0.191	0.138
	Sig. (2-tailed)	0.198	0.526	0.066	0.304	0.053	0.479	0.61
	N	16	16	16	16	16	16	16
Fam10	Pearson Correlation	-0.208	-0.294	-0.262	-0.193	-0.234	0.217	-0.065
	Sig. (2-tailed)	0.439	0.27	0.327	0.473	0.382	0.42	0.812
	N	16	16	16	16	16	16	16
Fam11	Pearson Correlation	-0.289	-0.256	-0.206	-0.262	-0.248	0.183	-0.357
	Sig. (2-tailed)	0.278	0.338	0.444	0.326	0.354	0.498	0.174
	N	16	16	16	16	16	16	16
Fam12	Pearson Correlation	-0.129	-0.239	-0.456	-0.134	-0.255	.528(*)	-0.036
	Sig. (2-tailed)	0.634	0.372	0.076	0.622	0.341	0.035	0.895
	N	16	16	16	16	16	16	16

Table 19 (Continued)

Fam13	Pearson Correlation	-0.425	-0.488	-0.276	-0.285	-0.124	-0.152	-0.296
	Sig. (2-tailed)	0.101	0.055	0.3	0.284	0.648	0.573	0.266
	N	16	16	16	16	16	16	16
Fam14	Pearson Correlation	-0.013	-0.197	-0.332	-0.048	-0.077	.539(*)	0.024
	Sig. (2-tailed)	0.961	0.465	0.209	0.86	0.778	0.031	0.93
	N	16	16	16	16	16	16	16
Fam Index	Pearson Correlation	-0.224	-0.265	-0.324	-0.174	-0.279	0.231	-0.121
	Sig. (2-tailed)	0.405	0.322	0.221	0.519	0.295	0.388	0.656
	N	16	16	16	16	16	16	16
Env. Att.	Pearson Correlation	-0.278	-0.482	-0.291	-0.336	-0.34	0.396	0.001
	Sig. (2-tailed)	0.298	0.059	0.274	0.203	0.198	0.129	0.996
	N	16	16	16	16	16	16	16
Knowledge	Pearson Correlation	0.148	-0.098	0.335	0.342	0.204	-0.264	0.138
	Sig. (2-tailed)	0.584	0.717	0.205	0.195	0.448	0.323	0.611
	N	16	16	16	16	16	16	16
#7	Pearson Correlation	-0.022	-0.08	-0.437	-0.176	-0.083	.619(*)	0.009
	Sig. (2-tailed)	0.934	0.77	0.09	0.513	0.761	0.011	0.975
	N	16	16	16	16	16	16	16
#8	Pearson Correlation	0.477	0.118	0.178	0.253	0.429	.699(**)	0.284
	Sig. (2-tailed)	0.062	0.662	0.509	0.344	0.097	0.003	0.286
	N	16	16	16	16	16	16	16
#9	Pearson Correlation	0.423	0.036	0.098	0.182	0.466	.674(**)	0.318
	Sig. (2-tailed)	0.103	0.893	0.718	0.5	0.069	0.004	0.23
	N	16	16	16	16	16	16	16
#10	Pearson Correlation	-0.08	-0.253	-0.443	-0.116	-0.245	.533(*)	0.143
	Sig. (2-tailed)	0.769	0.344	0.085	0.67	0.361	0.034	0.598
	N	16	16	16	16	16	16	16
#11	Pearson Correlation	0.221	-0.037	-0.131	0.108	0.173	.600(*)	0.167
	Sig. (2-tailed)	0.41	0.892	0.629	0.691	0.523	0.014	0.536
	N	16	16	16	16	16	16	16

Table 19 (Continued)

Fam1	Pearson Correlation	0.157	0.268	0.075	0.172	-0.03	0.059	-0.011
	Sig. (2-tailed)	0.561	0.316	0.784	0.524	0.913	0.827	0.966
	N	16	16	16	16	16	16	16
Fam2	Pearson Correlation	-0.104	-0.015	-0.01	-0.297	-0.126	0.46	-0.393
	Sig. (2-tailed)	0.7	0.956	0.97	0.263	0.642	0.073	0.132
	N	16	16	16	16	16	16	16
Fam3	Pearson Correlation	.597(*)	0.487	0.441	.711(**)	0.366	0.075	0.202
	Sig. (2-tailed)	0.015	0.056	0.087	0.002	0.163	0.782	0.452
	N	16	16	16	16	16	16	16
Fam4	Pearson Correlation	0.431	0.19	.586(*)	0.262	0.257	0.44	0.082
	Sig. (2-tailed)	0.095	0.481	0.017	0.328	0.337	0.088	0.763
	N	16	16	16	16	16	16	16
Fam5	Pearson Correlation	0.349	0.287	0.435	0.353	0.145	-0.047	0.213
	Sig. (2-tailed)	0.185	0.281	0.092	0.18	0.593	0.863	0.429
	N	16	16	16	16	16	16	16
Fam6	Pearson Correlation	.505(*)	0.226	.656(**)	0.398	0.353	0.204	0.277
	Sig. (2-tailed)	0.046	0.399	0.006	0.127	0.18	0.45	0.299
	N	16	16	16	16	16	16	16
Fam7	Pearson Correlation	.627(**)	0.43	.522(*)	.601(*)	0.435	0.129	0.371
	Sig. (2-tailed)	0.009	0.097	0.038	0.014	0.092	0.633	0.157
	N	16	16	16	16	16	16	16
Fam8	Pearson Correlation	0.14	0.077	0.016	0.094	0.015	0.167	0.162
	Sig. (2-tailed)	0.606	0.776	0.954	0.729	0.956	0.537	0.548
	N	16	16	16	16	16	16	16
Fam9	Pearson Correlation	-0.003	0.059	0.037	-0.224	-0.189	0.261	0.063
	Sig. (2-tailed)	0.991	0.829	0.891	0.405	0.483	0.33	0.815
	N	16	16	16	16	16	16	16
Fam10	Pearson Correlation	0.429	0.22	0.375	0.411	0.297	0.129	0.296
	Sig. (2-tailed)	0.097	0.413	0.153	0.114	0.264	0.634	0.265
	N	16	16	16	16	16	16	16

Table 19 (Continued)

Fam11	Pearson Correlation	-0.342	-0.298	-0.297	-0.48	-0.377	0.488	-0.379
	Sig. (2-tailed)	0.195	0.263	0.265	0.06	0.15	0.055	0.148
	N	16	16	16	16	16	16	16
Fam12	Pearson Correlation	0.236	-0.002	-0.106	0.181	0.205	0.454	0.192
	Sig. (2-tailed)	0.379	0.994	0.696	0.502	0.446	0.077	0.475
	N	16	16	16	16	16	16	16
Fam13	Pearson Correlation	-0.127	-0.044	-0.207	-0.032	0.069	-0.048	-0.277
	Sig. (2-tailed)	0.639	0.871	0.442	0.906	0.801	0.861	0.298
	N	16	16	16	16	16	16	16
Fam14	Pearson Correlation	0.179	0.028	-0.155	0.079	0.096	.724(**)	-0.103
	Sig. (2-tailed)	0.506	0.919	0.567	0.77	0.723	0.002	0.705
	N	16	16	16	16	16	16	16
Fam Index	Pearson Correlation	0.393	0.255	0.333	0.298	0.192	0.355	0.131
	Sig. (2-tailed)	0.132	0.34	0.208	0.263	0.477	0.178	0.628
	N	16	16	16	16	16	16	16
motivation	Pearson Correlation	0.371	0.318	0.254	0.322	0.283	0.061	0.22
	Sig. (2-tailed)	0.157	0.23	0.343	0.224	0.288	0.823	0.412
	N	16	16	16	16	16	16	16
gender	Pearson Correlation	.540(*)	.591(*)	0.263	.598(*)	0.496	-0.252	0.354
	Sig. (2-tailed)	0.031	0.016	0.325	0.015	0.05	0.347	0.179
	N	16	16	16	16	16	16	16
motivation2	Pearson Correlation	0.371	0.318	0.254	0.322	0.283	0.061	0.22
	Sig. (2-tailed)	0.157	0.23	0.343	0.224	0.288	0.823	0.412
	N	16	16	16	16	16	16	16

First, it was found that two of the overall attitudes on the pre-test were found correlated with overall environmental belief and some of its components. Those questions referred to perceived knowledge of subject and whether the student felt they would want to attend camp again in the future. One component of the environmental

belief scale, responsibility, was found correlated with questions 12 and 14 asked in the family and home life factors section of the pre-test. No other correlations were found on the pre-test.

On the post-test environmental responsibility was again found correlated with question 14 in the family and home life factors. It was also found correlated with overall belief questions 7,8,9,10, and 11. Several of the family and home life factors asked on the post-test were also found correlated. Family factor three was found statistically correlated with overall belief and the affective dimension of belief. Family factor four was found correlated with actual commitment. Family factors 6 and 7 were both found correlated with change in environmental belief and with actual commitment. Factor 7 was also found correlated with Affect. Gender was found correlated with overall belief, verbal commitment, and affect. In all cases females were found to have stronger environmental beliefs than males.

Thus, while the family factors as a whole did not correlate with any of the changes in environmental beliefs reviewed, three of the factors in the set of questions did correlate. Those three questions asked about whether the family taught about ways to protect nature, whether the student attends other camps that talk about nature, and whether the student watches nature related media at home.

A set of correlations for the delayed post-test data is not given here. Little attention has been given to the delayed post-test because of its small sample size. The correlation matrix was reviewed and was consistent with the trends found in both the pre and post test iterations of the instrument.

Regression Analysis

Three different types of regression equations are explored in this research. The first explores those factors related to the overall environmental beliefs found on the pre-test, the second explores those factors related to the overall environmental beliefs found on the post-test, and the last explores those factors related to the change in overall environmental belief.

In the regression equations the dependent variable is in all cases based on the overall environmental belief score. This decision to use the overall score rather than to use a multivariate approach was based on the degree to which all six subsets of this score were found correlated in both the reliability analyses and the Pearson's correlations. There is little evidence in this research that the camps chosen for observation are having a selective effect on these subsets. It was thought sufficient in this research to suggest what factors are contributing to the overall environmental belief of a student.

The first regression equation explored was the linear regression of overall environmental belief on the pre-test explained by the single factor (Family Index) where family index served as the sum of the 14 family variables asked (See Table 20). The analysis suggests that the slope of the line (environmental belief) as a function of family index is not zero ($p=<.0001$) and that the single variable explains 61% (R squared=.606) of the overall data. A visual scatter plot showing this relationship appears in Figure 7

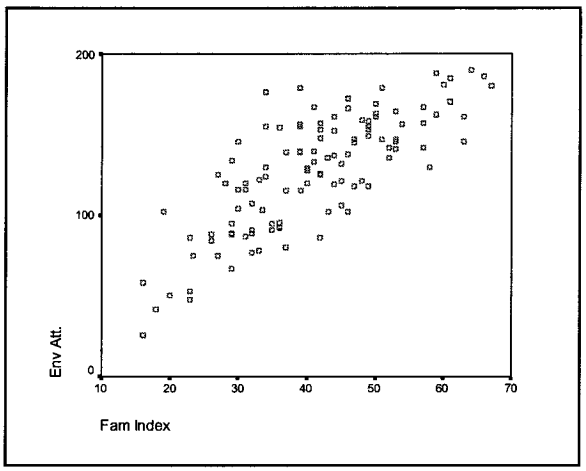


Figure 7

Scatter plot showing pre-test environmental belief vs. pre-test family index score

In a more extensive equation for determining environmental belief, all other factors were included in the equation and then selected by SPSS through a backward selection technique (See Table 20). The method was chosen to produce the most information rich equation still meaningful in explaining environmental beliefs. The resulting equation included the family index as the most influential factor followed by "motivation", or why the student came to camp, "question8", or whether the student enjoys learning about science, and gender. This model explained 68% of the variability in data (R squared = .681). Each of the factors included in the chosen equation was found statistically meaningful in describing the data at the .05 level.

Table 20

Linear Regression results for pre-test overall environmental belief for family index alone and best predictive equation

Model	R	R Square	Stand. Slope	Significance
= Family Index	.779	.606	.779	<.001
= Family Index + Gender +Motivation +Question 8	.825	.681	. 646 -.194 .144 .155	<.001 .001 .014 .013

The same two procedures were conducted on the post-test data and results are given in Table 21. The model defined only by the family factor index was found to describe 41% of the variability in data (R squared = .409). A visual representation of this relationship appears in Figure 8. The most factor rich model chosen by SPSS through backward selection included the family index score as most influential as well as "questions 9", or whether the student would want to go to camps like this in the future, "question 10", or whether the student talked about things learned with parents, and "motivation", or why a student attended camp. This equation as a description of environmental belief explains 59% of the total variability (R squared = .586). It is important to note that in both this analysis and the one included on the pre-test that whether a student attended an environmental education camp was included as a potential factor. In neither case was attending the EE camp found as a predictor of environmental belief.

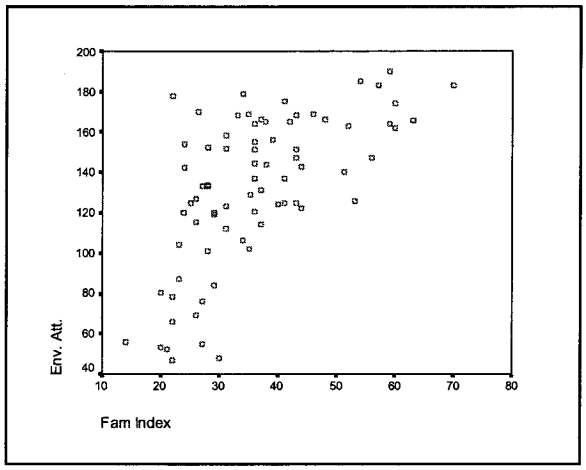


Figure 8

Scatter plot showing post-test environmental beliefs vs. post-test family index score

Table 21

Linear regression results for post-test overall environmental belief for family index alone and best predicting equation

Model	R	R Square	Stand. Slope	Significance
= Family Index	.637	.406	.637	<.001
=Family Index	.766	.586	.441	<.001
+Question 9			.176	.053
+Question 10			.204	.021
+Motivation			.271	.002

The above procedures were used on an analysis to explain the delayed post-test overall environmental belief scores. A model was constructed where the family index score on the delayed post-test was used as the single factor explaining environmental beliefs and then a full model was constructed using all available factors (See Table

22). A scatter plot of the relationship between environmental belief and family index is given in Figure 9. Through backwards elimination SPSS removed all variables except family index. When family index is used to explain environmental beliefs 48% of the variation in data is explained (R squared = .478). The effect of family index on environmental belief is found to be statistically significant (p=<.001).

Delayed Post-Test Family Index vs. Environmental Belief

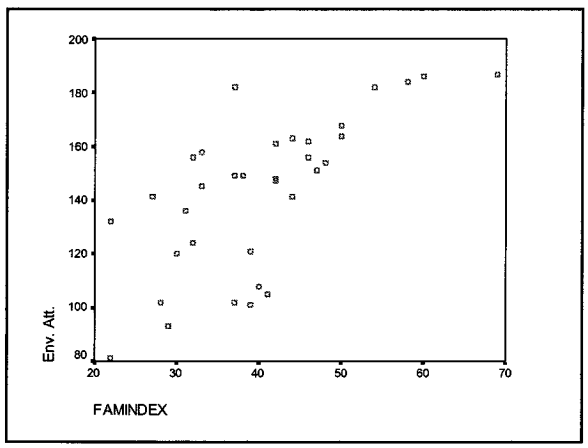


Figure 9

Scatter plot showing delayed post-test environmental belief vs. delayed post-test family index score

Table 22

Linear regression results for delayed post-test overall environmental belief for family index score and best predicting equation

Model	R	R Square	Stand. Slope	Significance
= Family Index	.691	.478	.691	<.001

The last sets of regressions were done on the compared data between pre-test and post-test where the change in environmental belief served as the dependent variable (See Table 23). First, two models were tested where the family index score on the pre-test and the family index score on the post-test were used solely to explain the data (See Figure 10). In the model where the pre-test family index score was used to explain change in environmental belief less than 1% of the data was explained (R squared = .005). In addition the probability that the factor was affecting the environmental belief was not found to be statistically meaningful (p = .582). Where the family index score on the post-test was used as a descriptor of change in environmental belief 12% of the variation was explained (R squared = .118). This factor was found to be statistically meaningful or was found to contribute to a non-zero slope of the line fitted (p = .005).

A full model for explaining the change in environmental attitude included both of these family index scores along with age, gender, general attitudes, and whether the student attended an EE camp or not. Again SPSS selected the most information rich and meaningful equation through backward selection. The resulting equation included both family index scores followed by "motivation" or why a student attended camp, and whether the student attended an EE camp or not. However, the family index score on the pre-test was found to have a negative slope, indicating that an increase in the pre-test family index score has a negative effect on environmental belief. In this equation the slope of the line as a result of each of these factors was found to be non-zero. The resulting equation explains 30% of the total variability (R squared = .300).

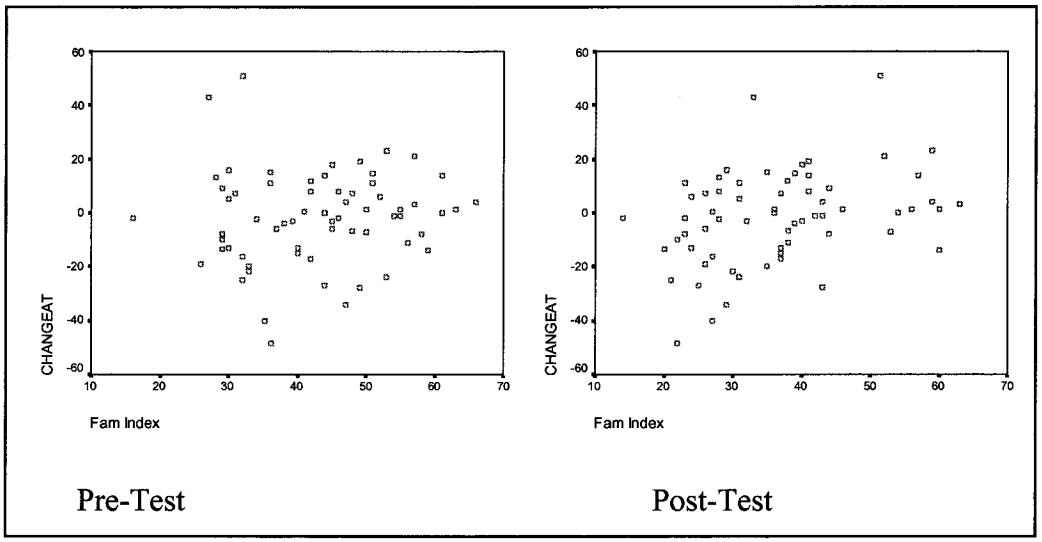


Figure 10

Scatter plots showing change in environmental belief vs.
pre-test family index and post-test family index

Table 23

Linear Regression results for change in environmental belief from pre/post test for family index scores and best predicting equation

Model	R	R Square	Stand. Slope	Significance
=Pre Fam Index	.070	.005	.070	.582
=Post Fam Index	.343	.118	.343	.005
=Pre Fam Index +Post Fam Index + EE course + Motivation	.548	.300	-.448 .523 .254 .302	.007 .002 .031 .014

PERSONAL INTERVIEWS (Questions 10,11)

Personal interviews were conducted with all consenting students enrolled in three EE courses at the Science Factory. These 14 students met with the researcher during their lunch break for roughly 30 minutes. Three of the students were enrolled in the Blue Planet course, six students were enrolled in the Photo Safari course, and five students were enrolled in the Wild Edibles course. Not all students in any of these courses chose to participate.

The first question in the interview addressed the types of activities a student engages in outdoors, how frequently those activities occur, and with whom they are shared. Responses to this question might be grouped into three categories.

1. Outdoor activity is limited or avoided
2. Outdoor environment as a stage
3. Outdoor environment as a subject

Two of the respondents to this question remarked that outdoor activity is avoided. The first stated that he participates only when he is forced to participate through walks or bike rides with parents. The second commented that he goes outside only rarely, perhaps once per month, when his parents take him outside.

Nine of the students responded to this question by describing activities where the outdoor environment served as a stage for the activity itself. Examples included: playing team sports, shooting hoops, rollerblading, running, swimming, and riding a bicycle.

Four students described activities that are explicitly utilizing the environment as the subject of the activity itself. Examples included: exploring for animals, feeding hummingbirds, picking fruit, and identifying insects.

Many of the activities described may be adequately placed in both of the above categories where the degree to which the activity falls in one or the other category depends largely on intent. Examples of activities in this category include: walking, hiking, bike riding, and climbing trees.

The activities described in this category were described to take place as often as daily and as infrequently as once per year. In addition, the activities were said to be shared with parents only infrequently. Only five of the students commented that they spend time outdoors with parents of their own free will. Two others, described above participate with family when they require the activity. Students that described activities with their parents often commented that those activities with parents occur only rarely. Only three students reported spending time with parents outdoors frequently. Five students mentioned siblings specifically and two others mentioned Boy Scouts as the venue for their involvement.

Despite the degree to which any activity occurs or with whom it occurs, students were able to recall singular experiences in the distant past as important in forming their opinion of nature. Of the 14 students interviewed ten were able to recall an event that formed their opinion of nature. A complete list of these events follows:

1. A trip with mom where he saw fish suffering
2. Fell in the mud

3. Trip to Yellowstone
4. Catching her first fish with her dad
5. Bit by a dog
6. Planting trees with a school program
7. His fish died
8. Stepped on a bee
9. Camping trips with mom
10. Going on work related trips with mom (environmental lawyer)

Although 10 students were able to recall an event that changed their perception of the environment and many of these events occurred with family, most of these same students spent little time with parents overall. That is to say, they were recalling distant singular events in addition to more regular and current events as important in belief formation.

When asked about where students learn about the environment most students had difficulty understanding the nature of learning, but after prompting were able to suggest locations for learning. These locations can be generally classified as follows.

1. Parents
2. School
3. Camps
4. Books
5. Organizations (BSA)

These five locations are listed in order of frequency in which they were reported. Parents in this case were understood to be the primary caregivers and were reported as the principle source of learning in nine of the 14 cases. However, in most cases this learning was infrequent and in some cases had ceased some time ago when parents were removed from the home for one reason or another.

Students were also asked to comment on how spending time outdoors makes them feel. Perhaps more than any other question, this proved to be difficult for students to answer. It was apparent that students did not fully understand or could not describe their own emotions. The responses ranged from feelings of great peace to feelings of boredom and did not appear to necessarily relate to what a student does outdoors.

When asked about what the student and his or her household do to help protect the environment, the only responses were recycling and planting a garden. Even in these instances it required listing several options before a student could recall an activity that was utilized in the home to help the environment.

Finally students were asked to comment on whether they talk with family members about the environment and what sorts of things are talked about. Seven of the 14 students commented that they did talk about the environment with their parents. These conversations varied in topic from ways to protect the environment to who should be the next U.S. President. In two cases the student said that they talk about the environment often, but when asked about content, they said they talked about a dislike of the current U.S. President. One student commented that she talked

frequently about the environment with parents and described this conversation as when to feed the hummingbirds and how much to feed them. It may be necessary then to understand the content and context of conversations with parents to understand how these conversations will influence environmental belief. It is likely that frequent discussions about how to protect the environment and occasional discussions about animal care will have different results on a student's beliefs.

OBSERVATION AND INTERACTIONS

Although informal observations and the interactions between students and this researcher are difficult to quantify, they may be nonetheless important in understanding the results of the data outlined above. Observations will be limited here to those thought to be of both considerable interest and considerable surprise or which may contradict previous assumptions. It is understood that these observations are biased and ought to be viewed only as potential factors of significance and not as evidence or support of any thesis.

First and foremost, it was surprisingly evident that the population of students who took part in this study did not represent the population originally thought to be represented. Eugene is generally regarded as environmentally progressive and as such, the population of students at the Science Factory was thought to represent that trend. However, several indicators suggest otherwise. First, enrollment in courses related to the natural sciences and environmental science was low or courses were canceled completely. Further, interviews and instrument scores indicate environmental beliefs far lower than were expected. Finally, it was found during this

research that a number of other camps in the area provide EE exclusively. At least one of these programs reported exceptional enrollment in their EE courses. This suggests that students interested in EE may have been going elsewhere. Thus, the population of students interviewed does not represent the population of students in Eugene in general as well as predicted or the population of Eugene does not hold the set of environmental beliefs predicted.

The Science Factory is host to a considerable number of students from unique family backgrounds. Many of the students enrolled in courses under investigation were referred to the program directly from state agencies. Thus, there is reason to question whether the definition of family as it was defined in this research is adequate in describing the homes of the students participating in the study. This relatively large population of students without long term caregivers may also reflect on the family and home life factors asked about and the environmental attitudes of students. In one class taught by this researcher more than half of the students were without long-term caregivers.

Another potentially linked observation was the degree to which disciplinary action was necessary in the instruction and administration of these courses. While discipline is always likely to have an effect on the experience of those enrolled in a class, discipline given in many of these courses was severe. In one of the environmental education courses a student had to be removed from a course after throwing a helmet through a pane of glass while trying to strike another student. The same student fled a field trip through a fire escape and had to be chased down. In yet

another course a student with a known attention disorder had to be chased down after he ran from a small group and attempted to jump into a river. Numerous other disciplinary actions were taken in these courses.

Severe emotional distress was also prevalent in the population under question. In several cases students experienced emotional stress beyond that which might be normally associated with learning. One middle school student fell to the floor in tears and remained curled in a fetal position for 20 minutes while working on developing a landscape photo in a darkroom. When later asked what had happened, she was only able to exclaim a fear of darkness. Two students were invited to remove themselves from group work after continually threatening to kill other members of the classes in which they were a part. As one last indicator of the emotional stress experienced during courses taught by this instructor, a young student had to be physically removed from the class when he fell in a field and refused to move after being told he could not crush spiders. His mother explained that the response was normal for the child.

Past experience in teaching all of the grade levels in question in this research suggests that the emotional stress and discipline required in these courses was not normal. While these observations pertain only to courses taught by this instructor, discussion with other instructors suggests that these experiences were shared by all instructors during this time period to one degree or another. It is not known to what degree this abnormality affects the environmental beliefs of an individual or the family and home life of an individual. It is suspected that the population being researched here has an exceptional family history and may be focusing on such pressing issues in

their lives that a focus on environmental attitude or behavior is near impossible. This assumption may explain to some degree why the environmental beliefs were found to be quite low, why students reported little involvement with parents in the written instrument, and why students interviewed were often unable to recall positive experiences with parents or guardians. A more thorough review of the implications of this observation is given in the final chapter.

CLOSING

The results of the literature review, the written instrument, the personal interviews, and observations have now been given. The data that has been collected likely contain more information relevant to this field. However, the review and analysis of data has been restricted to analysis relevant to answering the primary questions of interest. While the data would likely reveal more valuable information if analyzed differently, these analyses are beyond the scope of this paper. In the chapter that follows information that has been presented here will be used to formulate conclusions and suggest models for better understanding how family and home life factors related to environment are affecting environmental beliefs and environmental education.

CHAPTER 5

DISCUSSION AND CONCLUSION

"There are those who dismiss parental responsibilities, feeling they can be deferred until the child grows up. Not so, the evidence reveals. Prime time for teaching is fleeting. Opportunities are perishable." "It is in the home that we form our attitudes, our deeply held beliefs."
---Thomas S. Monson (Monson 2004, p.5)

INTRODUCTION

A discussion will now be given of the results of the research presented in Chapter 4 and conclusions will be drawn to the answers posed throughout the work. In addition, the answers to the research questions will be used in an attempt to inform current models for understanding environmental beliefs and environmental education. An attempt will be made to outline existing needs in this research and the needs which were revealed by this research.

Chapter five is outlined as follows. First a review of the data collected will be reviewed by research question and discussed as needed to more consistently detail or explain the results outlined in Chapter 4. The next portion of this chapter will be devoted to using the inferences drawn to inform the existing models in use and create a typology of family and home life factors that inform environmental beliefs. Next, considerable effort will be given to a proposal for how this new knowledge might be applied in practice and what it might mean for current trends in environmental education. Finally, concerns and questions will be explored of this work and of the work that is still needed to answer the questions of interest.

DISCUSSION: QUESTIONS 3 AND 4

The first two questions addressed in Chapter 4 were research questions three and four. Both questions ask about the relationship between items asked on the written instrument. This relationship was investigated in part through a series of tests of the reliability of the instrument or of its internal consistency. Cronbach's alpha for all three iterations of the written test and on both the family and home life factors and environmental beliefs sections were considerably higher than expected. It appears based on the alpha values reported in Chapter 4 and based on the item-total item correlations reported that the instrument is internally consistent (See Tables 3-10). This finding, along with added support in the form of face validity suggest that the instrument designed may well be suited for additional research of the family and home factors related to environmental beliefs. This instrument is the first of its type to be designed for children and is comparable only to Sia's dissertation instrument designed as a retrospective analysis of adults (Sia 1984).

The manner in which the fourteen questions asked about the family and home were found correlated suggest an important conclusion about the teachings in question. If a considerable relationship exists between these factors and it is demonstrated that these factors are related to environmental beliefs, then an inference can be drawn between environmental beliefs and the overall family environmental sensitivity. In the few prior studies that have examined a relationship between family and home experiences and environmental beliefs, only specific actions were suggested as related. The relationship that exists here is evidence that the relationship exists not

only between specific types of formative experiences, but between the overall formative experiences provided in the home to learn about and experience nature and the environment and environmental belief.

A similar relationship was found between questions asked on the environmental beliefs portion of the written instrument. Nineteen questions were asked on this section of the instrument and were designed to represent six distinct categories of questions: verbal commitment to environment, actual commitment to environment, affect or feelings toward environment, locus of control as it relates to environment, feeling of environmental responsibility, and perceived knowledge about environment.

The results of the reliability analyses conducted in Chapter 4 suggest that all questions asked in this portion of the instrument properly belonged a part of both the distinct section of the environmental belief in which they were asked and as part of an overall environmental belief. The high level of correlation between the six components of environmental belief suggests that the scores can be collapsed into one overall score that is both convenient and quite meaningful. This finding is useful to further research that may wish to address environmental beliefs in general rather than a specific subset of environmental beliefs.

In the last analysis conducted on the reliability of the environmental belief section, a Cronbach's alpha was computed if any one of these six components were dropped from the overall environmental belief score (See Table 10). It was found that alpha would suffer meaningfully if any section were omitted. This suggests that a

meaningful description of environmental belief ought to be comprised of at least these six categories. What additional categories might make this score of environmental belief more meaningful is still a question of interest.

DISCUSSION: QUESTIONS 5,6,7

Research questions five, six, and seven are questions of comparison. Of interest in this discussion is how EE students differ from non EE students and how pre-test scores compare with post-test scores or delayed post-scores. First a discussion of overall attitudes will be given, followed by family and home life factor differences, and finally a discussion will be given of environmental belief differences. As mentioned in Chapter 3, analyses here have been conducting using t-tests. Differences in populations compared should imply that the specific differences in means found are only suggestive. Both the F-statistic found in ANOVA and the t-statistic found here produce identical significance values or probabilities.

Overall attitudes

The overall attitudes asked about on this instrument were the attitudes which the Science Factory hoped to be influencing and were not contingent on whether the course was an EE course or not. Thus, the comparisons given were of the overall scores on the pre-test compared to those on the post-test. Of the four overall attitudes available for comparison only two were found statistically significant from pretest to posttest (See Table 11). A student's perceived knowledge of the subject did go up between testing. This suggests a positive influence of the curricula on the cognitive component of the camp experience. This is valuable information for the Science

Factory and might be interpreted to mean that the summer camp courses are indeed educational.

Unfortunately, a student's interest in science as a subject decreases meaningfully from pre-test to post-test. This may suggest that student's become "burned out" after spending a week of there summer studying some aspect of science or could mean that after becoming more fully aware of the subject, they are making an informed value judgment in opposition to the subject. This data may also imply, however, that the camps are having a negative impact on inspiring a student to become positively interested in science. This latter judgment would mean a failure on the part of the Science Factory to meet one of its intended objectives.

The two attitudes for which no change occurred were the student's level of excitement about the subject of the camp and their level of excitement about going to camp in the future. A lack of change in either of these two areas suggests again that the Science Factory is failing to foster an interest in the content of each camp and failing to foster an overall positive experience. However, it may also be that high pre-test scores in both areas make a positive change in attitude hard to detect. This final possibility may be evidence of a "ceiling affect" on these questions. However, the change in other attitudes and the data gathered through interview and observation suggest a true lack of change over the camp's time or suggest at least that the student's do not believe their attitudes have changed. It is always possible that the affects of a program will not be immediate.

Family and Home life Factors

The family index score, or sum of 14 questions asked does not appear to differ between EE students and Non EE students before the program. However, there is a statistically meaningful difference between populations after the program and it was found to persist after six weeks (See Table 12). This finding suggests that the EE course itself has an effect on the family and home life factors of the student. This inference is based on the fact that no difference in the family index scores of EE vs. Non EE students exist until after a student has attended camp. Several of the questions contained within the family and home life section specifically asked whether conversations about nature or environment occur during the week. Given that EE students are presently being introduced to this material, it is not surprising that this would have led to higher scores on this section in the post-test. It is also possible that activities or involvement outdoors or in the discovery of nature inspired continual involvement.

If this effect is truly still evident after six weeks as the data suggests there may be an exciting unanticipated result of EE courses. As it will be discussed later, there is little or no change in environmental belief as a result of an EE course in this study. However, there is a positive relationship between family and home life factors and environmental belief. It may be then that the most meaningful impact of an EE course is to inspire or motivate a series of formative experiences in the home that will eventually lead to pro-environmental beliefs. If a five day course is able to alter the formative experiences in the home six weeks later, then there is reason to believe that

the course is having a significant and potentially useful impact. From this it may be inferred that courses which require or suggest family involvement in the course will ultimately lead to more pro-environmental beliefs.

One potential problem with the previous assumption rests in the degree to which the family and home life factors are found related to environmental beliefs. In the pre-test iteration 61% of the variance in environmental beliefs can be understood by family index alone. However at the post-test iteration only 59% of the variance is explained and at the delayed post-iteration only 48% of the variance is explained. This could potentially mean that the class inspired or motivated conversation and dialogue about environment that isn't necessarily positive. If this were the case, then the family index score might actually go up while environmental beliefs went down or remained constant. However, it seems very unlikely that a negative discussion like the one suggested would persist for six weeks.

Environmental Beliefs

The comparison of environmental beliefs between students taking an EE course and those who do not and the change in environmental belief during a camp provide considerable insight into the effects of environmental education on environmental beliefs. First it is notable that a statistical difference in overall belief did not exist between EE students and non EE students until after their course (See Table 13). This, of course, suggests that EE courses have an impact on their students. It is also important that this difference persists after six weeks. However, despite this statistically meaningful difference, an analysis of whether EE students scores change

meaningfully from pre-test to post-test suggest no positive improvement (See Table 14). This discrepancy in data is understood by an observation of the environmental belief scores of non EE students. Over the period of the five day camp, non EE student environmental beliefs actually decline, and this decline approaches statistical significance.

The results of these two sets of analyses suggest that environmental education at the Science Factory is having an effect on its students but it is not inducing a positive change in environmental belief, rather it is serving to stabilize existing environmental beliefs. Where students in non EE courses seem to waiver in their beliefs, those attending the EE courses develop a more stable and predictable long term belief. This finding would suggest that EE courses may be effective and important even if evaluations of the students find no meaningful change in belief. The importance of the program may be then to stabilize beliefs and to induce or inspire dialogue and activity over the long term that may eventually lead to pro-environmental beliefs.

In addition to the overall environmental beliefs, a comparison was made between the individual components of environmental belief. As was presented in Chapter 2, it has been suggested that EE programs may be effective at changing some aspects of belief and not others. In the comparison of EE vs. non EE students it was found that actual commitment to environment and feelings of environmental responsibility differ between groups after a five day course in environmental education (See Table 15). However, when each of the groups were compared through a pre vs.

post-test comparison it was found that these differences occur because of a statistically meaningful decrease in scores on these sections on non EE student tests and not the result of an increase in score for the EE students (See Table 16). Nevertheless, it may be possible to suggest then that these courses are having a greater effect on these two components of environmental belief. However, the actual commitment section of the instrument is dependent in a great part on the beliefs in other components of the overall environmental belief. If the course is having an effect on actual commitment or behavior, then it is likely affecting related beliefs as well. This data then suggests that these EE courses are not selectively effective at improving environmental beliefs, and in fact may not be effective at all in altering environmental beliefs, at least in short term.

Finally, a close examination of the environmental belief components between EE students and non EE students reveals that the environmental beliefs of EE students are in every case greater than non EE students even before the course begins. This is evidence that students or parents who enroll their students in an EE course are already prepared to learn or are interested in environmental topics. This finding is not especially novel, but when coupled with the finding that this difference exists before but is not statistically meaningful until after the course, again suggests that the courses are having an effect on students and may be of a benefit to students who already have pro-environmental beliefs by serving to stabilize those beliefs.

DISCUSSION QUESTIONS 1,2,8

Correlations or relationships between the factors asked about on the written instrument; family factors, demographics, and overall attitudes with environmental beliefs is an essential component of this study. The relationships that exist in this study were explored by means of Pearson Correlations and by means of linear regression. Both procedures were used to ensure any relationship might be detected even if that relationship wasn't large or as relevant as other relationships. In addition, the correlation matrix allowed for a large number of factors to be reviewed at once. Regression was used to identify any linear relationships and develop a model for prediction. Regression, of course, suggests a causal relationship and was the most aggressive approach to understanding the relationships in question. The relationships found in Chapter 4 are discussed here where correlations are discussed first followed by the application of these correlations in a regression.

Correlation

The correlations presented in Chapter 4 provide useful information that would not have been revealed without the analyses (See Tables 17,18,19). First, the correlations reveal important relationships between demographics and environmental beliefs. Age and grade level were found correlated in a large measure to environmental belief and its components in each of the iterations explored. It appears that as a student gets older his or her environmental beliefs decrease. This finding has been documented in additional research that was related in part in Chapter 2. The idea that time corrupts environmental beliefs, or at least moderates environmental beliefs,

presents both a problem and a clue for environmental educators. In part, it becomes important to begin asking what happens as a child grows up that causes an individual to lose a sense of responsibility and relationship. On the other hand, it motivates environmental educators to modify or rethink the current educational process that may cause this corruption. Until now it may have been suggested that the teachings that need modification are those of our public school system. As a result of this study, it becomes especially meaningful to question how teachings at home change as a student gets older. It is important to note a finding here not reported in Chapter 4 but relevant to this argument. Many of the family and home life factors were found negatively correlated with age and grade level and that in several cases this correlation was statistically significant. Thus, it appears that teachings and experiences in the home as it pertains to environment may decrease as a child gets older.

In addition to age, gender was also found highly correlated with environmental belief. It appears in both the pre-test and the post-test that females have higher pro-environmental beliefs than males. This relationship has been supported widely and is an important relationship that is beyond the scope of this research. However, when gender and change in environmental belief are correlated it appears as though males are more likely to adopt more pro-environmental beliefs during the week than females. It may be then, that females have already been introduced to environment and nature whereas males are not introduced to nature and environment until the EE course. A further explanation of gender as a factor influencing environmental belief is beyond the scope of this study. Importantly, the grade level or age of a student was not found

correlated with a change in environmental belief. Thus, while it may be that younger students are more likely to have a pro-environmental belief, both young and old students are just as likely to be affected by an EE program.

Family and home life factors were found to be highly correlated with each other in this study. This finding as reported above in the reliability analyses suggest that there is a strong connection between types of environmental teachings in the home. More importantly it was found that these family and home teachings pertaining to environment are correlated with environmental beliefs as was proposed as the thesis of this work. This work supports the thesis that the family and home life teachings of a student are in fact an essential component to understanding environmental beliefs. While this is not an especially novel finding, it is evidence of an important relationship that has been undervalued and underdeveloped. This correlation is explored in greater detail later in this chapter.

One further correlation found unexpectedly was the degree to which overall attitudes toward science and the program were found correlated with environmental beliefs. The correlation between overall beliefs about the program and science and environmental belief may suggest several relationships. First it may be, as has been proposed by others that there is a relationship between attitudes toward science and attitudes toward environment (Ma and Bateson 1993). It also may be the case that an overall positive attitude lends itself to be revealed in the instrument as high attitudes towards science, the program, and environment where it is truly a measure of a students overall positive attitude. It may also be the case that students who have been

taught gratitude or appreciation tend to appreciate or be grateful for the environment. They would also then, demonstrate an appreciation for science, and the Science Factory. While many of these relationships are statistically meaningful they do not approach the degree of relationship between the family variables and environmental belief as will be discussed in the regression portion of this discussion.

Correlations in this section were analyzed against overall environmental belief as well as each of the six distinct components of environmental belief. There is no evidence from any correlation matrix that one aspect of environmental belief is being affected consistently different than another. For this reason and because of the high level of correlation between each of the six components, it appears the six aspects may be collapsed into one environmental belief score for use in regression analysis.

The last set of correlations attempted to identify correlations between factors associated with a change in environmental belief. Results from this portion of the study are less clear in part because there is little evidence of any positive change in environmental belief. However, the research does suggest several relationships with environmental beliefs. First, the overall attitudes toward science and the program were found associated with a positive change. This suggests that a positive overall attitude not only has a relationship with environmental belief, but that a positive attitude may actually affect the likelihood of altering environmental beliefs. It is possible that students who are generally content are able to focus on the content of their course and even perhaps adopt new ideas or beliefs whereas students with a

generally negative attitude or students facing other challenges may have a hard time focusing on environmental content or adopting new relationships and commitments.

The family and home life factors played much less of a direct role in the change in environmental belief over the five day period than expected. None of the family factors found on the pre-test and only three of the fourteen questions found on the post-test were found correlated with overall environmental belief. These three questions were: 1) My family taught me about ways to protect nature this week, 2) I went to camps or other places where we talked about nature this week, 3) I watched television or movies at home about nature this week.

It was anticipated that family and home life factors would play a larger role in a change in environmental belief. It does not appear that a clear and direct relationship exists as anticipated. However, as has been discussed above, it does appear that family and home teachings are related to environmental beliefs. This finding along with the finding that environmental beliefs do not improve over the five day period suggest that family and home factors are influencing environmental belief in a way that is longer in development and perhaps independent of an EE course at the Science Factory. It is proposed then that environmental beliefs are introduced and formed in the home and may be reinforced and stabilized by additional teachings outside of the home. In this model, both the family and home teachings as well as the EE initiative are essential in development of environmental beliefs.

Regression

The regression equations generated by SPSS or tested by SPSS are suggestive of those same inferences made in the correlations section above. It is notable that in every regression equation generated as the best equation to predict variation in environmental belief, family index score was the best predictor (See Tables 20-23). This result affirms and re-affirms the already stated conclusion that the teachings and experiences in the home are related to overall environmental beliefs.

As Chapter 4 describes, 61% of the environmental belief on the pre-test iteration was described by the single variable family index. The best equation for the relationship included gender, motivation (or why a student wanted to attend camp), and question eight which asked about a student's attitude toward science. This full equation explained 68% in the total variation of environmental belief. The post-test iteration regression suggests that family index explains 41% of the variation where the best equation included additional overall attitudes to explain 59% of the variation. The delayed post-test best equation contained only the family index variable and explained 48% of the variation. A visual analysis of all three of the above equations reconfirms the above inferences (See Figures 7-9).

When the regressions are used to predict the change in environmental belief neither the pre-test nor the post-test family index are exceptionally useful. However, the slope of the line against post-test family index was non-zero, or it was found that post-test family index was statistically meaningful in predicting change in environmental belief. The best equation for predicting change in environmental belief

included both family index scores as well as whether or not a student attended an EE camp and why they attended camp. This model explains 30% of the variation in environmental belief. When the pre-test family index score was used in this analysis it has a slightly negative impact on the total slope of environmental belief scores. However, when entered as a predicting factor alone it has a very small positive slope found to be non-significant.

The effect of family and home teachings and experiences as it pertains to the environment do not, as predicted, appear to have a significant direct linear impact on change in environmental belief. However, they do appear to have an impact. Based on the data that has been reviewed, it appears as though the home as a place of learning is influential on changes in belief but not directly nor does it have an impact that would be detectable over the period of a five day course.

It was predicted that certain individuals with high levels of environmental sensitivity, or past experience with nature and environment, would become highly motivated by an EE experience and be highly affected by the course. Students without these same experiences would not find themselves as motivated or inspired by the course and would therefore not show a distinct difference in environmental belief. However, it appears an alternative hypothesis needs exploration. First, it is entirely possible that few or even no individuals of the type described above attended the EE camps in question. As mentioned previously, the students attending these camps had pre-test environmental belief scores and family and home life scores far lower than expected. It may be that the reason a relationship was not evident is because few

students had been sufficiently motivated by formative experiences at home. It is also possible that the effect of an EE experience on a student is not such that it will directly cause an increase in environmental beliefs. If EE courses are stabilizing beliefs then change in belief will be exhibited by those not involved in an EE course and this change may be positive or negative, but tends to be negative over time. Family and home experiences with nature and environment will not be associated with a change in environmental belief then, but rather, may be associated with the stability of environmental beliefs over the short term and a gradual progression of environmental beliefs over the long term.

PERSONAL INTERVIEWS (QUESTION 9,10)

The personal interviews conducted as part of this research were of significant importance in understanding the results. In large measure, the results of these interviews were presented as a discussion in Chapter 4. Additional inferences are made here as relevant to the questions above.

First, it was noted that when asked about time spent outdoors "in nature", students perceived the meaning of "in nature" in unique ways. In many cases an experience or activity meant that the outdoor environment would serve as the location for the activity whereas for others this question implied that the activity involved the outdoor environment in some meaningful way. If, when asked about time spent outdoors two students respond that they spend considerable time outdoors but where one spends that time on a football field and the other spends that time doing restoration work with her father, it would be expected that the relationship developed

with the natural world will be different. Thus, the interviews suggest that any future attempts to quantify outdoor experiences will need to specifically address diverse activities certain to inform relationships in different ways.

Only five of the fourteen students reported regularly spending time with parents in outdoor settings. This response suggests that developing an understanding or relationship with the outdoor environment or with a place is not highly valued by parents. It is worth commenting then that the development of children has largely become an indoor pursuit. If children learn to understand their world and form relationships within the world entirely in an indoor world, relationships will not be developed of the kind sought after by environmental educators. Whereas a child, 50 years ago would likely have participated in outdoor recreational pursuits and assisted in essential family responsibilities outdoors, children are now found more readily behind a television or computer screen.

Ten different activities were listed by students as having a profound effect on their relationship with nature. Those ten experiences were diverse but had something profound in common. Of the six positive experiences mentioned, every one took place in the presence of other closely related adults and five took place in the presence of parents. In one case, the activity mentioned as having a profound effect took place in a public school field trip setting. This data is useful to both parents and to environmental educators and suggests that singular events may have profound impacts on children although it is still uncertain when these impacts will be detectable.

It is also important to note that four of the events mentioned were negative experiences with nature. Interestingly one student mentioned falling in the mud as the reason she no longer desires to be outdoors. Another student was so profoundly affected by being bitten by a dog that he is now fearful of outdoors. The experiences parents and educators create for the development of children are unquestionably important and must be created in ways where the child will have a positive experience. If singular negative events can play a large role in determining beliefs then parents, educators, and all who may be involved in the life of a child must be challenged to carefully consider and thoughtfully prepare for the lessons and experiences they will share.

Negative experiences must not always eventuate into a fear of or dislike for natural settings. One young boy described the experience he had when his pet fish died. He commented that while he was very sad for the loss he felt, that he learned how connected he was with other animals and how their loss can cause him to suffer. His negative experience became a teachable experience which was not allowed to pass. In this example a caring and thoughtful mother turned an otherwise unpleasant experience into a teachable moment that appears to have persisted years after that singular event.

The venue environmental education was explored in these interviews and found to originate most dominantly from the teachings of parents. If students learn about nature and environment from parents more often than from schools, camps, books, or other organizations, then educators must be challenged to find ways to

educate parents as teachers or ways to target the family rather than only the student. In addition, it becomes evident that environmental education is not prevalent in formal education. It is assumed if the student had been asked where she or he learned algebra, they would almost certainly have chosen school as the source of information. Environmental education must become a more prevalent part of the everyday learning of a student in the home and a mentionable part of a student's formal education.

Environmental teachings were found to originate most often from parents in these interviews. As was mentioned in Chapter 4 the content of educational discussions in the home ranged widely and might be interpreted as more or less effective. While there is likely a benefit from all constructive discussions between a parent and child, it does not appear that parents have adequate information from which to draw to educate students about nature and environment. It is likely that many parents do not possess the knowledge that would equip them to establish meaningful understanding in their children. This finding is likely again a phenomenon of the times. Parents have always taught about human/non-human relationships. These relationships were essential to existence and may have been rather simple, but long-term effective. The loss of this knowledge and the loss of its teaching are of great importance.

OBSERVATIONS

The students interviewed and questioned in this research were unique as described in Chapter 4. The implications of this unique population on the results of this research are unknown, but some predictions may be reasonably formulated. First,

it seems highly unlikely that the lower than expected environmental beliefs and family and home teaching experiences observed in this research and the degree of physical and mental disturbance exhibited are independent. Rather, it appears that severe emotional and physical distress on children hinders the development of environmental beliefs, or at least may hinder belief formation. It appeared as though the challenges being faced by these children made focusing on new relationships and new ideas difficult and perhaps even impossible. In one case a student enrolled in an EE course at the Science Factory talked continually about getting new parents. After a life in foster care, he and his younger brother were being adopted. In the midst of this life changing event, the EE course was introducing ideas about how pollutants affect phytoplankton levels in oceans. Given the lack of concentration this young man had in class, it seems unlikely that this course was particularly effective at this time.

In one other example a young girl and her mother were adjusting to life after her father had been admitted to a correctional institution. The mother and daughter were apparently facing economic as well as emotional stress. It was during this emotional stress that the daughter was being challenged to ask her mother questions about recycling and discuss what they could do at home to protect the environment. It again seems unlikely that this family is going to prioritize environmental education highly given current circumstances.

Thus, while the unique population most certainly had an effect on the results of the research, it also provides a unique experiment from which to draw data about extreme life experiences and their relationship with environmental beliefs. It appears

from this study that extreme circumstances in the life of a child and on his or her family have adverse effects on environmental beliefs and on belief formation.

If the ability of children to form pro-environmental beliefs is based in part on the quality of life they currently enjoy, then a distinct link is evident between environmental quality and social quality. It appears, based on this research, that addressing environmental quality through environmental education is dependent on social quality. The implications of this suggestion are beyond the scope of this study, but are nonetheless, important.

MODELS FOR UNDERSTANDING RESULTS

While the data that has been presented thus far is useful and formative, it is more valuable when used to inform current models for understanding EE and environmental beliefs. The data collected can be used to model or describe the relationship between family experiences, environmental beliefs, and EE. A series of relationships and suggestions are given here as based on the data collected. The models and suggestions that conclude this work are informed and carefully constructed as to add to the effectiveness of EE and in the development of a necessary EE network.

Effect of Formative Experiences on Environmental Beliefs

Formative experiences in the home and family pertaining to environment have an effect on several levels of environmental beliefs. It has been proposed by Hines et. Al. that behavior is informed by an intent to act as well as by situational factors (Hines, Hungerford et al. 1986). This intent to act is formed through a variety of skill,

knowledge, and personality factors of which attitudes, locus of control, and responsibility are a part. The latter component, personality factors, has been labeled environmental sensitivity by Hungerford and Volk and defined as empathetic perspectives toward the environment (Hungerford and Volk 1990). It appears based on this research that formative experiences in the home are having an effect at all levels of this model, or to use the model proposed by Hungerford and Volk, they play a role as entry-level variables, ownership variables, and empowerment variables. To (Hungerford and Volk 1990) what extent these family factors are affecting a specific component of overall beliefs is unknown and may be based largely on the quality and quantity of any one variable. However, based on the models for predicting environmental behavior by Hines et. Al. and by Hungerford and Volk a new model for understanding the role of formative experiences in the home is proposed where these factors are affecting and being affected by environmental sensitivity, knowledge and skills, and behavior. In turn environmental sensitivity, knowledge and skills, and behavior affect each other. This model is presented below in Figure 11.

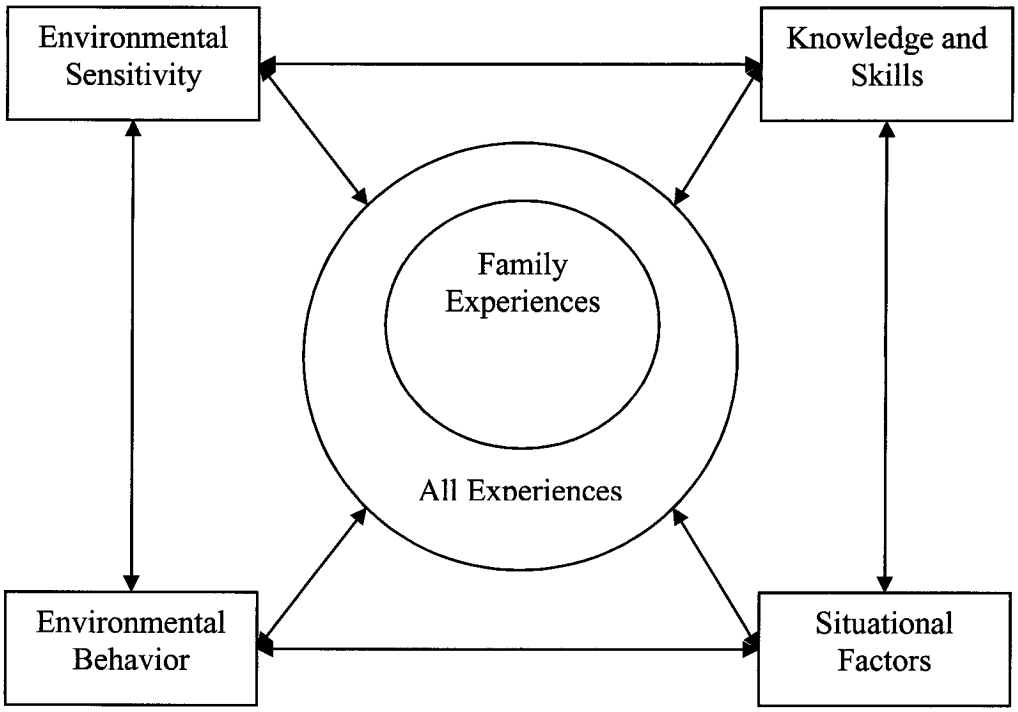


Figure 11

Proposed model for understanding the role of family and outdoor formative experiences on environmental beliefs in children

A Typology of Formative Experiences

The specific experiences in the home and family asked about in this research allow for a typology of family and home experiences to be modeled as associated with environmental belief. A diagram outlining this typology is presented in Figure 12. The presence or lack of formative factors and the quantity of each play a role in determining environmental beliefs in children. While each of these factors were found

correlated in this research, it is unlikely that all families would engage in all of the above activities. Thus, it is the sum of the overall experience and not the dependence on any one specific experience that is suggested as relevant.

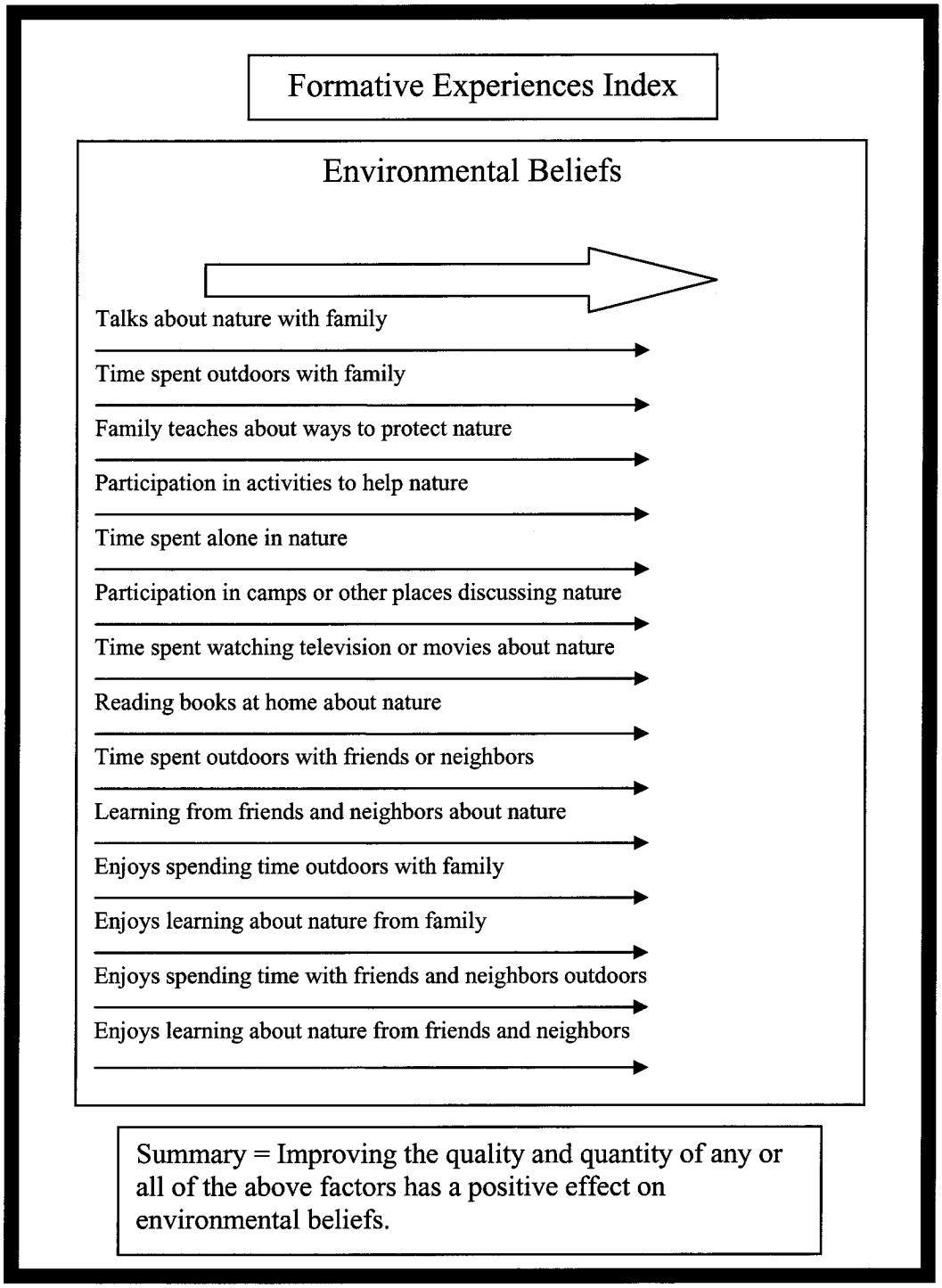


Figure 12

Typology of formative experiences in the home and family pertaining to environment responsible for environmental beliefs in children

Role of an EE Network on Environmental Belief Formation

The model for understanding environmental education initiatives has typically included formal and non-formal settings for EE introduction. While the family and home may well be thought of as both a formal and non-formal setting, it is proposed that it stand alone as an important and undervalued setting for EE. A model for understanding this relationship appears in Figure 13. In order for environmental education to effectively reach children and adults, cooperation between venues will be needed. It is a widespread and integrated EE network that is needed to inform environmental beliefs in a real and sustainable way.

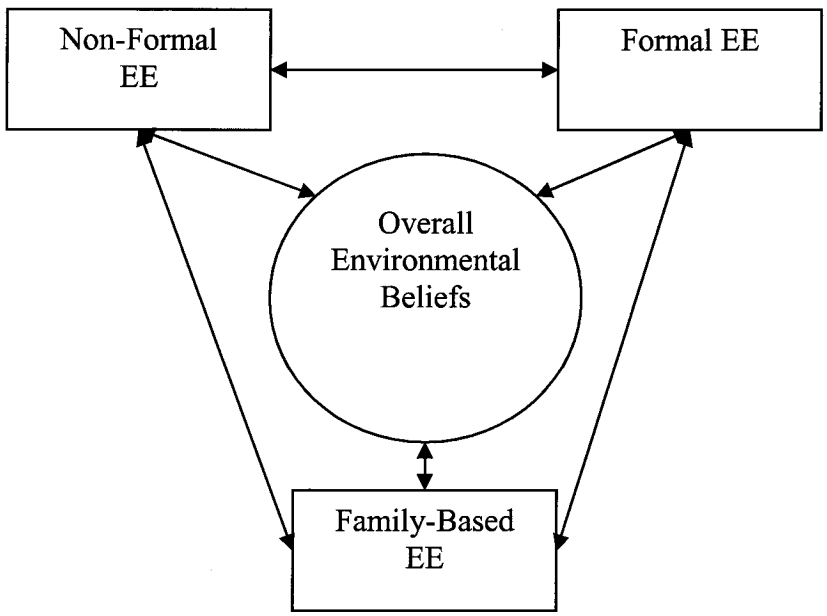


Figure 13

Role of Environmental Education in determining environmental beliefs in children

ENVIRONMENTAL EDUCATION SUGGESTIONS

Environmental education as a structured discipline is a relatively new idea. The success of environmental education as a tool for solving the environmental problems of today depends largely on the ability of the discipline to be defined by new ideas and concepts in an emerging field. The role of the family and home and its potential usefulness as a location for EE is a surprisingly unexplored field. The results of this research suggest that EE must begin to recognize and utilize these relationships.

It has always been evident that parents have profound influence over their children. Deeply held beliefs are rooted in the early fundamental teachings that go on in the home. However, EE as a discipline has sought to introduce beliefs far later in development and outside of the home. It is suggested then that early introduction of environmental beliefs in the home is an essential component to fostering overall environmental beliefs. It is well understood that this introduction is not always possible when parents themselves are unwilling to change habits or beliefs, or when the parents are unwilling to participate in a child's development. Possible strategies for dealing with scenarios in which parents are unwilling to participate in EE are equally important and are explored here as well.

A series of suggestions follow for how the results of this study might be used and interpreted by environmental educators. The list of suggestions outlined here is by no means a complete list of suggestions, but are primary suggestions based on the evidence revealed in this study.

Suggestion 1

EE materials are developed widely and distributed through EE educators and public school teachers. An attempt must be made to distribute EE materials to parents at an early stage in their child's development. Local nature centers, university extension services, and local government may all play a role in the distribution of these materials. Parents, for example are flooded with material about sex education and fire prevention, yet they are not equipped with environmental education. It might be assumed that parents who wish to introduce environmental beliefs will do so but without the necessary materials and ideas they may feel overwhelmed or unequipped.

Therefore, it is proposed that EE materials be designed and distributed to the family as a place of learning. While nature centers, museums, and schools may still play an important role in EE, the home will become a fundamental place for the fostering of environmental beliefs. Materials may include informational pamphlets, activities, lessons, and even extended curricula for teaching particular subjects. Parents who are willing, or who are inspired by these materials will then become the primary source of environmental education and that education will be supplemented by formal and non-formal EE initiatives outside of the home.

Suggestion 2

The curriculum of an EE course must extend its reach beyond the scope of the classroom or environment in which it is held. It has been demonstrated here that EE courses can inform parents and initiate meaningful dialogue. It is proposed then that environmental educators design programs that promote parent involvement through

conversation and shared activity. These activities may be sent home with students during a course, sent to parents before a course begins, and sent home at the end of a course for continual development. The results of this research suggest that integrating the learning that is taking place in the classroom with learning taking place in the home will provide the necessary catalyst for environmental belief formation. By introducing this curriculum before a course, a student is likely more prepared to receive new insight. By promoting activity after the course, the student becomes involved in learning at home and is not removed entirely from the source of inspiration or change.

Suggestion 3

Environmental education initiatives must target communities as well as individuals where the family is a community of special interest. The results of this research suggest that EE in the home plays an enormous role in belief formation. In fact, it appears that this effect far outweighs any program effects. An effective program then may target the family as a whole rather than the individual student. Family days, family workshops, and home visits are important EE initiatives where the family is taught and teaches itself. Parents may also be invited to participate in a day or more of a child's EE initiative and perhaps asked to share thoughts pertaining to the content of the day. While it is certainly the case that many parents would refuse involvement or lack the interest to participate themselves, many parents are or would be interested if invited or motivated by their own child's interest.

In addition to targeting families, EE initiatives may target other communities or interested groups. When invited as a community, meaningful dialogue and teaching can begin and be promoted from within the community after the EE initiative is complete. Youth organizations will look to their leaders as teachers and mentors and may value their insight in the same way they value a parent's insight. It must be remembered then that EE initiatives targeted to organizations must target not only the members of the organization but its leaders as well especially when no prior interest in nature or environment existed before contact.

Suggestion 4

The personal interview portion of this research revealed that school is not viewed as the primary source of learning about nature and environment. Parents or family members were listed as primary teachers. While this suggests an emphasis be placed on teaching families, it also suggests that formal education has failed to include EE into its curriculum. In many cases the parents will not support nor will they be inspired to support EE. In this event, environmental education must be included as a regular part of a student's learning experience. This suggests not only the inclusion of EE into formal education, but a regular and meaningful inclusion of EE into the curriculum. Deeply held beliefs, including those pertaining to environment will not be inspired through occasional discussion unless that discussion is linked to something more regular. Thus, EE must find its way into the curriculum of formal education.

Suggestion 5

Environmental beliefs appear to be influenced by singular events in a child's life. These events may be positive or negative and can have a long lasting impact. Educators and parents must then be particularly thoughtful and considerate as formative experiences are designed and shared with children. Special activities that promote positive experiences must be sought after and events that may lead to negative experiences must be avoided. From the perspective of the environmental educator this may mean designing programs that challenge a student to consider new ideas or engage in new behaviors without causing excessive fear or stress. It may also mean for both parents and educators that when negative experiences occur they ought to be used as a learning experience rather than hoping the experience will be forgotten.

Suggestion 6

Environmental education may serve the purpose of stabilizing environmental beliefs in children. Stabilization of beliefs is important and ought to be viewed as a worthwhile program goal. Programs that are not found to foster environmental beliefs must not necessarily be regarded as failing, but rather as contributing to a series of opportunities to change behavior long-term. Students or families already known to possess pro-environmental beliefs should not be overlooked. Students and families who demonstrate pro-environmental beliefs may benefit from programming as the program will serve to ground those beliefs and inspire long term change.

Suggestion 7

Environmental education must engage in regular and meaningful program evaluation. The lack of clarity in this research and in the research reviewed suggests that environmental educators do not clearly understand the impact of programs or materials. More detailed and thoughtful evaluations will serve to demonstrate weaknesses in EE and inform needed changes. Currently wide spread program evaluations are poorly designed, designed only to demonstrate overall positive attitudes, or are not conducted at all. A lack of quality evaluation has likely lead to a largely uninformed discipline.

REMAINING CHALLENGES

As would be expected, this study suggests the need for further research. In part, the small size of this study suggests that a larger and more thorough study of the role of formative experiences in the home and family is needed to make more meaningful inferences. Future studies must necessarily draw from the advances and mistakes made here and in other studies to further overall understanding. The sample size in this study was small and has been found to be of an exceptional nature. Studies utilizing more diverse groups of individuals will be necessary. In addition, the finding that environmental beliefs are developing slowly over time suggests the need for studies willing to track children through time. Studies may employ an agreement with schools or school districts as a means to track children over their K-12 development.

As work in environmental belief formation and how environmental education might address environmental beliefs continues, a merger between disciplines will

become necessary. Collaborative efforts between psychologists, sociologists, environmental scientists, and educators are needed to make meaning of the complex relationships that exist and must be addressed in environmental education. The simplification of this process has lead to inadequate program development or in some cases misinformed programs.

This study looked specifically at children and the development of environmental beliefs in children as a consequence of family and home experiences. However, in depth knowledge about how parents or family might react to the above suggestions is imperative. It is unclear to what extent parents are under-equipped to address EE or to what extent they are disinterested in EE. A study investigating both the students and parents involved in EE initiatives would be useful.

One complex question which has become apparent in this research and which must be resolved is how family ought to be defined. It is apparent, based on the observations of students in this study, that not all students' interpretation of family would include parents. In fact, it may have been that siblings were important contributors to the beliefs formed in the home. However a loose interpretation of family to include any individual who cares for a student may fall short of identifying meaningful relationships between specific individuals in the life of a child and their environmental beliefs. Future studies will need to draw on a more inclusive definition of family, seek to distinguish between students' understanding of family when interpreting data, or specifically address all aspects of a student's family.

It is apparent that the information being generated and published on environmental education is not readily a part of the information distributed to environmental educators. Environmental educators (those actually in the process of educating others about environmental issues) are not benefiting from the knowledge generated in academic settings. In addition, environmental education departments and professionals are not being meaningfully informed by environmental educators. This division between information generation and its application has and will continue to hinder the discipline. Those in a position to conduct research on environmental education must consider the needs of environmental educators if they wish their work to be of true benefit. Information generated must additionally be distributed or made available to environmental educators rather than only those willing and able to read from professional journals.

One remaining challenge is the visible trend in environmental education to structure environmental education as a strictly cognitive discipline. While it may be useful to distinguish between reliable information delivery and advocacy, the vision of environmental education as a tool to address environmental problems may be corrupted if environmental education becomes only environmental science education. It has been demonstrated that a knowledge of environmental issues alone does not predict environmental behavior. It was further demonstrated in this research that overall environmental beliefs are dependent on feelings of responsibility, feelings of control, and attitudes toward issues. Thus, while there may be the need for general science education in part, the lack of adequate development of other dependent

domains in the home may call for curricula that address all factors of environmental belief in creative venues. The fundamental difference between environmental science education willing to inform what is, and an environmental education offering what then ought to be will remain a practical challenge for environmental educators.

CONCLUDING REMARKS

The results of this work on formative factors in the home as related to environmental beliefs and environmental belief formation support the significant life experiences research. Outdoor and other formative environmental experiences and especially those experiences with family are essential in the development of environmental beliefs in children. This realization calls for a focus on the family as a target for environmental education and as an important source of environmental education. The marked lack of EE materials and programs targeting and supporting families demonstrates a gap in the educational process. Furthermore, the lack of focus on families and homes is indicative of a failing to see relationships between formal and non-formal education and the formative experiences in the home as an integral part of this system. Formal, non-formal, and parental education must be viewed systemically and addressed as such in order to achieve the lofty ambitions of environmental education. A widely supported, integrated, and informed environmental education network will ultimately be essential to the address and ultimate correction of the environmental crisis we face today.

BIBLIOGRAPHY

(1970). Environmental Education Act. 84. **1312**.

(1990). National Environmental Education Act. 104. **3325**.

Adams, M. (1993). "A Computerized Program to Educate Adults about Environmental Health Risks." Journal of Environmental Health **56**(2): 13-18.

Adler, J. H. (1993). "A Child's Garden of Misinformation." Consumer's Research Magazine **76**(9): 11-17.

Aird, A. and A. Tomera (1977). "The Effects of a Water Conservation Instructional Unit on the Values Held by Sixth Grade Students." The Journal of Environmental Education **9**(1): 31-42.

Ajzen, I. and M. Fishbein (1980). Understanding Attitudes and Predicting Social Behavior. Englewood Cliffs, NJ, Prentice-Hall Inc.

Armstrong, J. B. and J. C. Impara (1991). "The Impact of an Environmental Education Program on Knowledge and Attitude." The Journal of Environmental Education **22**(4): 36-40.

Ballantyne, R. and J. Bain (1995). "Enhancing Environmental Conceptions: An Evaluation of Cognitive Conflict and Structured Controversy Learning Units." Studies in Higher Education **20**(3): 293-304.

Ballantyne, R., J. Fien, et al. (2001). "Program Effectiveness in Facilitating Intergenerational Influence in Environmental Education: Lesssons From the Field." The Journal of Environmental Education **32**(4): 8-15.

Ballantyne, R., J. Fien, et al. (2001). "School Environmental Education Programme Impacts upon Student and Family Learning: a Case Study Analysis." Environmental Education Research **7**(1): 23-38.

Bandura, A. (1977). Social Learning Theory. Englewood Cliffs, NJ, Prentice-Hall Inc.

Barry, J. (1976). "The Belgrade Charter: A Global Framework for Environmental Education." Connect UNESCO-UNEP Environmental Education Newsletter **1**(1): 1-3.

Bickman, L. (1972). "Environmental Attitudes and Actions." The Journal of Social Psychology **87**: 323-324.

Bogner, F. X. (1998). "The Influence of Short-Term Outdoor Ecology Education on Long-Term Variables of Environmental Perspective." The Journal of Environmental Education **29**(4): 17-29.

Bradley, J. C., T. M. Waliczek, et al. (1999). "Relationship between Environmental Knowledge and Environmental Attitude of High School Students." Journal of Environmental Education **30**(3): 17-21.

Brown, F. (2001). "Finding Environmental Education in the National Science Education Standards." Electronic Green Journal **Spring**(14).

Carlson, J. E. and D. Baumgartner (1974). "The Effects of Natural Resource Camps on Youths." The Journal of Environmental Education **5**(3): 1-7.

Carson, R. (1956). The Sense of Wonder. New York, Harper and Row.

Chawla, L. (1998). "Significant Life Experiences Revisited: A Review of Research on Sources of Environmental Sensitivity." The Journal of Environmental Education **29**(3): 11-21.

Chawla, L. (1999). "Life Paths Into Effective Environmental Action." The Journal of Environmental Education **31**(1): 15-26.

Childress, R. B. (1978). "Public School Environmental Education Curricula: A National Profile." The Journal of Environmental Education **9**(3): 2-10.

Christy, W. R. J. (1982). An Assessment of the Effects of Two Residential Camp Settings on Environmental Attitude Development, Virginia Polytechnic Institute and State University**:** 122.

City of Eugene (2004). Basic Facts About Eugene. www.ci.eugene.or.us/local/euggov.htm. Eugene, Oregon.

City of Eugene (2004). City of Eugene Environmental Policy. www.ci.eugene.or.us/environment/city_policy.htm. Eugene.

Cook, S. W. and J. L. Berrenberg (1981). "Approaches to Encouraging Conservation Behavior: A Review and Conceptual Framework." Journal of Social Issues **37**(2): 73-107.

Crater, H. L. and D. E. Mears (1981). "Evaluating Attitudes Toward, and Knowledge of, Energy Problems in the Eighth Grade." School Science and Mathematics **81**(2): 121-123.

Crompton, J. L. and C. Sellar (1981). "Do Outdoor Education Experiences Contribute to Positive Development in the Affective Domain?" The Journal of Environmental Education **12**(4): 21-29.

Cronin-Jones, L. L. (2000). "The Effectiveness of Schoolyards as Sites For Elementary Science Instruction." School Science and Mathematics **100**(4): 203-211.

Culen, G. R. and P. R. S. Mony (2003). "Assessing Environmental Literacy in Nonformal Youth Program." The Journal of Environmental Education **34**(4): 26-28.

Dettmann-Easler, D. (1999). "Evaluating the Effectiveness of Residential Environmental Education Programs in Fostering Positive Attitudes Toward Wildlife." The Journal of Environmental Education **31**(1): 33-39.

Dietz, T., L. Kalof, et al. (2002). "Gender, Values, and Environmentalism." Social Science Quarterly **83**(1): 353-364.

Dresner, M. and M. Gill (1994). "Environmental Education at Summer Nature Camp." The Journal of Environmental Education **25**(3): 35-41.

Eagles, P. F. J. and R. Demare (1999). "Factors Influencing Children's Environmental Attitudes." The Journal of Environmental Education **30**(4): 33-37.

Ewing, G. (2001). "Altruistic, Egoistic, and Normative Effects on Curbside Recycling." Environment and Behavior **33**(6): 733-763.

Falk, J. H. (2001). Free-Choice Science Learning: Framing the Discussion. Free-Choice Science Education: How We Learn Science Outside of School. J. H. Falk. New York, Teachers College Press.

Falk, J. H. and L. D. Dierking (2002). Lessons Without Limit: How Free-Choice Learning is Transforming Education. Walnut Creek, CA, AltaMira Press.

Gigliotti, L. M. (1990). "Environmental Education: What Went Wrong? What Can be Done?" The Journal of Environmental Education **22**(1): 9-12.

Gillett, D. P., G. P. Thomas, et al. (1991). "The Effects of Wilderness Camping and Hiking on the Self-Concept and the Environmental Attitudes and Knowledge of Twelfth Graders." The Journal of Environmental Education **22**(3): 33-44.

Gough, S. (1999). "Significant Life Experiences (SLE) Research: A View from Somewhere." Environmental Education Research **5**(4): 353-363.

Hamilton, J. P. I. (1983). Some Relationships Among Knowledge, Locus of Control, Perceived Importance, and Perceived Personal Responsibility Regarding Environmental Problems. State College, Pennsylvania State University**:** 136.

Henerson, M. E., L. L. Morris, et al. (1978). How to Measure Attitudes. Beverly Hills, Sage Publications.

Hines, J. M., H. R. Hungerford, et al. (1986). "Analysis and Synthesis of Research and Responsible Environmental Behavior: A Meta-Analysis." The Journal of Environmental Education **18**(2): 1-8.

Hsu, S.-J. and R. E. Roth (1998). "An Assessment of Environmental Literacy and Analysis of Predictors of Responsible Environmental Behavior Held by Secondary Teachers in the Hualien Area of Taiwan." Environmental Education Research **4**(3): 229-249.

Hungerford, H., R. Peyton, et al. (1980). "Goals for Curriculum Development in Environmental Education." The Journal of Environmental Education **11**(3): 42-47.

Hungerford, H. R. and R. B. Peyton (1976). Teaching Environmental Education. Portland, Maine, J. Weston Walch.

Hungerford, H. R. and T. L. Volk (1990). "Changing Learner Behavior Through Environmental Education." The Journal of Environmental Education **21**: 8-21.

Hwang, Y.-H., S.-I. Kim, et al. (2000). "Examining the Causal Relationships Among Selected Antecedents of Responsible Environmental Behavior." The Journal of Environmental Education **31**(4): 19-25.

Iwata, O. (2001). "Attitudinal Determinants of Environmentally Responsible Behavior." Social Behavior and Personality **29**(2): 183-190.

Iwata, O. (2002). "Coping Style and Three Psychological Measures Associated with Environmentally Responsible Behavior." Social Behavior and Personality **30**(7): 661-670.

Jaus, H. H. (1984). "The Development and Retention of Environmental Attitudes in Elementary School Children." The Journal of Environmental Education **15**(3): 33-36.

Jordan, J. R., H. R. Hungerford, et al. (1987). "Effects of Two Residential Environmental Workshops on High School Students." The Journal of Environmental Education **18**(1): 15-22.

Kapyla, M. and R. Wahlstrom (2000). "An Environmental Education Program for Teacher Trainers in Finland." The Journal of Environmental Education **31**(2): 31-37.

Keiffer, L. A. (1992). The Effects of a four-day Residential Camp on the Attitudes and Knowledge of Fifth Graders. State College, Pennsylvania State University**:** 103.

Knapp, C. E. (1972). "Attitudes and Values in Environmental Education." The Journal of Environmental Education **3**(4): 26-29.

Knapp, C. E. (1992). Lasting Lessons: A Teacher's Guide to Reflecting on Experience. Charleston, WV, ERIC Clearinghouse on Rural Education and Small Schools.

Kostka, M. D. (1976). "Nature Center Program Impact." The Journal of Environmental Education **8**(1): 52-64.

La Pierre, Y. (1992). "Learning Gone Wild." National Parks **66**(7/8): 47-50.

Leeming, F. C. and W. O. Dwyer (1995). "Children's environmental attitude and knowledge scale: Construction and validation." The Journal of Environmental Education **26**(3): 22-21.

Leeming, F. C., W. O. Dwyer, et al. (1993). "Outcome Research in Environmental Education: A Critical Review." The Journal of Environmental Education **24**(4): 8-21.

Leeming, F. C., B. E. Porter, et al. (1997). "Effects of Participation in Class Activities on Children's Environmental Attitudes and Knowledge." The Journal of Environmental Education **28**(2): 33-42.

Lemons, J. (1994). "Certification of Environmental Professionals and Accreditation Standards for University Programs." Bioscience **44**(7): 475-479.

Leopold, A. (1953). The Land Ethic. A Sand County Almanac with Essays on Conservation from Round River. New York, Ballantine Books.

Lisowski, M. and J. F. Disinger (1991). "The Effect of Field-Based Instruction on Student Understandings of Ecological Concepts." The Journal of Environmental Education **23**: 19-23.

Loughland, T. and A. Reid (2002). "Young People's Conceptions of Environment: A Phenomenographic Analysis." Environmental Education Research **8**(2): 187-197.

Loughland, T., A. Reid, et al. (2003). "Factors Influencing Young People's Conceptions of Environment." Environmental Education Research **9**(1): 3-20.

Lundmark, C. (2002). "Lifelong Learning." Bioscience **52**(4): 325.

Ma, X. and D. J. Bateson (1993). "A Multivariate Analysis of the Relationship Between Attitude Toward Science and Attitude Toward the Environment." The Journal of Environmental Education **31**(1): 27-32.

Martin, W. W., J. H. Falk, et al. (1981). "Environmental Effects on Learning: The Outdoor Field Trip." Science Education **65**(3): 301-309.

Milson, J. L. (1990). "Museums, zoos and aquariums partners in Teaching and Learning." Education **110**(4): 521-525.

Monson, T. S. (2004). Teaching our Children. Ensign. **34:** 3-7.

Moorcroft, T. A., K. H. Desmarais, et al. (2000). "Authentic Assessment in the Informal Setting: How it Can Work for You." The Journal of Environmental Education **31**(3): 20-24.

Moore, K. D. (2004). "The Truth of the Barnacles: Rachel Carson and the Moral Significance of Wonder. Document." Environmental Ethics **In Press**.

Mordock, K. and M. E. Krasny (2001). "Participatory Action Research: A Theoretical and Practical Framework for EE." The Journal of Environmental Education **32**(3): 15-20.

Moyer, R. H. (1977). "Environmental Attitude Assessment: Another Approach." Science Education **61**(3): 347-356.

National Environmental Education Advisory Council (1996). Report Assessing Environmental Education in the United States and the Implications of the National Environmental Education Act of 1990. Washington, DC, EPA Office of Environmental Education.

National Project for Excellence in EE (1999). Excellence in Environmental Education: Guidelines for Learning (K-12). Dekalb, IL, North American Association of Environmental Education.

National Project for Excellence in EE (2004). Nonformal Environmental Education Programs: Guidelines for Excellence. Dekalb, IL, North American Association of Environmental Education.

Newhouse, N. (1990). "Implications of Attitude and Behavior Research for Environmental Conservation." The Journal of Environmental Education **22**(1): 26-32.

Niedermeyer, F. C. (1992). "A Checklist for Reviewing Environmental Education Programs." The Journal of Environmental Education **23**(2): 46-50.

North American Association of Environmental Education (2004). Events that have Influenced EE in the United States. www.ee.link.net/perspectives-timeline.html. **2004**.

Orion, N. and A. Hofstein (1994). "Factors that Influence Learning during a Scientific Field Trip in a Natural Environment." Journal of Research in Science Teaching **31**(10): 1097-1119.

Orr, D. W. (1994). Earth in Mind: On Education, Environment, and the Human Prospect. Covelo, CA, Island Press.

Palmberg, I. E. and J. Kuru (2000). "Outdoor Activities as a Basis for Environmental Responsibility." The Journal of Environmental Education **31**(4): 32-36.

Palmer, J. A. and J. Suggate (1996). "Influences and experiences affecting the pro-environmental behavior of educators." Environmental Education Research **2**(1): 109-121.

Payne, P. G. (1981). A Comparative Study of the Effects of Two Outdoor/environmental Education Instructional Approaches on the Attitudes and Knowledge of Selected Sixth Grade Children. Eugene, University of Oregon: 204.

Pope, C. (1997). "Schools of Thought." Sierra **82**(6): 20-21.

Ramsey, C. E. and R. E. Rickson (1977). "Environmental Knowledge and Attitudes." The Journal of Environmental Education **8**(1): 10-18.

Ramsey, J., H. R. Hungerford, et al. (1981). "The Effects of Environmental Action and Environmental Case Study Instruction on the Overt Environmental Behavior of Eighth-Grade Students." The Journal of Environmental Education **13**(1): 24-29.

Ramsey, J. M. (1993). "The Effects of Issue Investigation and Action Training on Eighth-Grade Students' Environmental Behavior." The Journal of Environmental Education **24**(3): 31-36.

Ramsey, J. M., H. R. Hungerford, et al. (1992). "Environmental Education in the K-12 Curriculum: Finding a Niche." The Journal of Environmental Education **23**(2): 35-45.

Reid, I. and I. Sa'di (1997). "Jordanian and British Primary Schoolchildren's Attitudes Toward the Environment." Educational Studies **23**(3): 473-480.

Reid, S. (2000). "From Dog Waste to Daisy Pickers: Leave No Trace Educates Outdoor Recreators." Parks and Recreation **35**(7): 70-77.

Rockland, D. B. (1995). "Where are the Gaps in Environmental Education?" EPA Journal **21**(2): 12-13.

Roth, R. E. (1970). "Fundamental Concepts for Environmental Management Education (K-16)." The Journal of Environmental Education **1**(3): 65-74.

Salmon, J. (2000). "Are We Building Environmental Literacy?" The Journal of Environmental Education **31**(4): 4-10.

Shepard, C. L. and L. R. Speelman (1986). "Affecting Environmental Attitudes Through Outdoor Education." The Journal of Environmental Education **17**(2): 20-23.

Sia, A. P. (1984). An Investigation of Selected Predictors of Overt Responsible Environmental Behavior. Department of Curriculum, Instruction, and Media. Carbondale, IL, Southern Illinois University.

Sia, A. P., H. R. Hungerford, et al. (1985). "Selected Predictors of Responsible Environmental Behavior: An Analysis." The Journal of Environmental Education **17**(2): 31-40.

Simmons, D. (1991). "Are We Meeting the Goal of Responsible Environmental Behavior." The Journal of Environmental Education **22**(3): 16-21.

Simmons, D. (1998). "Using Natural Settings for Environmental Education: Perceived Benefits and Barriers." The Journal of Environmental Education **29**(3): 23-31.

Simmons, D. (2004). Standards. V. M. Smith. Corvallis, OR.

Sivek, D. J. and H. R. Hungerford (1990). "Predictors of Responsible Behavior in Members of Three Wisconsin Conservation Organizations." The Journal of Environmental Education **21**(2): 35-40.

Smith-Sebasto, N. J. (1998). "Environmental Education in the University of Illinois Cooperative Extension Service: An Educator Survey." The Journal of Environmental Education **29**(2): 21-30.

Solkov-Brecher, J. I. "A Successful Model for School-Based Planning." Educational Leadership: 52-54.

Sommerfeld, M. (1996). "Environmental Educaton Materials Evaluated." Education Week **15**(20): 7.

Stapp, D. W. (1969). "The Concept of Environmental Education." Journal of Environmental Education **1**(1): 30-31.

Stapp, W. B. (1974). Historical Setting of Environmental Education. Environmental Education: Strategies Toward a More Livable Future. W. B. S. James A. Swann. New York, John Wiley and Sons.

Swan, M. (1975). Forerunners of Environmental Education. What Makes Education Environmental? D. A. Noel McInnis. Louisville, Environmental Educators, Inc. and Data Courier.

Tanner, T. (1980). "Significant Life Experiences: A New Research Area in Environmental Education." The Journal of Environmental Education **11**(4).

Tanner, T. (1998). "Choosing the Right Subjects in Significant Life Experiences Research." Environmental Education Research **4**(4): 399-415.

Thompson, T. L. and J. J. Mintzes (2002). "Cognitive Structure and the Affective Domain: On Knowing and Feeling in Biology." International Journal of Science Education **24**(6): 645-660.

Tung, C.-Y., C.-C. Huang, et al. (2002). "The Effects of Different Environmental Education Programs on the Environmental Behavior of Seventh-Grade Students and Related Factors." Journal of Environmental Health **64**(7): 24-30.

Tunnicliffe, S. D. and M. Laterveer-de Beer (2002). "An Interactive Exhibition about Animal Skeletons: Did the Visitors Learn any Zoology." Journal of Biological Education **36**(3): 130-134.

UNESCO/UNEP (1978). Declaration of the Tbilisi Intergovernmental Conference on Environmental Education. UNESCO/UNEP Intergovernmental Conference on Environmental Education. Tbilisi, Georgia.

Van Matre, S. (1990). Earth Education: A New Beginning. Greenville, West Virginia, The Institute for Earth Education.

Wals, A. E. J. and T. van der Leij (1997). "Alternatives to National Standards for Environmental Education: Process-Based Quality Assessment." Canadian Journal of Environmental Education **2**: 7-27.

Wicker, A. W. (1969). "Attitudes versus Actions: The Relationship of Verbal and Overt Behavioral Responses to Attitude Objects." Journal of Social Issues **25**(4): 41-78.

Wicker, A. W. (1971). "An Examination of the "Other Variables" Explanation of Attitude-Behavior Inconsistency." Journal of Personality and Social Psychology **19**(1): 18-30.

Wilson, R. A. (1996). "Environmental Education Programs for Preschool Children." The Journal of Environmental Education **27**(4): 28-33.

Young, R. A. (1980). "The Relationship Between Information Levels and Environmental Approval: The Wilderness Issue." The Journal of Environmental Education **11**(3): 25-30.

Zelezny, L. C. (1999). "Educational Interventions that Improve Environmental Behaviors: A Meta-Analysis." The Journal of Environmental Education **31**(1): 5-14.

APPENDIX A

RESEARCH INSTRUMENT
PRE-TEST

Formatting has been modified and
text has been reduced.

Significant Formative Experiences

Oregon State University
The Science Factory

STUDENT EVALUATION

1. My first and last name is: _____

2. Are you a BOY or a GIRL (Circle one)

3. How old are you? (circle one)
   4 5 6 7 8 9 10 11 12 13 14 15

4. What grade will you be in when school starts? (circle one)
   1 2 3 4 5 6 7 8 9

Identification Number (Office use only) (Pre-test)

Identification Number (Office Use Only) (Pre-test)

Circle Answer

1. I have been to Science Factory camps before: YES NO

2. I have been to this camp before: YES NO

3. I have brothers or sisters who have been to Science Factory camps before: YES NO

4. I am here at camp because:
   a) I want to be here. b) someone made me come. c) Both

5. How much do you know about the subject of this weeks camp?
   a. Almost everything
   b. Many things
   c. a few things
   d. only a little
   e. nothing

Agree or Disagree Please circle the response that best describes how you feel about the statement.

Example: I enjoy being sick.	1	2	3	4	5

1 = Strongly Disagree
2 = Disagree
3 = Don't know
4 = Agree
5 = Strongly Agree

7. I am excited about the subject of my camp	1	2	3	4	5
8. I enjoy learning about science	1	2	3	4	5
9. I want to go to camps like this one in the future	1	2	3	4	5

SECTION 2

Circle the response that best describes you. For each statement circle the number that best describes how often you participate in the activity described.

Example: I eat green eggs and ham for breakfast	1	2	3	4	5

1 = Less than once per year
or not at all
2 = At least once per year
3 = At least once per month
4 = At least once per week
5 = Everyday

1. My family and I talk about nature.	1	2	3	4	5
2. I spend time outdoors with family members	1	2	3	4	5
3. My family teaches me about ways to protect nature.	1	2	3	4	5
4. I participate in activities to help nature with my family.	1	2	3	4	5
5. I spend time alone in nature.	1	2	3	4	5
6. I go to camps or other places where we talk about nature.	1	2	3	4	5
7. I watch television or movies at home about nature.	1	2	3	4	5
8. I read books at home about nature	1	2	3	4	5
9. I spend time outdoors with friends or neighbors.	1	2	3	4	5
10. I learn about nature with friends	1	2	3	4	5

and neighbors.	

Agree or Disagree Please circle the response that best describes how you feel about the sentence.

Example: I like to play with my little sister	1	2	3	4	5

1 = Strongly disagree
2 = Disagree
3 = Don't know
4 = Agree
5 = Strongly Agree

11. I enjoy spending time with family outdoors.	1	2	3	4	5
12. I enjoy learning about nature from my family.	1	2	3	4	5
13. I enjoy spending time with friends or neighbors outdoors.	1	2	3	4	5
14. I enjoy learning about nature from friends or neighbors.	1	2	3	4	5

SECTION 3

INSTRUCTIONS: In this section you must circle a number from 1 to 10 that best describes how you feel about the statement. The numbers range from 1 to 10 where 1 is Very False and 10 is Very True.

Example: I would be willing to help cook dinner	1 2 3 4 5 6 7 8 9 10

	Very False									Very True
1. I would be willing to separate my family's trash for recycling.	1	2	3	4	5	6	7	8	9	10

2. To save water, I would be willing to turn off the water while I wash my hands.	1 2 3 4 5 6 7 8 9 10
3. I would be willing to volunteer to help nature.	1 2 3 4 5 6 7 8 9 10
4. I would be willing to build homes for animals near my house.	1 2 3 4 5 6 7 8 9 10
5. I have talked with my parents about how to help nature.	1 2 3 4 5 6 7 8 9 10
6. I turn off the water in the sink while I brush my teeth to save water.	1 2 3 4 5 6 7 8 9 10
7. To save energy, I turn off lights at home when they are not in use.	1 2 3 4 5 6 7 8 9 10
8. I pick up trash when I see it on the ground.	1 2 3 4 5 6 7 8 9 10
9. I am frightened to think people don't care about nature.	1 2 3 4 5 6 7 8 9 10
10. I worry about the rainforest being cut down.	1 2 3 4 5 6 7 8 9 10
11. I worry about animals becoming extinct.	1 2 3 4 5 6 7 8 9 10
12. It makes me sad to see houses and buildings where animals used to live.	1 2 3 4 5 6 7 8 9 10
13. I believe that I can, by myself, help nature.	1 2 3 4 5 6 7 8 9 10
14. I believe that I can, with other people, help nature.	1 2 3 4 5 6 7 8 9 10

15. It is my responsibility to help solve problem with nature.	1 2 3 4 5 6 7 8 9 10
16. It is my responsibility to protect nature.	1 2 3 4 5 6 7 8 9 10
17. I know about nature.	1 2 3 4 5 6 7 8 9 10
18. I know ways to help protect nature.	1 2 3 4 5 6 7 8 9 10
19. I know about problems with nature	1 2 3 4 5 6 7 8 9 10

APPENDIX B
RESEARCH INSTRUMENT
POST-TEST

Formatting has been modified and
text has been reduced.

Significant Formative Experiences

Oregon State University
The Science Factory

STUDENT EVALUATION

5. My first and last name is: _____

6. Are you a BOY or a GIRL (Circle one)

7. How old are you? (Circle one)
   4 5 6 7 8 9 10 11 12 13 14 15

8. What grade will you be in when school starts? (Circle one)
   1 2 3 4 5 6 7 8 9

Identification Number (Office use only) (Post-test)

Identification Number (Office Use Only) (Post-test)

Circle Answer

1. I have been to Science Factory camps before: YES NO

2. I have been to this camp before: YES NO

3. I have brothers or sisters who have been to Science Factory camps before: YES NO

4. I am here at camp because:
   A) I want to be here. B) someone made me come. C) Both

5. How much do you know now about the subject of this weeks camp?
   a. Almost everything
   b. Many things
   c. a few things
   d. only a little
   e. nothing

Agree or Disagree Please circle the response that best describes how you feel about the statement.

Example: I enjoy being sick.	1	2	3	4	5

1 = Strongly Disagree
2 = Disagree
3 = Don't know
4 = Agree
5 = Strongly Agree

7. I am excited about the subject of my camp	1	2	3	4	5
8. I enjoy learning about science	1	2	3	4	5
9. I want to go to camps like this one in the future	1	2	3	4	5
10. I talked about the things I learned this week with family or friends.	1	2	3	4	5

11. I had a good time at camp this week	1	2	3	4	5

12. What is the most interesting thing that you learned this week? (Explain Below)

13. What are the three things you remember most about camp? (Explain Below)

SECTION 2

Circle the response that best describes you. For each statement circle the number that best describes how often you participate in the activity described.

Example: I eat green eggs and ham for breakfast	1	2	3	4	5

1 = Not once this week
2 = Once this week
3 = 2 times this week
4 = 3 or more times this week
5 = 5 or more times this week

1. My family and I talked about nature this week.	1	2	3	4	5
2. I spent time outdoors with family members this week.	1	2	3	4	5
3. My family taught me about ways to protect nature this week.	1	2	3	4	5
4. I participated in activities to help nature with my family this week.	1	2	3	4	5

5. I spent time alone in nature this week.	1	2	3	4	5
6. I went to other camps or other places where we talked about nature this week.	1	2	3	4	5
7. I watched television or movies at home about nature this week.	1	2	3	4	5
8. I read books at home about nature this week.	1	2	3	4	5
9. I spent time outdoors with friends or neighbors this week.	1	2	3	4	5
10. I learned about nature with friends and neighbors this week.	1	2	3	4	5

Agree or Disagree Please circle the response that best describes how you feel about the statement.

Example: I like to play with my little sister	1	2	3	4	5

1 = Strongly Disagree
2 = Disagree
3 = Don't know
4 = Agree
5 = Strongly Agree

11. I enjoy spending time with family outdoors.	1	2	3	4	5
12. I enjoy learning about nature from my family.	1	2	3	4	5
13. I enjoy spending time with friends or neighbors outdoors.	1	2	3	4	5

14. I enjoy learning about nature from friends or neighbors.	1 2 3 4 5

SECTION 3

INSTRUCTIONS: In this section you must circle a number from 1 to 10 that best describes how you feel about the statement. The numbers range from 1 to 10 where 1 is Very False and 10 is Very True.

Example: I would be willing to help cook dinner	1 2 3 4 5 6 7 8 9 10

	Very False Very True
1. I would be willing to separate my family's trash for recycling.	1 2 3 4 5 6 7 8 9 10
2. To save water, I would be willing to turn off the water while I wash my hands.	1 2 3 4 5 6 7 8 9 10
3. I would be willing to volunteer to help nature.	1 2 3 4 5 6 7 8 9 10
4. I would be willing to build homes for animals near my house.	1 2 3 4 5 6 7 8 9 10
5. I have talked with my parents about how to help with problems with nature.	1 2 3 4 5 6 7 8 9 10
6. I turn off the water in the sink while I brush my teeth to save water.	1 2 3 4 5 6 7 8 9 10
7. To save energy, I turn off lights at home when they are not in use.	1 2 3 4 5 6 7 8 9 10
8. I pick up trash when I see it on the ground.	1 2 3 4 5 6 7 8 9 10
9. I am frightened to think people don't care about nature.	1 2 3 4 5 6 7 8 9 10
10. I worry about the rainforest being cut down.	1 2 3 4 5 6 7 8 9 10

11. I worry about animals becoming extinct.	1 2 3 4 5 6 7 8 9 10
12. It makes me sad to see houses and buildings where animals used to live.	1 2 3 4 5 6 7 8 9 10
13. I believe that I can, by myself, help nature.	1 2 3 4 5 6 7 8 9 10
14. I believe that I can, with other people, help nature.	1 2 3 4 5 6 7 8 9 10
15. It is my responsibility to help solve problems with nature.	1 2 3 4 5 6 7 8 9 10
16. It is my responsibility to protect nature.	1 2 3 4 5 6 7 8 9 10
17. I know about nature.	1 2 3 4 5 6 7 8 9 10
18. I know ways to help protect nature.	1 2 3 4 5 6 7 8 9 10
19. I know about problems with nature .	1 2 3 4 5 6 7 8 9 10

APPENDIX C
RESEARCH INSTRUMENT
DELAYED POST-TEST

Formatting has been modified and
text has been reduced.

Dear Science Factory Summer Adventure Participant,

This summer a study is being conducted at the Science Factory to improve the quality of science education. On the first day of your child's camp, you signed an informed consent document that expressed your permission to allow your child to participate in this evaluation. As part of that document we explained that a final evaluation would be sent to your home one month after camp completion. That evaluation is enclosed and is of great importance to this study. By helping your child fill out and return this evaluation you are helping to complete the final stage in an important study of science education. We would remind you once again that participation in this study is voluntary.

The purpose of this research study is to better understand how prior educational experiences affect the potential for a school to educate and inspire children and how later experiences influence retention. Information collected will be used to help the Science Factory and other places of learning improve the quality of their programs. This research focuses on improving programs that address nature study or environmental science. Information will be collected on student's beliefs about nature or the environment and about learning experiences in or about nature. Your child will be asked to answer questions about learning experiences at home. These questions are meant to understand how the learning and experiences that take place in the home influence the learning that takes place in school or at camp.

Your child may need your help reading the questionnaire. We would ask that you assist your child if it is needed, but would ask that you do not influence their decisions. It is important that your child responds based on his or her own opinion. There are no right or wrong answers to this evaluation. Please ask your child if they would be willing to fill out the evaluation and return completed evaluations to The Science Factory in the enclosed envelope within one week of receipt.

Again we thank you and your child for participating in this study.

Sincerely,

Vincent M. Smith

Principle Investigator: Dr. Larry Enochs
Oregon State University
Science and Math Ed
Corvallis, Oregon
541-737-1305

Vincent M. Smith
Oregon State University
Environmental Science/Ed
Corvallis, Oregon
541-753-0427

Significant Formative Experiences

Oregon State University
The Science Factory

STUDENT EVALUATION

9. My first and last name is:

   _____

10. Are you a BOY or a GIRL (Circle one)

11. How old are you? (Circle one)
    4 5 6 7 8 9 10 11 12 13 14 15

12. What grade will you be in when school starts? (Circle one)
    1 2 3 4 5 6 7 8 9

Identification Number (Office use only) (Delayed post-test)

Identification Number (Office Use Only) (Delayed post-test)

Circle Answer

1. I have attended Science Factory camps before: YES NO

2. I have attended this camp before: YES NO

3. I have brothers or sisters who have been to Science Factory camps before: YES NO

4. I went to camp because:
   a) I wanted to be there. b) someone made me go. c) Both

5. How much do you know about the subject of last month's camp now?
   a. Almost everything
   b. Many things
   c. a few things
   d. only a little
   e. nothing

Agree or Disagree Please circle the response that best describes how you feel about the statement.

Example: I enjoy being sick.	1	2	3	4	5

1 = Strongly Disagree
2 = Disagree
3 = Don't know
4 = Agree
5 = Strongly Agree

7. I am excited about the subject of my camp.	1	2	3	4	5
8. I enjoy learning about science.	1	2	3	4	5
9. I want to go to camps like this one in the future.	1	2	3	4	5
10. I talked about the things I learned at camp with family and friends.	1	2	3	4	5
11. I had a good time at camp last month.	1	2	3	4	5

12. What is the most interesting thing that you learned at camp last month? (Explain Below)

13. What are the three things you remember most about camp? (Explain Below)

SECTION 2

Circle the response that best describes you. For each statement circle the number that best describes how often you participate in the activity described.

Example: I eat green eggs and ham for breakfast	1	2	3	4	5

1 = Not once since camp
2 = At least once since camp
3 = At least once per week
4 = Several times each week
5 = Everyday

1. My family and I talked about nature since camp.	1	2	3	4	5
2. I spent time outdoors with family members since camp.	1	2	3	4	5
3. My family taught me about ways to protect nature since camp.	1	2	3	4	5
4. I participated in activities to help nature with my family since camp.	1	2	3	4	5
5. I spent time alone in nature since camp.	1	2	3	4	5
6. I went to other camps or other places where we talked about nature since camp.	1	2	3	4	5

7. I watched television or movies at home about nature since camp.	1	2	3	4	5
8. I read books at home about nature since camp.	1	2	3	4	5
9. I spent time outdoors with friends or neighbors since camp.	1	2	3	4	5
10. I learned about nature with friends and neighbors since camp.	1	2	3	4	5

Agree or Disagree Please circle the response that best describes how you feel about the statement.

Example: I like to play with my little sister	1	2	3	4	5

1 = Strongly Disagree
2 = Disagree
3 = Don't know
4 = Agree
5 = Strongly Agree

11. I enjoy spending time with family outdoors.	1	2	3	4	5
12. I enjoy learning about nature from my family.	1	2	3	4	5
13. I enjoy spending time with friends or neighbors outdoors.	1	2	3	4	5
14. I enjoy learning about nature from friends or neighbors.	1	2	3	4	5

SECTION 3

INSTRUCTIONS: In this section you must circle a number from 1 to 10 that best describes how you feel about the statement. The numbers range from 1 to 10 where 1 is Very False and 10 is Very True.

Example: I would be willing to help cook dinner	1 2 3 4 5 6 7 8 9 10

	Very False Very True
1. I would be willing to separate my family's trash for recycling.	1 2 3 4 5 6 7 8 9 10
2. To save water, I would be willing to turn off the water while I wash my hands.	1 2 3 4 5 6 7 8 9 10
3. I would be willing to volunteer to help nature.	1 2 3 4 5 6 7 8 9 10
4. I would be willing to build homes for animals near my house.	1 2 3 4 5 6 7 8 9 10
5. I have talked with my parents about how to help with problems with nature..	1 2 3 4 5 6 7 8 9 10
6. I turn off the water in the sink while I brush my teeth to save water.	1 2 3 4 5 6 7 8 9 10
7. To save energy, I turn off lights at home when they are not in use.	1 2 3 4 5 6 7 8 9 10
8. I pick up trash when I see it on the ground.	1 2 3 4 5 6 7 8 9 10
9. I am frightened to think people don't care about nature.	1 2 3 4 5 6 7 8 9 10
10. I worry about the rainforest being cut down.	1 2 3 4 5 6 7 8 9 10
11. I worry about animals becoming extinct.	1 2 3 4 5 6 7 8 9 10

12. It makes me sad to see houses and buildings where animals used to live.	1 2 3 4 5 6 7 8 9 10
13. I believe that I can, by myself, help nature.	1 2 3 4 5 6 7 8 9 10
14. I believe that I can, with other people, help nature.	1 2 3 4 5 6 7 8 9 10
15. It is my responsibility to help solve problems with nature.	1 2 3 4 5 6 7 8 9 10
16. It is my responsibility to protect nature.	1 2 3 4 5 6 7 8 9 10
17. I know about nature.	1 2 3 4 5 6 7 8 9 10
18. I know ways to help protect nature.	1 2 3 4 5 6 7 8 9 10
19. I know about problems with nature.	1 2 3 4 5 6 7 8 9 10

APPENDIX D
RESEARCH INSTRUMENT
INTERVIEW FORM

SURVEY SHEET

Name: Date: Identification Number:

Initial Comments:

Questions:

1. What kinds of things do you do outdoors? How frequently? With whom?

2. Sometimes certain experiences or events make big differences in our lives. Are there any experiences in your life that made you feel close to nature? Could you describe those experiences?

3. There are many ways we learn things. Sometimes we learn at school, other times we learn by talking to parents, or by going to a park. Where have you learned things about nature?

4. Some people like to be outdoors and learn about nature and other people don't. How does learning about nature make you feel? How does spending time in nature make you feel?

5. What types of things do you and your family do at home to help the environment?

6. Do you ever talk about nature or the environment with your family? If so, what kinds of things do you talk about?

Additional Questions Asked: Responses:

Notes: