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The majority of research in environmental education (EE) has focused on measuring knowledge, attitudes, and behavior using quantitative tools and methods. Few studies have attempted to elicit and characterize children's conceptions of the environment or nature, particularly those resulting from a residential EE experience, which contextualize knowledge, attitudes, and may be used to predict behaviors. Therefore little is known about how physical, socio-cultural, and personal dimensions are reflected in conceptual learning in the context of a guided outdoor program. This study begins to address this relative knowledge void by employing qualitative and phenomenological methods in a grounded theory approach. Interviews, writings and drawings on the topic of nature were collected from 5th grade students before and after a three-day residential outdoor school program conducted on the Oregon coast. Students' responses were analyzed in terms of breadth and depth of their nature conceptions. Individual students' additions to the emergent categories of breadth, including new organisms, habitats, processes, and non-living things, were used to measure change in the breadth of students' nature concepts. Change in depth of students' nature concepts was

measured by means of emergent hierarchical typologies representing ideas included in students' understanding of nature. Factors affecting students' learning, including the themes students use to frame their interpretations of nature, emergent misconceptions, references to TV and books, students' interest, and weather, are discussed in terms of their impact on the breadth and depth of students' nature conceptions. Findings indicate almost universal gains in breadth and modest gains in depth of students' nature concepts. Children's preconceived ideas about nature, particularly an idealized view in which nature is seen as the opposite of human environments, appear to play an important role in learning.

Children's Conceptions of Nature as Influenced by a Residential Environmental Education Program

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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.

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Bryan M. Rebar, Author

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INTRODUCTION

Environmental learning centers that specialize in programs for visiting school groups are a relatively new phenomenon in education, and they continue to grow. These centers which provide programs complete with instructors, materials, and unique settings first began emerging in the early 1970s shortly after the first Earth Day celebration. They have grown in part due to the demand created by teachers seeking to enhance their students' learning of the environment. Their popularity with teachers, students and parents has further contributed to their growth throughout the United States. One of the pervasive and underlying assumptions about environmental education (EE) is that an experiential approach is the most effective way of facilitating learning about the environment (Uzzell, Rutland, & Whistance, 1995). Typically, this assumption coupled with anecdotal evidence has sufficiently justified the efforts and costs involved in organizing such trips. Increasingly, however, there have been greater efforts to evaluate students' learning resulting from these trips.

Environmental Centers: A Definition

For purposes of this study, an environmental learning center refers to both a physical place and a program specifically designed to offer visiting students unique learning opportunities aimed at accomplishing the goals of environmental education (discussed later). I use environmental learning center and environmental center interchangeably. This definition is intentionally broad and inclusive because these centers have evolved, for the most part, independently, utilizing a wide variety of

resources (for example, relying primarily on grants, student tuitions, community support, or school district funds) and settings. Consequently, size, logistics, and programming vary extensively such that some programs include overnight accommodations while others do not, for example. This study focuses particularly on the impact of residential programs. Many of these programs include a mix of classroom and outdoor time, hands-on and experiential opportunities. What unifies these programs today is their central mission--which finds its roots in the Belgrade Charter of 1975 and the Tbilisi Declaration of 1977--of education about, for and in the environment of interest. Environmental centers serve as one choice among many others as a destination for school field trips, even among those trips designed to augment environmental learning.

The Problem

The impact of school visits to environmental learning centers on students' perceptions of the environment is an emerging area of interest that, at present, is not well-understood (Rickinson, 2001). Experiences during field trips that have personal meaning, particularly ones that are affective in nature, are more likely to be remembered far into the future (Wolins, Jensen, & Ulzheimer, 1988). From these experiences, general concepts about the environment visited, rather than facts introduced during lessons, are the type of knowledge students are most likely to retain far into the future. And it is concepts and attitudes that inform people's actions.

Previous studies have identified the potential impact of school field trips on students' environmental literacy, attitudes, and predicted behaviors, yet virtually all studies of outdoor education experiences use surveys or other quantitative methods to

infer conceptual learning (Marcinkowski, 1993; e.g., also see Gilbertson, 1990; Becker, 1977; Burrus-Bammel & Bammel, 1986). Surveys are also employed to measure changes in attitudes (e.g., Bogner, 1998; Uzzell, Rutland, & Whistance, 1995; Smith-Sebasto & Semrau, 2004; Mittelstaedt, Sanker, & VanderVeer, 1999), yet they hardly capture feelings. Falk (2003) even goes so far as to suggest that studies that rely on Positivist-Behaviorist models of learning, that is, most designs relying on surveys without a baseline, may be flawed due the underpinning epistemology which most psychologists now reject. And despite this change in thinking toward a Relativist-Constructivist model which gives credence to the now widespread acceptance of the cognitive, affective and social value of experiences in museums and environmental centers (Rennie & McClafferty, 1996; see, e.g., Falk & Dierking, 1992), few studies have attempted to explore the nature of students' understandings resulting from school field trips. Ballantyne and Packer (1996) suggest that an understanding of the range of environmental conceptions held by students—that is, the results of such studies—must be used by educators to design EE programs which result in meaningful learning experiences. In sum, most of the past studies of students' learning from outdoor education experiences have failed to directly measure what many educators consider to be the most important outcomes: students' resulting appreciation, understanding, and feelings about the environment. The following study begins to address this void.

Environmental Education Goals

Conceptual learning beyond basic information and facts is one of the central goals of the National Science Education Standards (1996). For students in grades 5-8, the grades targeted by most environmental learning centers, emphasis on concepts continues

with additional emphasis on decision making skills and addressing misconceptions. Awareness of environmental issues and environmental problems is specifically included for these grades by the National Science Education Standards.

One of the primary goals of environmental education is fostering ecological understanding. According to Bogner, "direct nature experiences are widely acknowledged to enhance environmental awareness and to foster corresponding attitudes" (1998, p. 17). Another goal of environmental education is developing an environmentally responsible citizenry. A vital link in this process, therefore, is the breadth and depth and perspective of the understanding that students acquire as a result of their experiences.

While educators speaking from the diverse perspectives of classroom teachers, environmental learning center staff, and administrators from both realms find encouragement in evidence showing cognitive gains in quantitative terms, they often refer to the broader value of an outdoor environmental experience. On field trips, teachers' major goals for their students focus on awareness and appreciation rather than factual knowledge (Stocker, 1996). In particular, they often comment on the memorable, even life-changing nature of such an experience. Such childhood experiences, Tanner (1980) postulates, may be instrumental in developing concern for the environment, which is among the chief stated goals of many environmental learning centers. Certainly, there is evidence that "childhood relations with the outer landscape seem to affect how one perceives, values and structures one's world view and stance" (Hester & O'Donnell, 1987, p. 30). Sebba (1991) further contributes to our understanding of childhood by noting that "an experience in which the child is actively involved, with his body, his

senses, and his awareness, is likely to be etched in memory for a long time" (p. 395). Based on her research rooted in psychology, Sebba goes on to assert that "the sympathetic attitude the child displays toward nature is likely to accompany the experience even when recalled in memory."

Learning

Falk and Dierking assert that what people remember from trips also represents what they learned (1992). Experiences during field trips that have personal meaning, particularly ones that are affective in nature, are more likely to be remembered far into the future (Wolins, Jensen, & Ulzheimer, 1988). Similarly, Hayward and Jensen contend that a holistic impression of an experience is essential in giving it meaning (1981). Because people's memories often retain impressions and general concepts better than specific facts and information, it follows that students' impressions and general concepts about the environment resulting from an environmental center visit is a logical focus of study. Falk and Dierking's and Wolins et al.'s findings suggest that studies of students' conceptual gains may be the most important indicator of environmental learning when considered in the context of desired outcomes of environmental education. This leads to the central question, *does an experience in the context of a natural setting, one that presumably imparts meaning and has great potential to affect the senses, enhance students' concept of the environment as well?*

If we consider the potential lasting impact of field trips on students' attitudes and behaviors, the importance of students' environmental concepts resulting from a field trip experience becomes more evident. To what degree are students' nature concepts developed and enhanced, in terms of depth and breadth of understanding, by way of an

environmental learning center visit? In other words, if students' perceptions of nature were classified, what changes would result from their experience?

The conceptual framework for this study may be summarized as follows:

1. Experiences that can be recalled represent learning.
2. Therefore, learning is constantly assimilated with existing knowledge.
3. Students recall concepts from field trips which influence attitudes and behaviors in other settings.
4. A field trip experience in a natural setting has great potential to impact students' concept of nature and create a lasting impression.

Due to the relative knowledge void about the impact of school field trips on students' environmental conceptions, the above questions guide this study based in grounded theory. The approach and methodology that follows was designed to generate hypotheses about students' experiences and learning from a residential environmental center.

Significance

The significance of this study is that it contributes to the knowledge base about the impact of environmental learning centers on students' conceptions of nature and, moreover, it does so by use of qualitative methods thus far underutilized in environmental education research (Marcinkowski, 1993). Considering the limitations of surveys, which represent the major source of our present understandings about students' learning from outdoor experiences, this study employs an interview methodology, adapted from one known as Personal Meaning Mapping (PMM), in order to measure the breadth and depth of students' nature conceptions and furthermore characterize this aspect of students' learning. Similar to PMM, the method employed here is designed to look at the breadth and depth of participants' understandings, which includes both conceptual and affective

dimensions (Falk, 2003). Because PMM was developed specifically for research on museum visitors, its application to outdoor education opens a new perspective to the field. In a broader sense, this study also builds upon the earlier phenomenological research in environmental education (e.g., Rejeski, 1982; Wals, 1994; Keliher, 1997; Payne, 1998a, b; Loughland, Reid, & Petocz, 2002; Loughland, Reid, Walker, & Petocz, 2003; Shepardson, 2004) and demonstrates the qualitative and phenomenological approaches' applicability to measuring the impact of an educational experience (treatment), for example, the effects of visiting a residential environmental learning center on students' nature conceptions. Because this study involves the application of techniques with limited development to a new context, it is therefore best described as an exploratory study. In the spirit of grounded theory, the goal of this study is to open new lines of inquiry to studies of students attending environmental programs. In other words, this study introduces somewhat novel ways for investigating and recording students' learning derived from an environmental education treatment and, moreover, leads to more specific questions of interest. Thus, the approach discussed here and results of this study open the door to further qualitative research into students' learning, particularly studies that attempt to link factors involving experiences and the subsequent understandings.

The importance of introducing this sort of qualitative approach to understanding an environmental center experience is that it shifts the focus toward social, affective, and experiential dimensions of such a trip. Therefore, this study introduces a greater context for interpreting students' learning. This study furthermore provides measures of students' learning not previously reported in studies of environmental centers. Because

previous studies of learning from environmental centers (e.g., Culen and Mony, 2003; Becker, 1977) and learning from EE experiences in general (Rickinson, 2001; Leeming, Dwyer, Porter, & Coburn, 1993) have not universally affirmed the efficacy of these programs, there is a need to identify learning areas which have been previously overlooked for evidence of learning. The importance of measuring students' learning from such trips is magnified when considering the time, money, and effort educators, parents and others dedicate to such endeavors. Moreover, as education continues to move toward standards based learning, evaluations increasingly gain emphasis. Therefore, evaluation of EE programs can help demonstrate their efficacy in achieving EE goals and can be used to justify the time, money, and effort expended. Finally, it should be noted that few teachers have the opportunity to develop their EE skills (Marcinkowski, 1997), and therefore rely on environmental center trips as their primary EE curriculum. In summary, this study contributes to the study of EE in general and to the study of environmental centers in specific in five distinct ways: (1) by demonstrating learning from an environmental center experience; (2) by demonstrating new measures of learning; (3) by further contextualizing learning; (4) by introducing relatively new methodologies to environmental center research; (5) and by providing a forum for reflection on ways to improve students' experiences.

BACKGROUND

As described above, the aim of this study is to address the new area of research related to documenting and describing students' conceptual learning about the environment resulting from a residential environmental center experience. Considering this goal, I will, in the pages that follow, attempt to situate this research among previous findings in EE. What follows, therefore, is an overview of EE including its origins, specific findings relevant to intensive overnight experiences, conceptual learning, and relevant theories of learning.

History of EE

Although the term "environmental education," used much as it is today, first appeared in the literature in 1968 (Disinger, 1998a), the notion of teaching about the environment in the environment has much older roots. Some of the antecedents to environmental education include nature study, conservation education, outdoor education, and progressive education (Disinger, 1998a). It has been suggested that, in some form, environmental education has existed as long as environmental degradation has existed (Swan, 1975).

National focus on the environment and environmental issues grew in the 1960s. Rachel Carson's famous 1962 publication of *Silent Spring* alerted the public to growing environmental problems. Consequently, increased public awareness and concern led to a flurry of related environmental movements all took place in the early 1970s. Responding to Carson's suggestions, 1970 saw the creation of the Environmental Protection Agency (EPA), an independent agency established for the purpose of regulating air, water, radiation, pesticides, and solid-wastes in the interest of human health. The first Earth

Day was celebrated in 1970 marking the beginning of an environmental movement (Merchant, 2002). 1970 also witnessed the establishment of the first Office of Environmental Education and a National Advisory Council for Environmental Education due to the Environmental Education Act. The first professional journal for reporting EE research in the United States, the *Journal for Environmental Education*, also began in 1970. In the following years, many of the first residential environmental learning centers were founded. Alluding to the significance of this era for environmental thinking, the passage of the 1973 Endangered Species Act is cited by Nash (1989) as the most recent hallmark in a long historical pattern of expanding rights which has grown at various noteworthy times to include other oppressed minorities such as English barons, American colonists, slaves, women, native Americans, laborers, and blacks. At about the same, several international conferences focusing on environmental education were hosted by the United Nations. The first was the 1972 Stockholm Conference on the Human Environment which identified the need to create citizens aware of environmental problems and capable of solving them (Disinger, 1998a). This was followed by the 1975 International Workshop of Environmental Education which produced the Belgrade Charter containing goals statements for EE which were subsequently revised at the 1977 UNESCO-UNEP Intergovernmental Conference on Environmental Education in Tbilisi, Georgia. Since that time, environmental education initiatives have continued to grow despite setbacks including the termination of the departments created by the Environmental Education Act in the 1980s and the omission of explicit EE goals in the National Science Education Standards published in 1996 (Brown, 2001). Today the EPA houses an Office for Environmental Education which publishes several environmental

curricula, the National Association for Environmental Educators continues to add members, an increasing number of Universities offer degree programs in EE, and residential environmental learning centers are growing and serving more visitors.

Definition of EE

No single definition is agreed upon by educators and researchers, and a multitude of definitions have been proposed (Disinger, 1998a). Some of the earliest and most cited definitions are as follows. Stapp (1969, p. 30) first articulated that "environmental education 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 solution." From the 1975 Belgrade Charter,

> Environmental education should be an integral part of the educational process, aimed at practical problems of an interdisciplinary character, build a sense of values, and contribute to public well-being. Its focus should reside mainly in the initiative of the learners and their involvement in action and guided by both the immediate future subjects of concern.

From the 1977 Tbilisi Declaration:

> Environmental education is a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems, and has the attitudes, motivations, knowledge, commitment and skills to work individually and collectively towards solutions of current problems and the prevention of new ones.

Also of note, the often cited goals of environmental education included in the Tbilisi Declaration are as follows:

- To foster clear awareness of, and concern about, economic, social, political, and ecological interdependence in urban and rural areas;
- To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
- To create new patterns of behavior of individuals, groups, and society as a whole towards the environment.

Also frequently referenced, categories of environmental education objectives included in the Tbilisi Declaration are:

> Awareness—to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.
>
> Knowledge—to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems.
>
> Attitudes—to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.
>
> Skills—to help social groups and individuals acquire the skills for identifying and solving environmental problems.
>
> Participation—to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

Assumptions of EE

The dogma of EE posits that learning begins with awareness of the natural environment and relevant issues. This awareness, in turn, leads to interest in learning about environmental issues thus leading to knowledge. The construction of environmental knowledge promotes an environmental attitude and corresponding motivation to address environmental issues. An environmental attitude translates into environmental behavior built on acquired skills. In short, environmental knowledge leads to a change in attitudes (affect), which results in environmental behavior. This widely accepted process of learning in EE, which can be found in numerous permutations throughout EE literature, can be traced to the previously referenced 1969 article by William Stapp and, in a later more frequently cited iterations, to the Belgrade Charter and the Tbilisi Declaration which Stapp oversaw as the first International Director of Environmental Education for the United Nations Educational, Scientific, and Cultural Organization (UNESCO). The consequence of this pervasive dogma is that research has

traditionally been divided into studies focusing on knowledge, attitude, and behavior or some combination thereof. In practice, often programs are designed which focus exclusively on awareness and knowledge assuming this will lead to the desired outcome of environmentally responsible behavior (Peyton & Miller, 1980).

Learning

Learning has many definitions. Virtually every educational researcher chooses his or her own operational definition for study purposes. One definition which suits this study is Falk and Dierking's assertion that "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" (2000, p. 136). Another relevant definition was put forth by Kapyla: "learning is a liberation from the power of authorities. Learning is a shift from unconscious to conscious" (1998, p. 236). Both of these definitions stem from an underlying constructivist framework in which learning is an active process whereby meaning is constructed with the use of existing conceptions (Driver & Bell, 1986). As such, a new idea must have relevance to the learner in order to be accepted. The process by which a student revises a previous held conception in favor a new one has been described as accommodation (Piaget, 1952) and as a paradigm shift (Kuhn, 1970).

The use of a constructivist approach is extremely common in EE research and teaching. It suggests that "experiences by themselves are not enough to change students' conceptions and we may need to consider a new range of pedagogical strategies which enable students to reflect, construct meanings and to encourage conceptual change" (Driver & Bell, 1986, p. 454). Many of theses strategies are integrated in typical EE

curricula such as those of environmental centers. They include having students share their own ideas, challenging student ideas, encouraging hypotheses, allowing students to explore their hypotheses, and providing students opportunities to apply their ideas in new situations (*ibid*, 1986). When a misconception surfaces, in order to address it, Strike and Posner's (1992) theory suggests, the educator should determine its source: does the misconception suggest a deeply held paradigm built on other beliefs or is it weakly held on the basis of misleading language? Long before such pedagogical theory was developed, Piaget discussed how the adult use of metaphors and the confusing, sometimes illogical structure of language can perpetuate misrepresentations of adults' meanings for children (1929). Piaget suggests that children process words by deconstructing them and then assimilating them according to their own "mental structure" (1929, p. 31).

The constructivist view goes beyond an explanation for how learning occurs; it provides the framework necessary for describing the process by which the objectives of the Tbilisi Declaration may be accomplished. That is, the conceptual and corresponding attitudinal and behavioral changes targeted by the Tbilisi Declaration rely on a facilitated learning process consistent with a constructivist model. In the constructivist framework, learners are empowered, which also means that learners are responsible for their own learning (Driver & Bell, 1986). The constructivist model and the goals of EE as put forth by the Tbilisi Declaration both therefore support EE programs designed such that educators facilitate the learning process by creating an atmosphere conducive to inquiry and discussion. Not coincidentally, this model is quite pervasive in EE.

Context of Study

In order to frame the new application of the methodology employed for this study, one must consider the context of previous research investigating the impact of environmental learning centers. Therefore, what follows is an overview, with examples, of the types of previous research of school and club field trips which have focused on three main areas: cognitive domains, environmental attitudes and behaviors, and environmental learning outcomes (Rickinson 2001; also see, e.g., Uzzell et al., 1995; Emmons, 1997; Bogner, 1998; Becker, 1977; Gilbertson, 1990; Smith-Sebasto & Semrau, 2004; Mittelstaedt, Sanker, & VanderVeer, 1999). Each of these studies provides some evidence regarding the efficacy of residential environmental experiences sponsored by schools or clubs.

Environmental Literacy Studies (Cognitive Studies)

Despite considerable discussion, a consensus definition of environmental literacy has yet to be found in EE (Disinger & Roth, 1992). Nevertheless, studies of this sort typically use questionnaires to quantitatively assess students' environmental literacy in cognitive terms (e.g., Gilbertson, 1990, Burrus-Bammel & Bammel, 1986). Studies measuring cognitive gains often demonstrate the effectiveness of a specific experience (the treatment) such as a week-long environmental camp (e.g., Burrus-Bammel & Bammel, 1986), but may also involve quasi-experimental designs that compare the effectiveness of different types of treatments (e.g., Gilbertson, 1990). In addition, they may be used to compare the efficacy of different treatments in imparting knowledge (e.g., Howie, 1972; Hosley, 1974; Ford & Payne, 1986). For example, Ford and Payne (1986) found that a creative EE program based around the analogy of Earth as a spaceship

exceeded a traditional EE program in improving participants' environmental knowledge, although both programs resulted in gains.

Environmental Attitudes Studies

In a classic design, an early study of the impact of a residential environmental center by Becker (1977) measured the change in students' attitudes toward the environment resulting from a five day experience. Becker's study involved administering written pre- and post-tests to both students participating in the environmental program and to students receiving only classroom environmental instruction. Becker then compared the resulting changes in attitude between the two groups. Becker concluded in often echoed idea that a residential environmental experience is more effective than classroom instruction alone in increasing concern toward the environment.

Another approach to measuring attitudes resulting from a residential environmental center involves ranking student responses to a questionnaire administered to random participants before, after and six weeks following the experience. Such an approach was employed by Uzzell et al. (1995) to determine students' perceptions over time of the severity of various environmental problems at different scales. Uzzell et al. findings indicate that the experience had a moderate impact on students' attitudes immediately afterward, but follow up responses suggest that attitude changes did not persist. By contrast, using pre- and post-surveys, Bogner (1998), found long-term changes in attitudes resulting from a residential environmental center experience.

More recent studies continue to measure attitudes by comparing pre- and post-tests, but also have begun to include other supporting data. For example, Smith-Sebasto and Semrau (2004) used interviews to complement their survey findings measuring

changes in environmental attitudes following a residential environmental center program. Mittelstaedt et al. (1999), on the other hand, measured attitudes quantitatively and intended behaviors qualitatively following a residential center program and then correlated those data with self-reported actions reported a year later. Mittelstaedt *et al.* found a universal increase in positive attitudes and reported that students acted upon nearly one fourth of intended behaviors.

Several of the survey instruments used in such studies have undergone considerable review. One of the most widely applied instruments to measure attitudes in a variety of settings is known as the New Environmental Paradigm (NEP), originally developed by Dunlap and van Liere (1978). Although it was presented as a simple twelve question survey of environmental attitudes (as measured on a Likert scale), rigorous subsequent research has revealed it can reveal multidimensional views of the environment (e.g., Albrecht, Bultena, Hoiberg, & Nowak, 1982). Nevertheless, data obtained by means of the NEP invariably show no more than statistics indicating people's preference for a pro-environmental orientation. Critiques and revised NEP tools have primarily focused on adding and rewording questions rather than employing qualitative methods to understand or complement our understanding of environmental attitudes (e.g., Lalonde & Jackson, 2002; Dunlap, Van Liere, Mertig, & Jones, 2000). Thus, most environmental attitudes studies including those used to measure the impact of EE programs continue to heavily depend on quantitative tools and methods.

Environmental Learning Outcomes Studies

Studies in this category generally attempt to attribute changes in students' learning and behaviors to specific experiences. For example, Bogner (1998) and Culen

and Mony (2003) compared students' self-reported environmental action between one group participating in environmental education activities with another group who received no such treatment. Based on data collected on self-reported responsible environmental behavior by means of a survey instrument, Culen and Money reported that students in EE programs scored higher in all areas. In Bogner's study, several comparisons of behavior were analyzed following separate treatments groups of one day and five day outdoor ecology programs. By delaying post-tests one month and also completing a follow-up survey six months later, Bogner found evidence for intended long-term behavior shifts. Again, the primary data presented in such studies typically consist of survey statistics. Many of the studies which try to infer responsible environmental behavior refer to Sia, Hungerford and Tomera's landmark 1985 study reporting seven predictors for responsible environmental behavior: (1) level of environmental sensitivity; (2) perceived knowledge of environmental action strategies; (3) perceived skill in using environmental action strategies; (4) psychological sex role classification; (5) individual locus of control; (6) group locus of control; (7) attitude toward pollution.

Summary of School Field Trip Studies

The above classifications are useful in identifying the types of previous research and their findings. The dogma for measuring learning environmental literacy, attitudes, and behaviors that can be attributed to an EE experience is as follows: pre-test/post-test surveys for an experimental (treatment) group and a control group and subsequent comparison of differences between groups. Because data collection for each of these types of inquiries can be done simultaneously, it should therefore be apparent that many

studies can be classified in more than one category. However, the larger message contained herein is that the majority of studies that examine some aspect of an environmental education program, particularly those at environmental centers, fall into one or more of the above categories.

Because studies of literacy and environmental attitudes typically employ surveys, well planned studies of this design provide highly reliable data, but their validity is often limited. In other words, what we learn from surveys is limited to the questions we ask. Although a good deal of evidence has been compiled which shows the varying success of EE programs, the surveys upon which this evidence is based fail to provide a meaningful context to students' learning. For example, a survey could be used to ask students a multiple choice questions each with only one correct answer. By looking at survey results, we can measure students' cognitive gains or attitude shifts, but we learn little about how that learning did (or did not) take place. Therefore, if we, as educators, want to learn how we can enhance an outdoor educational experience, we need more information about students' conceptual knowledge. Both the relative absence and the importance of such studies focusing on children's environmental conceptions have been recognized by researchers in the environmental field (e.g., Rejeski, 1982; Payne, 1998b; Rickinson, 2001;).

The upshot is that we know that an environmental learning center visit can significantly shape students' knowledge about and concern for the environment and, additionally, can affect their behavior with respect to the environment. Yet, there is little known about what sorts of concepts about the environment such experiences foster. Studies which show gains in environmental knowledge, attitudes, and intended behavior

typically do not characterize the learning in terms of breadth and depth and themes by which that knowledge is interpreted. Hence, if students develop incomplete or misguided concepts about the nature of the environment, these may, in turn, affect the ways in which they express their concern. In addition, as Falk (2005) points out, what people learn from EE experiences may not relate to what educators intended them to learn. Therefore, only open-ended methods could possibly uncover evidence of this sort of learning.

Rejeski (1982) critiques EE for applying minimal knowledge of biological and behavioral sciences to curricula. Furthermore, most studies in EE, Rejeski adds, focus on environmental outcomes of EE programs, thereby adding little to the understanding of the development of psychological processes involved. A scan of more recent literature confirms that the emphasis on outcomes (particularly on knowledge, attitudes, and behaviors) continues to persist. By contrast, the study that follows simultaneously addresses both the theoretical concerns of child development and the outcomes from an EE program.

Environmental Perceptions

A handful of exploratory studies, the most relevant of which are discussed below, begin to address the void regarding young people's conceptions of nature and the environment. In one such early study Rejeski (1982) employed a methodology similar to the drawing and writing activity used in this study and included 1st, 4th, and 8th graders in his sample. Rejeski presents the results to illustrate the point that distinct normative characteristics corresponding with the dominant characteristics for each age, literalism, 1st grade (age 6-7), organization, 4th grade (age 9-10), moralism, 8th grade (age 13-14),

may be found in students' interpretations of nature. In another such study based on six and seven year-olds' drawings of nature and their responses to interview questions, Keliher (1997) concludes that children have well developed ideas about nature and the threats posed by pollution. Because these ideas are similar to ideas reported of studies involving older children, Keliher postulates that childhood perceptions of nature and the environment change very little as children mature. The author attributes her finding to children's schooling and nature experiences and further speculates that television may play an important role in shaping children's ideas. Bonnett and Williams (1998) also utilized students' drawings, in their case, of students' favorite places. Drawings along with subsequent photographs were used to elicit discussion of nature and the environment (described separately). The authors use students' spoken ideas to characterize the main elements of students' perceptions of nature and the environment as well as to comment on sources of influences on these ideas. Wals' (1994) used findings based on notes taken as a participant-observer in a community problem solving project and subsequent interviews of inner city and suburban middle school students to illustrate that urban adolescents establish complex relationships with nature. Wals' study further demonstrates that youths can have a wide range of experiences which, in turn, are reflected in diverse perceptions of nature which the author characterizes. Payne (1998b), who used an informal 'philosophy for children' class to capture sixth grade children's ideas, found that his students tended to characterize nature as a place where living and non-living things exist apart from humans. Shepardson (2004) utilized student drawings of an environment accompanied with explanations and student responses to photographs representing natural and human managed environments in order to investigate patterns of

change across grade levels seven, eight, and nine. Shepardson's primary finding, much like Payne's, is that the students included in the study tend to possess limited ecological perspectives of the environment and characterize the environment as an object separate from humans. Based on written student responses to an open-ended question about the meaning of the word "environment" Loughland et al. (2002) comes to the similar conclusion that most children characterize the environment as an object rather than a relation. Finally, Brody (1996) demonstrated the utility of interviews in eliciting students' marine science knowledge and developing concept maps to describe their understandings. To sum up, a few recent studies have introduced qualitative and phenomenological approaches to understanding children's environmental conceptions and these exploratory techniques described above offer promise of closing the theory-practice gap between what is known about children's pre-existing ideas and how environmental education is conducted. However, these techniques have not yet been applied to learning at environmental learning centers, hence opening a line of inquiry ripe for investigation, the findings of which could significantly alter the role of environmental centers.

Marine Education

Marine education may be considered a subset of EE and represents a key focus of the program used for this study. A recent study of the public's ocean literacy revealed that the public is not particularly familiar with environmental terms and knowledge about the ocean (Steel, Smith, Opsommer, Curiel, & Warner-Steel, 2005). This research was conducted by a random mail/phone survey of 1233 individuals from the lower forty-eight states. In presenting their findings, the authors challenge the assumption of the 2004 Pew

Ocean Commission report "that increased public awareness and knowledge of oceans will lead to increased public support for ocean restoration efforts" (p. 97). The results actually point to a negative effect of television and radio on knowledge. Although residents from coastal states only showed marginally higher levels of informedness, one of the most significant situation-specific variables to correlate with ocean literacy are visits to the coasts. Steel et al. conclude by stating "the underlying message of this study is that more articles in the media may give the illusion of building better knowledge in the public, but these data suggest people need to actually experience the problems before they are likely to change their views" (p. 111). Another interpretation of the findings therefore suggests that a coastal educational experience would best accomplish EE's goal for enhancing children's attitudes and behaviors with respect to the oceans.

In a study of Oregon 4th, 8th, and 11th grade students of marine concepts, a team of researchers conducted interviews with students from both urban and rural schools. The interviews were then used to identify principle concepts related to Oregon's marine environment. Findings showed mixed results when compared to scientific benchmarks. In the areas of physical and chemical properties and processes student understandings did not advance beyond the level of the lower grades. Misconceptions emerged as well. Brody (1996) posits that an interdisciplinary approach to science, such as that of environmental science, increases the odds of fostering misconceptions due the complex relationships from various disciplines. One such example he provides is a pattern in which students described how fish extract oxygen for respiration from water. This misconception represents the synthesis of two valid ideas, one from biology—that fish breathe oxygen—and one from physics (or chemistry)—that oxygen is contained in water

molecules, but is ultimately flawed. Again, this study hints at the potential benefits of a hands-on environmental experience, particularly for secondary students who have few guided opportunities to integrate their knowledge from different subject areas.

In that vein, both Loughland et al. (2003) and Shepardson (2004) have provided evidence to suggest that the structure of classroom schooling, in secondary education especially, in which subjects are taught independently of one another results in a rather undeveloped ecological conception of nature where nature is considered a place or object. By teaching subjects independently from one another, formal education implicitly fosters separation between ideas stemming from the social sciences and the natural sciences. This separation contrasts sharply with the integrated model for teaching EE. In practice, however, environmental center programs often separate science and social science lessons, although the divide is less defined.

The Value of Nature Experience

Although some studies provide evidence that knowledge and attitudes derived from residential EE experiences are linked with pro-environmental behavior (e.g., Bogner, 1998; Mittelstaedt et al., 1999; Emmons, 1997), disconfirming evidence has appeared in the literature as well (e.g., Culen & Mony, 1998). The relationship between knowledge, attitudes and behavior is complex, and a causal relationship cannot be assumed (Burrus-Bammel, 1978). However, the immediate and long-term value of nature experience cannot be easily discounted. Sebba (1991) reports that the vast majority of adults cite outdoor areas, particularly natural areas, as the most significant place in their childhood. Moreover, childhood experience in the outdoors appears to shape one's world view (Hester & O'Donnell, 1987). Adding to the value of experience,

Chawla and Hart (1995) note, "it is impossible for children to value ecological systems until they know that they exist" (p.149). In other words, children must be exposed to nature in order to develop an environmental ethic based on the intrinsic value of nature. The other sources of environmental concern Chawla and Hart identify, self-preservation and interpersonal preservation, may be more readily reinforced by verbal information rather than experience. In any case, it is evident that nature experience introduces an opportunity for all forms of environmental concern to enter children's thinking.

Piaget (1929) discusses animism in children. According to Piaget, animism is used by children early in their development to ascribe to living and non-living things a similar consciousness to that of the child. Therefore, it might be argued, early experiences with nature allow children to consider nature's perspective, albeit in terms not typically employed by adults. Chawla and Hart (1995) suggest this emotional understanding of non-human things may constitute the "emotional basis for environmental concern" (p.155).

Children need sensory stimuli to foster cognitive development until they mature and can process at a higher level (which enables learning without such stimuli). According to Sebba (1991), the sensory stimuli offered by natural phenomena are particularly well suited to fostering cognitive development because, by contrast to human-made environments, nature stimuli (paraphrasing Sebba): (1) assault the senses at an uncontrolled strength; (2) continually change; (3) require alertness and attention; (4) generate life and forces which move inanimate objects; (5) contain shapes which are usually soft and rounded, mostly ambiguous, and infinitely varied. As children mature they require fewer first-hand sensory experiences in order to construct knowledge.

Consequently, "the transition from reliance on sensory criteria to reliance on cognitive ones is accompanied not only by physical but also a by psychological separation from the environment" (Sebba, 1991, p.414). Thus, the value of childhood nature experiences takes on greater significance in light of what is known about child development. In addition to aiding in a child's cognitive growth, children who interact with nature begin to establish a relationship which may include affective and social dimensions.

Significant Life Experiences

Thomas Tanner published a landmark article in 1980 postulating that formative childhood experiences or influences may be the key to explaining the origins of environmental beliefs and active responsible environmental behavior. By conducting an open-ended survey of active, environmentally informed citizens, Tanner identified nine categories of experience representing what he labeled significant life experiences (SLEs). The emergent categories, in order of frequency mentioned, include: (1) outdoors; (2) habitat; (3) parents; (4) teachers; (5) books; (6) adults other than parents or teachers; (7) habitat alteration; (8) solitude; (9) miscellaneous. Several respondents identified more than one influential category. The implications of this study for EE are highly suggestive. First, it appears interaction with the outdoors is of great importance. Second, the fact that most respondents were able to identify formative influences suggests the importance of childhood experiences in fostering environmental sensitivity.

Research following Tanner's original line of inquiry has continued. Chawla (1998) reviews the findings of subsequent studies of SLEs and reports that most find some degree of accord with Tanner, particularly with the influence of outdoor experiences in childhood. Payne (1999) critiques that, although studies of SLEs may be

of great import, they fail to suggest any mechanisms for how these pro-environmental beliefs are fostered. Chawla (1999) began to address this void by conducting a study of SLEs in which she used a phenomenological approach to trace environmentalists' life histories and, furthermore, asked participants to suggest strategies for fostering environmental action. However, our present understanding of SLEs and the corresponding conceptions which are developed remains relatively unexplored.

Evidence that thinking about nature affects behavior

In a meta-analysis representing the synthesis of a decade of research on environmental behavior and related factors, Hines, Hungerford, and Tomera (1986) developed a model of responsible environmental behavior. In their model, knowledge of environmental issues, knowledge of appropriate actions, and action skills are all represented as prerequisites to responsible environmental behavior. However, an individual must also wish to act, which is affected by a variety of personality factors including a positive attitude, internal locus of control, and a sense of personal responsibility. Therefore, although certain components are necessary for action, predicting whether an individual will act remains uncertain and complex. Nevertheless, Hines *et al.* (1986) model confirms that how one thinks of nature affects how he or she behaves.

There is considerable additional evidence beyond EE that the way in which people think about nature is reflected in their decisions. Stapp (1969) discusses the increasing extent to which citizen decisions affect the environment, particularly with regard to policymaking. Wilson (1992) discusses how people shape their home environment and landscape based on their views of nature and how this, in turn, shapes

their views. From an historical viewpoint, reflecting the prevailing philosophy at the time of the need to tame wild lands, the Homestead Act of 1862 offered 160 acres of land to any head of a household who settled and cleared a portion of it. About a century later, by contrast, the 1973 Endangered Species Act recognized the need and public support to protect natural wild organisms.

Environmental thinking as reflected in policy is more closely examined by Merchant (1997) who traces the progression of fisheries policies (which correspond with other natural resources policies) and the underlying changing ethics which guide these policies. Merchant characterizes the early policies of the 1820s through the 1880s as based on an "egocentric ethic" which finds its roots in a Judeo-Christian worldview as well as in influential philosophical and political authors at the time, such as Thomas Hobbes, John Locke, and Adam Smith. An egocentric ethic espouses maximization of natural resources for individual profit. When the egocentric ethic proved to be insupportable, a utilitarian or homocentric ethic replaced it, again reflecting prevailing thinking of the time. The homocentric ethic espouses a philosophy of social good over individual good but nevertheless favors humans over all other species. By the 1950s, environmental thinking began to change as resource policies continued to prove unsustainable. An ecocentric ethic emerged which assigns equality to humans and other organisms. This ecocentric ethic finds its roots in the writings of Aldo Leopold (1949) and Rachel Carson who both describe the intrinsic value of nature. The ideas of Leopold and Carson, not coincidentally, also helped foment the modern environmental movement. The example of how thinking about the environment is reflected in policy is but one prominent example of how knowledge and attitudes may affect behavior. Studies within

EE tend to focus on individuals' behaviors as related to their knowledge and attitude rather than collective social actions. The preceding example therefore serves to illustrate that an understanding of how people think about nature may be situated in the larger context of society at large.

Thus, the way people think about the environment can manifest itself in such areas as policy and can greatly impact life. In other words, the depth of people's consideration of nature, an examination of the ethics behind policies reveals, may have significant consequences for life. Even conceptual thinking which places some value on nature may have dire consequences for natural ecosystems. And although the exact nature of the link between ways of thinking and behavior should not be assumed, evidence from both within and without EE supports a link. Perhaps a deeper understanding for the way in which thinking about nature occurs in children could be used to predict pro-environmental behavior both among individuals and societies. After all, as discussed above, the Tbilisi Declaration identifies the ultimate goal of EE as an effort to create new patterns of behavior of individuals, groups, and society as a whole towards the environment.

METHODOLOGY

Design

Description of environmental center and experience studied

The environmental center that served as the "treatment" in this study was the coastal ecology Outdoor Science School at Camp Magruder operated by the Oregon Museum of Science and Industry (OMSI). As an OMSI program, the Outdoor Science School falls under the direction of the OMSI mission: "to make science exciting and relevant through exhibits, programs, and experiences that are presented in an entertaining and participatory fashion" (*OMSI webpage*). True to their mission, the staff at the Outdoor Science Center uses its skill to attempt to engage students. Outdoor School instructors start with an advantage in class sizes which, typically, are limited to fifteen students, or roughly half the size of the school classrooms attending. Instructors have a number of other advantages over classroom teachers working in their favor, most notably: instructors relate to students on a first-name basis; instructors, as students are keenly aware, are not responsible for grading students; as new teachers in the eyes of students, instructor command a certain intrigue among students particularly stimulated due to their unfamiliar surroundings; class groups are accompanied by teachers or parent chaperones to assist with logistics (such as carrying supplies or keeping the group together on the trail), discipline, and guidance (for example, when students need help adjusting microscopes); instructors are intimately familiar with the program, outdoor teaching areas, and local ecology due to the repetitive format of their work, which typically involves teaching the same or similar courses with each visiting group. As is common among environmental centers, instructors are enthusiastic and high-energy

teachers. Instructors are trained in skills that promote a fun and exciting atmosphere: instructors use a variety of games and interactive techniques to involve students; a positive sense of humor is evident throughout instructors' teaching; instructors are encouraged to be playful, particularly during evening programs that include a mix of educational and purely fun activities such as skits and group dancing. Of course, the staff is also trained in the content of the courses they lead and they are hired on the basis of their natural science college degrees and their previous relevant experience. However, most staff members are young, have minimal career experience, and few have formal teaching credentials.

The program itself attempts to ensure that learning opportunities are maximized. Activities are scheduled throughout the day. Lessons begin with brief lectures or discussions of the topics, followed by hands-on explorations and investigations. In a three-day program, the second day includes a sack lunch to eat in the field. This allows greater flexibility of activities designed to expose students to an outdoor experience and thereby minimizes the disruption to the program. OMSI issues journals full of useful information and spaces for students to record their observations and respond to questions. Instructors incorporate review time into their lessons, specifically referring to pages in the journals.

OMSI asserts that their program is concept-based and aligns with the Oregon Common Curriculum Goals in Science (Camp Magruder Information Packet 2004). Lessons are bundled into broader topics known as "Field Studies". For students included in this study, the field study topics and their component lessons were as follows: Aquatic Ecology, composed of "critter catch", "water quality testing", "lab investigation", and

"water cycle"; Sandy Beach composed of "build a model of the state of Oregon", "dune formation", "beach grass ecology", and "critters in the sand"; and Tide Pooling. In addition, depending on their preferences, each student participated in two of the following shorter lessons known as "interest groups": "squid dissection", "survival", "early Oregon studies", or "team challenge." Following dinner, the first night's evening activity was an interactive tide pool slide show introducing students to the types of things they might expect to see the following day. The second night's activity was known as "eco-jeopardy" and consisted of review questions presented in a game show format. Both evening activities were followed by campfire activities including skits and storytelling.

The lessons mentioned above are characteristic of those offered at environmental centers in terms of subject matter but, more significantly, in how they are presented. Themed lessons utilize kinesthetic and experiential methods to involve students and stimulate learning. Take, for example, the lessons focusing on Aquatic Ecology. During the "critter catch" lesson students collect water samples from a lake using a variety of tools. Afterward, students observe, sketch, identify, place in a food chain and classify the macroinvertebrates according to a biotic index. Later, students undertake a similar study, this time using microscopes, of microinvertebrates from their sample during the "lab investigation". During "water quality testing", students further investigate the local aquatic ecology by measuring abiotic factors such as dissolved oxygen, pH, and temperature in two samples. They then compare and interpret the two samples and discuss possible human impacts. Finally, during "water cycle", students consider the

larger systems at work on the local bodies of water by simulating the steps in water's circulation throughout the biosphere.

One of the opportunities that make OMSI's Outdoor Science School particularly appealing is the tide pooling experience. Students were prepared for the experience by way of an interactive slide show highlighting some of the uniquely adapted organisms found in tide pools and the specific tidal zones in which they specialize. The experience itself was largely exploratory; the instructors' only apparent role was to find and name organisms of interest while students explored independently. The tide pools were not pristine as evidenced by the jetty composed of highly uniform rocks along which they formed.

Subjects

Thirty-seven 5th grade students were included in this study. The sample included eighteen males, nineteen females and represents approximately half of the students who participated in this particular program. Students came from two classrooms at one elementary in a modestly populated university community in Oregon's Willamette Valley. Students whose parents consented and who themselves willingly assented to participate were included in the study. A letter addressed to parents accompanied by an informed consent document provides an overview of the design and intent of the study (Appendices A and B).

Possible schools for inclusion in the study were identified by the OMSI program coordinator. Criteria for selection were size and dates of attendance. Larger schools were preferenced due to the large anticipated individual non-participation rate. Dates of attendance had to be considered in order to allow sufficient time for both pre- and,

particularly (because the majority of programs take place in the late spring), post-interviews during the school year. A letter addressed to the principal (Appendix C) was provided to the OMSI program coordinator to pass along to identified schools. Among the two principals who responded favorably, only one school also had sufficient students in cooperating teachers' classrooms. Both OMSI and Oregon State University Institutional Review Board approved this study (Appendix D).

Design and Data Sources

There were five phases of data collection within this study (see Fig. 1). The initial phase involved asking a classroom of students to first describe in words, then draw, what comes to mind when they think of "nature". The second phase involved individual pre-trip interviews, conducted with two students at a time during school hours. In phase three, following the trip to the outdoor school, students were given the opportunity, again in a classroom setting, to revise their drawings and descriptions (returned to them) of "nature". At this time (phase four) students were asked to fill out a brief survey (Appendix E). Finally, in phase five, individual post-trip interviews were conducted in which students were given the opportunity to revise and expand on earlier responses as well as respond to other lines of inquiry. What follows is an overview of the chronological phases of the research, then subsequent descriptions of the different techniques employed.

Phase one was conducted in the students' elementary school classroom with the cooperation of their teacher. Students from two classrooms were included in this study. In each classroom, the teacher introduced the researcher and briefly explained his study. The researcher then distributed blank sheets of paper and a black pen to each of the

students. Students were then asked to write in words everything that comes to mind when they think of nature. Next, students were asked to turn over their paper and draw a picture of everything that comes to mind when they think of nature. Finally, students the researcher instructed students to label each of the important parts of their pictures.

In phase two, participating students met with the researcher in pairs for interviews. Interviews took place during school hours over the course of the two weeks prior to the trip to Outdoor School. Students were selected for interviews based on their availability (for example, as students returned from swimming, those who returned first were selected). Before each interview, the researcher attempted to make students feel comfortable by means of casual talk and an explanation of the study (see Appendix G). Students were encouraged to ask questions about the study before the interview began. Furthermore, similar to the introduction for the description and drawing activity in phase one, interviewees were reminded that there are no wrong answers.

Following the school trip to Outdoor School, the researcher again met with each classroom of students in their elementary school. Students received their original responses to the description and drawing activity in phase one and were then asked to revise them. Students were asked to add any additional thoughts or ideas that came to mind when they thought of nature, either as part of their written description or as an addition to their drawing. If for, any reason, students thought part of their earlier response no longer applied, they were asked to cross off that response. For these revisions, students were given a blue pen such that the researcher could easily distinguish between pre-trip responses from phase one and post-trip revisions.

Immediately following phase three after the revised responses were collected, students were given a one page survey to complete (phase 4).

Over the course of the two weeks following the school trip to Outdoor School, post-trip interviews (phase 5) were conducted. These interviews were conducted in a very similar format as the pre-trip interviews, again taking place during regular school hours with pairs of students. When students were asked to respond to the same prompts used during pre-trip interviews, each student's earlier responses were summarized in order to allow them to add and revise their responses.

The overall design study was created to allow students multiple opportunities to share their ideas, knowledge, concepts and feelings with the researcher both before and following their outdoor school experience. Each of these opportunities was intentionally designed to be open ended so that unanticipated student ideas could emerge. For this reason, the researcher made a conscious choice to omit the use of multiple choice tests or surveys which limit the variety of student answers and are limited in their ability to measure and characterize conceptual learning. The wording of all questions was carefully crafted in order to avoid introducing any leading statements, relevant vocabulary, or other biases. Taken together, all the data sources provide a composite and more comprehensive indicator of each student's understandings before and after their trip to outdoor school.

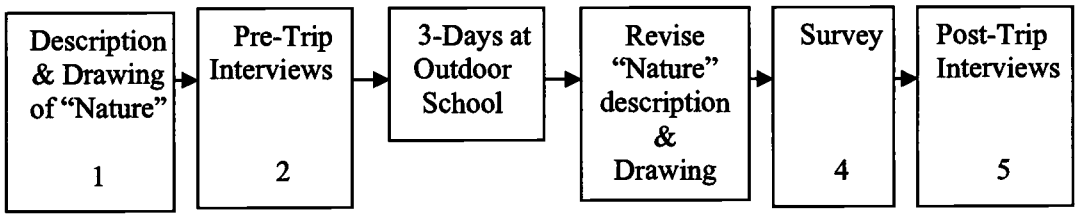


Fig. 1. An overview of the basic study design showing the five phases of data collection.

The absence of a control group is by design. The methods described here depart from the previous dogma of environmental learning center research reviewed above because the question of interest also deviates from the traditional lines of inquiry. As Rennie and McClafferty (1996) note from their background in science center research, when one acknowledges that every visitor has a unique experience, the assumptions of a pre-test/post-test design are not met. Therefore, finding a finding a control group becomes problematic. The same is true for the study of environmental learning centers. From the constructivist viewpoint, students' experiences vary depending on complex interactions between cognitive, affective and social spheres. Hence, we cannot simply replicate students' experiences minus one dependent variable and thereby simulate a parallel learning experience we might reasonably call a control.

Nature drawing and definition

The collection of data began with a writing and drawing activity. Students were given a blank piece of paper and a black pen and asked to write a description of everything the word nature means. Students were further instructed to draw a picture of everything that is part of nature. Next, students were asked to label the important things in their picture. Students were given all the time they required until they were satisfied with their responses.

Following the students' experience at outdoor school, students' descriptions and drawings of nature were returned to each of them. This time they were instructed to add, change, or cross off anything they wished to represent everything that now comes to mind when they think of nature. In order to differentiate pre-trip and post-trip responses, students were given a blue pen to make revisions. A description of the protocol used for the writing and drawing activity can be found in Appendix F.

The writing and drawing activity as a source of data was modeled after the classic Draw-A-Scientist Test (discussed by Mason, Kahle, & Gardner, 1991 and originally introduced by Mead & Metraux, 1957) and a newer technique known as Personal Meaning Mapping (Adams, Falk, & Dierking, 2004). The Draw-A-Scientist test has demonstrated the utility of employing participants' drawings to systematically characterize participants' ideas. Several more recent studies have successfully used drawing activities to elicit students' perceptions of nature (e.g., Shepardson, 2004; Bonnett & Williams, 1998; Keliher, 1997). Personal Meaning Mapping (PMM) is a responsive research methodology specifically designed to measure participant learning from experiences by allowing participants' perspectives to emerge. Each of these methods that ask participants to write and draw responses emphasize validity, meaning that participants' responses represent and fairly measure (when used appropriately) their understandings of the subject of interest. In other words, techniques such as these that encourage participants to respond using a pen and a blank piece of paper are ideally suited to elicit relevant and meaningful responses regarding the questions of interest, particularly when participants' biases, attitudes, and conceptions are of the focus of inquiry. Moreover, this approach allows participants' misconceptions to emerge as well.

It follows that this approach builds on a constructivist framework in which participants are presumed to hold pre-existing ideas, attitudes, and knowledge derived from previous experiences related to the subject. They then relate their new learning experiences to these prior understandings and thusly develop new conceptions or, as Driver and Bell put it, "we make meanings by bringing our present conceptions to bear on new situations" (1986, p. 448). It follows, therefore, that the researcher must present all materials and questions in as value-free manner as possible.

Interview Technique

Pre-trip interviews were conducted within a two week span of time preceding the visit to Outdoor School. Students were interviewed in pairs to promote a comfortable setting as well as to expedite the interview process. Pairs of students were chosen at random. Before conducting the interviews, the researcher reminded students of the purpose of the study, advised students to share any and all thoughts because there are no "right" or "wrong" answers, and encouraged students to speak one at a time. During the interview, students were presented a series of three prompts (determined by way of a pilot test) and asked to respond with everything that came to mind as a result. Consistent with the Personal Meaning Mapping technique, prompts consisted of simple words printed in large font, each on separate pieces of paper, presented and read to students one at a time. The three prompts used, in order, were "Outdoor School", "Nature", and "Tide Pools". Students were encouraged to speak whatever ideas, images, memories, or thoughts that came to mind with each prompt. Prompts were not directed to one student at a time but, rather, presented so that either student could answer. Each student was given time to respond and encouraged to elaborate his or her response until he or she had

no more to say. The researcher recorded all students' responses with shorthand notes. Following the three prompts, students were asked three questions regarding their interest in outdoor school and nature. Pre-trip interviews ranged in time from fifteen to forty minutes. The interview protocol can be found in Appendix G.

Post-trip interviews were conducted within a two week span of time following the visit to outdoor school. Similar to pre-trip interviews, post-trip interviews utilized the three same series of prompts. However, in post-trip interviews, students' previous responses were first read to them when each prompt was presented. Students were asked to listen and revise their earlier response by adding to it or changing it. Again, students were asked the same three short answer questions, as well as several additional questions. Students were further asked to observe their written descriptions and drawings and comment on them. Finally, toward the end of the interview I often returned to a previous response to probe deeper about a certain response, particularly if I recognized a misconception that the student did not address. Post-trip interviews ranged in time from twenty-five to sixty minutes.

The Researcher

As the researcher I was the key instrument for data collection in this study. Therefore, in an effort to offer transparency, what follows is a description of my personal background, views on teaching, and views on environmental education. Given this information, the reader should be better prepared to interpret the results by recognizing my personal biases.

My views on education have been strongly shaped by over five years of experience teaching and administering hands-on education programs, primarily in

residential settings with similar missions and logistics as the one described in this study. My undergraduate academic background based in Biology and Anthropology, for which I earned a Bachelor's degree in Human Impact Ecology as an independent major at Grinnell College, is also influential on my perspective. In addition, I have further academic influences derived from a nine month student naturalist internship I completed at an accredited residential environmental education center where I simultaneously earned a Naturalist Diploma from Wolf Ridge Environmental Learning Center and a Certificate of Environmental Education from the University of Minnesota-Duluth. Further shaping my views, I have four years experience, divided among several roles of increasing responsibility from instructor to assistant program director to program director, at a residential center focusing on physical sciences located in California. Also of note, I have experience leading teens on intensive adventure and wilderness trips both in the United States and Central America. Finally, my views presently are influenced by my pursuit of a Master's degree in Environmental Sciences, focusing on Environmental Education at Oregon State University.

Throughout all of my experiences, I have developed strong views about how students learn best. I believe students must be first captivated by the creation of an exciting learning environment. I further believe in encouraging questions, critical thinking, and discussion among students. Whenever possible, I assert, teachers should allow students to guide the direction of class, for example, by letting students test their questions experimentally. Hands-on activities should be stressed. Cooperative learning is encouraged. I further contend that students learn through experiences, questioning, and discussion. Knowledge acquired should be related to real phenomena. Concepts should

be stressed above facts. Hence, students should be able to apply their knowledge to problem-solving situations. In sum, my educational philosophy might be best characterized as a mix of progressivism with social reconstructionism (for more detail of these philosophies, see Parkay & Stanford, 2001).

Environmental education, I submit, is most effective when students are immersed in guided experiences outside the traditional four-walled classroom. In keeping with my educational philosophy, I feel that well framed outdoor activities can inspire students' curiosity about the world and can then be used to further explore relevant topics and concepts in further depth. My approach to environmental education finds a certain degree of agreement with the National Science Education Standards (1996) in that the standards encourage teaching that promotes an active citizenry whose understandings and decisions derive from lessons concerning health, populations, resources, and environments. Moreover, the standards emphasize conceptual learning via experience. My belief further reflects the standards' notion of unifying themes: Environmental education activities, I assert, can serve as a foundation for integrating lessons from different subject areas and thereby compel students to recognize the application and interconnectedness of diverse areas of study.

Limitations

While this study offers a somewhat unique perspective on a subset of students from two classrooms who attended an environmental center, the findings must be regarded with caution with respect to their generalizability. While patterns among the responses of students in this study emerged, as the researcher I did not exhaustively explore variables that might help establish the correlations between individuals that could

be used to predict responses from future subjects. Moreover, I used a limited number of data points—shortly before and after the experience of interest—which inherently limits what is known about the lasting effects on students to speculation. While this may be viewed as a limitation on generalizability, the advantage of such a study is the relative richness of the data collected from the subjects included in the study. The details of students' responses might, therefore, find a certain degree of accord with other studies and, subsequently, be found to have greater applicability than this design would at first suggest. In any case, the trade-off in this design is one which sacrifices immediate generalizability for in-depth data about students' views, and the latter best addresses the primary question of interest.

As the researcher I employed an effective form of shorthand that enabled me to capture students' main ideas and a multitude of quotes, but this method must be regarded as inferior to the use of audio or video recorded interviews with respect to the level of detail of students' responses. On the other hand, more than one student remarked about his or her initial anxiety when being interviewed, and the addition of recording equipment undoubtedly would have added to at least some students' apprehension and therefore may have altered their responses. Qualitative researchers continue to discuss the constraints of using recording equipment, among them: (1) the obtrusiveness of recorders and their effect on a setting that otherwise appears informal; (2) researchers' heavy reliance on technology which, even at best, affects the researchers' ability to recall conversations solely from memory and, at worst, can result in lost data; (3) the additional permissions and thus potentially heightened participant and parental concerns about interviewing (adapted from Rubin & Rubin, 2005). Knowing that recorders can influence participants'

answers (Rubin & Rubin, 2005), I intentionally maintained as casual an interview setting as possible (depending on availability, often meeting in a resource room or quiet corner of the library), particularly because I anticipated that fifth grade children (approximately ten years of age) were likely to be discomforted by the unfamiliar interview process more so than adults would be. Hence, recording equipment did not seem to fit my design needs. Furthermore, the additional permissions required for recordings of children may have interfered with this study's feasibility: it is uncertain whether the administrators and teachers involved would have been willing to cooperate with such a study and the likely number of participants would be fewer as a result. Consequently, the affordances of untaped interviews far exceeded those of taped interviews.

Despite my efforts to create a comfortable and informal atmosphere, the comments that students shared with me, the researcher, may have been filtered by the students themselves due to any of a variety of possible reasons. Chief among these possibilities is the fact that the pre-trip interview was the first time each participant conversed with me face to face. An additional consideration is that some students may have been motivated to tell me what they thought I wanted to hear. There was no deception in my research approach and students were informed of my research goal to study their environmental learning from Outdoor School. Consequently, post-trip interviews revealed that, in several cases, students responded to the prompt "nature" as if I had meant "camp." In cases where I recognized this misunderstanding I was able to redirect the students' focus thus mitigating the impact. In other cases, it appears some students discussed topics closely related to materials in their logbook when responding to

the prompt "nature". The logbook, created by OMSI and assigned by the students' school teachers, contains information and review activities related to the Outdoor School lessons, thus making it difficult to differentiate students' logic for remembering and sharing the ideas they did between what they remembered from lessons and what they recalled from completing the logbook. This alone is not cause for much concern—if the use of the logbook reinforces learning experiences, the learning has still taken place and still may be in part attributed to the experience—except for the suggestion that some ideas shared (such as discussion of erosion and the rain shadow effect) do not seem particularly relevant to "nature" and may reflect students' attempt to tell me, the researcher, what I am seeking. Despite students' awareness of this study's focus and the possibility that students' attempted to say what they thought I wanted to hear, the information shared by students nonetheless represents their learning and therefore remains valid. Had I noted any evidence that students' were attempting not to cooperate and sought to intentionally sabotage the study by sharing ideas completely unrelated to nature, then I would have serious cause for concern about the data collected. Fortunately, this was not the case and I feel confident the data I collected fairly represents students' learning about nature.

One might view the interview design as an inherent limitation due to the practice of interviewing two students simultaneously. While this practice seemed to put students at greater ease to speak, the two interviewees may have influenced each other's responses. However, the affordances of this design appeared to outweigh the limitations it presented. Because the students' experience took place collectively, paired interviews may have actually helped students reflect on the social aspects of learning as well.

Researchers recognize the value of group interviews in helping participants recall events and shared experiences in greater detail (Fontana and Frey, 2000). Moreover, as Kitzinger reasoned, "people's knowledge and attitudes are not entirely encapsulated in reasoned responses to direct questions. Everyday forms of communication such as anecdotes, jokes, or loose word association may tell us as much, if not more, about what people know and thus group interviews have the potential to reveal 'dimensions of understanding that often remain untapped by the more conventional one-to-one interview or questionnaire'" (p.109, 1994). While it may at first appear to be a fair criticism that this pairing prompted the participants' memory of ideas that would otherwise have gone unvoiced, in response I assert that this social interaction better represents how students' acquired knowledge might be recalled and applied outside of a research setting. The construction of knowledge, after all, is mediated by social interactions (Vygotsky, 1986). Moreover, observational evidence based on the fact that most students were paired with a different peer in the post-trip interview and yet offered personal responses with similar themes suggests the minimal impact of their peer on main ideas expressed. In several cases, the two students being interviewed seemed to hold a friendly competition, each eager to share more details of their memories and ideas than the other. To summarize, the paired interview technique appeared to help elicit student responses in a way that one-on-one interviews could not both by making students feel comfortable as well as by encouraging them to think in greater depth about their knowledge and understandings.

Yet another limitation to this study was the curriculum offered by the outdoor school. The program is such that students were divided into learning groups of about fifteen students, each with their own instructor. Therefore, students' experiences varied

depending on each instructor's teaching style as well as each group's scheduled sequence of lessons. Further complicating matters was the option for preferenced classes that "interest groups" offered individual students. Despite these confounding variables, students' experiences ultimately varied little in terms of content and lessons; the instructors' training clearly reflected in quite similar lessons and even similar metaphors and uses of humor. With regard to interest groups, the program design resulted in all students experiencing two of the four options offered (survival, squid dissection, team challenge, early Oregon studies) and among these, all students participated in at least one of the first three mentioned. It should also be duly noted that the model described above for curriculum and program design reflects a similar model used at most residential environmental centers. Therefore, the potential limitations described above as they pertain to program design can also be viewed as an affordance; in other words, a somewhat variable curriculum design is the norm and somewhat unique individual experiences are to be expected at most environmental centers.

Finally, as discussed earlier, as the researcher, I was the primary instrument of data collection and analysis and my background and biases, therefore, must be taken into consideration when interpreting this study. My background and choice of study quite transparently reveal my strong belief in the potential effectiveness of outdoor hands-on education programs.

Method of Data Analysis

As with all qualitative research, the design and the methodology for data generation and analysis in this study was adapted to best suit my line of inquiry and the context of the study. Although there is no universal approach to qualitative data analysis

even within grounded theory, this flexible research strategy is a key to ascertaining a deep and interpreted understanding of people's experiences (Snape & Spencer, 2003). Because this study is based in grounded theory, methods are, by definition, iterative which means that, in certain ways, it is impossible to discuss methodology without some discussion of results as well. Therefore, in keeping with qualitative research tradition, the approach that I employed in this study first involved systematically codifying student concepts. In an effort to seek patterns, many of the categories I used to distinguish student answers I identified during the data collection process. The emergent categories, therefore, better reflect the participants' ideas than a priori categories considered by the researcher. Student interviews were transcribed in a timely manner in order to capture as much detail as possible and to allow me to reflect on emerging patterns with better clarity as to the meaning and context of responses.

Themes

Recurring themes in the data were used to develop theoretical constructs representing students' nature conceptions. These themes were identified by employing standard qualitative methodologies in grounded theory, such as those described by Auerbach and Silverstein (2002), Ritchie, Spencer, and O'Conner (2003), Dey (1999), and Bogdan and Biklen (2003). The process of identifying themes began with the identification of relevant text. Relevant text was determined by including any interview transcript materials discussing nature in which nature was described in any way beyond lists of objects that comprise or are found in nature. All raw interview data related to the students' perspectives on nature (that is, all relevant student quotes responding to the prompt "nature" or discussing "nature") were grouped into repeating ideas under

headings borrowed from the most representative quotes. These groups of repeating ideas were, in turn, organized into themes from which theoretical constructs were derived. These theoretical constructs represent students' varied interpretations of nature and serve as a foundation for framing students' learning resulting from their outdoor school trip. Moreover, the themes students employed to discuss nature both before and after their experience offers perspective on these students' thought processes.

Breadth of learning

In order to address the central question of interest, that is, are students' conceptions of nature enhanced by an outdoor school experience, differences in students' responses before and after their experience were noted and classified. As a measure of students' change in breadth of learning about nature, key additions to students' nature concept were identified. Each of these additions can be easily summarized with one or two words, many of which represent new vocabulary acquired by students during their experience. These additions were, in turn, grouped into categories. For example, a student whose post-trip response to the prompt "nature", either in their writing, drawing, or interview, includes the additions plankton, tide pools, food chains, and dissolved oxygen would exhibit an expanded breadth of knowledge in four areas: organisms, habitats, processes, and non-living things.

Depth of learning

Also designed to address the central question of interest, a measure of student's depth of knowledge with respect to nature was recorded through the use of typologies created by comparing students' responses. Those responses with common features were

grouped together and ultimately summarized by a brief statement capturing their shared features. These typologies were subsequently labeled using an enumerated hierarchical scale for rapid reference. The assigned typologies were then reconsidered more carefully drawing on multiple responses provided by each individual. At this point, the researcher was then able to use a form of triangulation to determine which typology best described each student's conceptual understanding of nature both before and after their experience of outdoor school. In most cases, evidence for determining each student's typology was found in one of two places: the student's written description of "nature" or the student's interview response to the prompt "nature". Student's drawings of nature and other comments throughout the interview were further considered in categorizing each student's understanding. Due to the hierarchical format of the scale representing students' conceptions of nature and because the scale represents increasing complexity in how students think of nature, data taken from different responses did not present conflicting evidence for identifying the appropriate typology. Rather, the multiple sources of data were interpreted together as one composite representation of each student's conception. Thus, while an individual student's written description of nature alone might indicate a lower typology, further data taken from the same student's interview might reveal greater depth of the student's understanding. However, it should be noted that evidence from one source of data alone had to exhibit sufficient depth of understanding to qualify being identified with a higher typology than the additional data would suggest.

The use of typologies derives from the approach of phenomenology.

Phenomenology

> implies an interest in the variation and change in capabilities for experiencing the world, or rather in capabilities for experiencing particular phenomena in the world in certain ways. These capabilities can, as a rule, be hierarchically ordered. Some capabilities can, from a point of view adopted in each case, be seen as more advanced, more complex, or more powerful than other capabilities. Differences between them are educationally critical differences, and changes between them we consider to be the most important kind of learning. (Marton & Booth, 1997, p. 111)

Thus, the typologies employed in this study offer insight into students' ways of experiencing nature.

The methodology for creating typologies was modeled after a study by Loughland, Reid, and Petocz's (2002) in which students' conceptions of the term "environment" were identified and grouped. In their study, Loughland et al. developed categories based on schoolchildren's response to the open-ended statement "I think the word environment means. . . ." The authors are keen to note that the six conceptions they identify do not represent developmental stages in a laddered sequence of learning. Moreover, the categories they identify neatly divide into conceptions that suggest the environment is thought of either as an *object* or as a *relation* between people and the environment.

In this study "nature" was chosen as the keyword over "environment" because of multiple definitions of the word environment. Although both words have a wide variety of connotations, all of the appropriate uses of the word nature refer to some aspect of the physical world, natural phenomena and living things, whereas the term environment often includes surroundings, social circumstances or the ambiance of any given setting, not necessarily a natural one. Moreover, in pilot testing with fifth graders, the prompt "nature" elicited more relevant responses than "environment" as a consequence of the ambiguity with the term environment as described above. This initial finding of students'

inconsistent interpretations of nature versus the environment finds considerable accord with an earlier study involving interviews of similar age students in Britain; in their 1998 study, Bonnett and Williams noted much overlap in students' perceptions of nature and the environment but also acknowledge the term 'environment' was more readily associated with the (human) built world by some students. Ambiguities aside, as the terms 'nature' and 'environment' apply to the natural world, their usage is almost interchangeable. As Wals (1994, p. 179) aptly points out, "how the concept of nature exists *within* us," or in our minds, is worthwhile uncovering due the broad implications for how we interact with the world.

As Loughland et al. note with regard to categorizing student conceptions, "the aim is not to classify or categorise any individual participant as having a particular conception, but rather to illuminate the full range of conceptions held by the group of participants" (2002, p. 191). In the case of this study, the aim is to illuminate the range of impacts of an outdoor school experience on students' conceptions. While the various conceptions may not be described as developmental, they do represent increasing complexity. Thus, comparing typologies before and after an outdoor school experience offers a measure of the depth of students' nature conceptions resulting from their experience.

In order to further illuminate students' nature conceptions, one key pre-trip and one key post-trip quote was selected for each student. These quotes highlight student thinking with regard to nature and provide a glimpse of the raw data that serve as the basis for the typologies assigned and the key concept additions identified. Essentially, the inclusion of direct quotes contributes to the transparency of the data analysis process.

Factors affecting learning

Student responses were further coded in order to identify some of the emergent factors affecting the students' learning. These data were collected in four primary areas: (1) emergent misconceptions; (2) emergent influences discussed by students; (3) self-reported attitudes; and (4) independent variables derived from survey responses. Each of these areas of analysis was represented using tables and/or matrices containing sample responses.

Quotes were cited both to identify misconceptions as well as to contextualize student comments regarding influences on their nature learning. Quotes provide a forum for interpretation. Interpretation of misconceptions involved labeling each with keywords taken from the quotes, noting whether or not misconceptions stated in the pre-trip interview were corrected when read back to them, and brief commentary further contextualizing the quote and possible origin of each misconception. Interpretation of TV and book references similarly involved labeling each reference and adding brief comments for the dual purposes of contextualizing and characterizing each quote. One difference in the labeling of influences such as TV and book references was the use of coded labels to group these references into categories. Examples of coded labels include "career idea" and "nature on TV". "Career idea" indicates that the context of the quote was one in which the student's stated career goal was inspired by a TV program. "Nature on TV" indicates that the student's quote refers to TV scenes to describe nature.

Finally, additional matrices were created to record and illustrate survey results and other objective data, such as students' stated career goals, favorite part of the trip,

and self-reported increases in interest and understanding of nature, that might be best described as independent variables.

RESULTS

Introduction

The purpose of this study was to address the relative knowledge void in the area of children's conceptual learning about the environment resulting from an overnight residential environmental learning center experience. Specifically I was interested in measuring phenomenological changes rather than identifying changes in student learning based on responses to questions with predetermined answers or categories of answers. In other words, my goal for this study was to establish environmental concept areas as defined by students themselves. In so doing, this study offers insight into students' thought processes as well as the impact of social and affective dimensions of learning.

Data

Data compiled from students' interview responses, drawings, and writings on the topic of "nature" indicate gains in both breadth and depth of conceptual learning. In the summary of results that follows, I will attempt to illustrate, both visually and metaphorically, the extent of students' conceptual gains, the variability in gains, and the context in which these gains may be understood. Furthermore, I will discuss how students' conceptual understandings of nature may be further contextualized within the identified theoretical constructs in which these students frame their thoughts about nature. Finally, I will share additional data collected which indicate factors affecting students' learning.

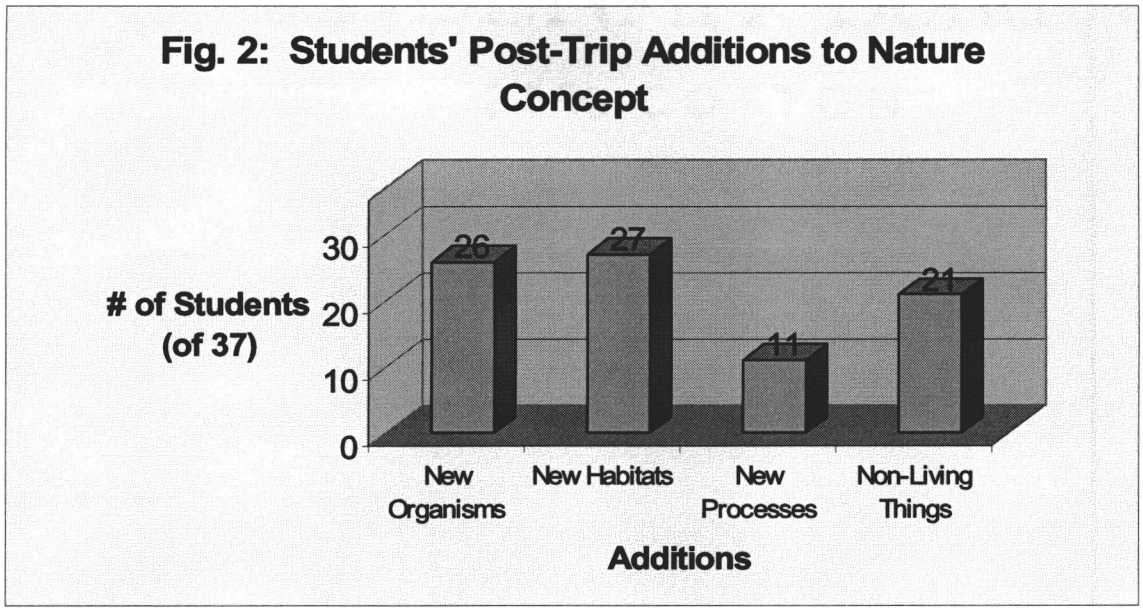
Breadth

With regard to breadth of learning about nature, all terms used by students to describe nature were identified and grouped to create four categories representing

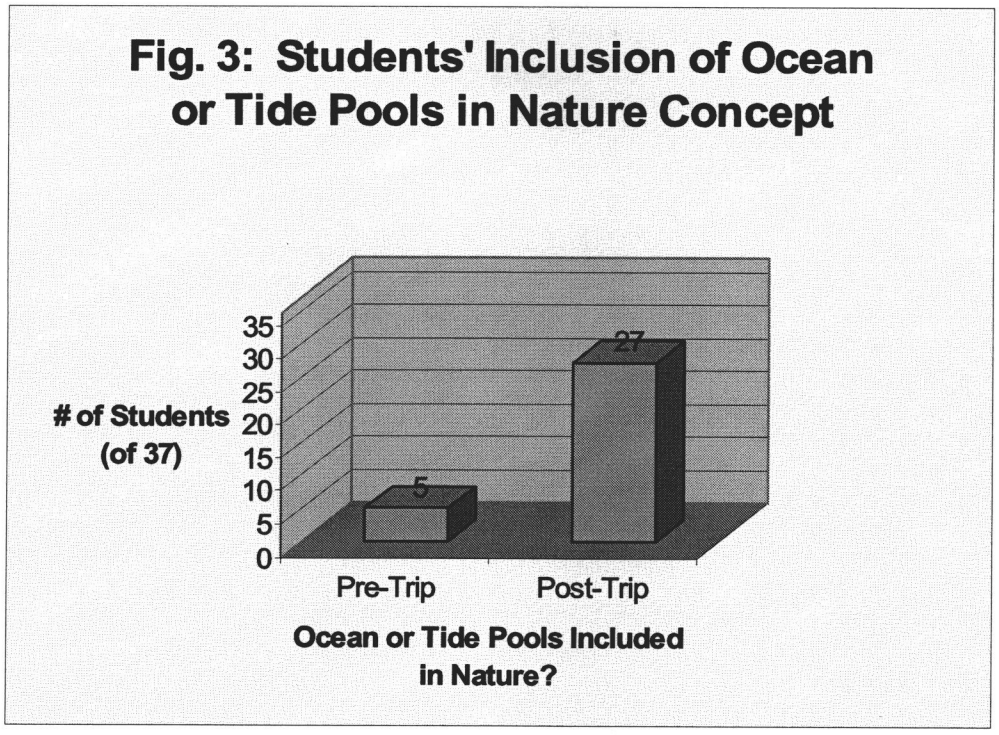
students' breadth of learning about nature. Students who included one or more new terms in any of the indicated categories (organisms, habitats, processes, non-living things) in their post-trip responses were considered to have added to their breadth of learning. Table 1 shows the responses which were used to measure breadth of learning about nature. Figure 2 illustrates that most students showed gains in three of the four categories represented. The average number of additions in the four breadth categories was 2.3 per student. Four students showed gains in all four categories while only one student showed no gains in breadth.

Table 1: Example Responses Used to Measure Breadth.

New Organisms	**New Habitats**	**New Processes**	**Non-Living Things**
Macroinvertebrates	Tide Pools	Food Chain	Rocks
Microvertebrates	Ocean	Water Cycle	Rain
Zooplankton	Rivers	Rain Shadow Effect	Dirt
Phytoplankton	Lakes	Decomposition	Water
Decomposers		Photosynthesis	pH
Water animals		Water Quality	Dissolved Oxygen
Humans			Sun
Sea Star			Moon
Sword Fern			Thunder
By-The-Wind-Sailors			Beach
Salal			
Oregon Huckleberry			
Sitka Spruce			
Skunk Cabbage			
Copepods			
Crayfish			
Water Boatmen			
Giant Squid			
Western Hemlock			
Limpets			
Barnacles			
Tube Worms			
Sea Anemone			
Oysters			
Hermit Crabs			



In a sub-category for habitats, I recorded how many students showed gains by specifically including "ocean" or "tide pools" in their conception of nature because of this habitat's relevance to Outdoor School's focus. Figure 3 shows that while only five of the thirty-seven participants included the ocean or tide pools in their pre-trip nature responses, twenty-seven included the ocean or tide pools in their post-trip responses. In other words, of the thirty-two students who did not mention the ocean or tide pools when responding to the prompt "nature" in the pre-trip interview, drawing and writing, twenty-two added "ocean" or "tide pools" to their post-trip responses. Reflecting on her learning in the post-trip interview, one student made the telling remark, "Oceans and tide pools are also part of nature. When I used think of nature I thought of animals, but now I also think about trees, rocks, bushes and oceans" [student 6].



It is important to note here that no data regarding the number of new organisms, habitats, processes, or non-living things were presented in this study because the methodology I employed does not provide a valid source of this information. Rather, the data collection techniques, as described in the methodology chapter, were specifically developed in accordance with other phenomenological methods to facilitate student responses which indicate different experiences rather than focusing on the extent of students' learning about one category of understanding. That is to say, I did not probe students during any of the data collection times in a way that encouraged them to enumerate each of the new ideas, for example each and every new organism, they discovered and learned about.

Depth

To measure change in students' conceptions of nature, I developed the following typologies based on common features in students' responses. These typologies are arranged in an ascending order representing increasing complexity of nature concepts expressed by the participating students.

Concept 1	Nature is a place that contains living things.
Concept 2	Nature is a place that contains living and non-living things.
Concept 3	Nature is a place that contains living and non-living things and humans.
Concept 4	Nature benefits humans.
Concept 5	Humans are part of nature and are responsible for it.

Table 2: Typologies representing depth of students' nature concepts.

Table 3 and Table 4 show key pre-trip and post-trip quotes that, by themselves, exemplify the features of one particular typology. As described in the methodology, each student's responses were considered as a whole before assigning a typology. Every participant's description of nature included or used living things to define nature. Trees and forests were among the most common elements employed by participants in both drawings and interview responses to describe nature. In fact, twenty-six students included trees, woods, or forests in their pre-trip interview response to "nature" and all thirty-seven students included trees in their pre-trip nature drawing. "Animals", often followed by lists of specific vertebrates, were also typical of most students' interview responses to the prompt "nature". Non-living things was broadly defined to include weather, celestial bodies, geographic features and landscapes—all features conspicuously absent from many students' descriptions of nature which, like similar but more advanced definitions, also included nature defined to include living things such as trees and animals.

#	Key Pre-trip quote(s)
1	"We need it to live, like air. Rain--it helps plants grow. Sun--it gives plants food."
2	"Trees--air for us to breathe. Fruits, berries."
3	"Trees, grass, water, plants, animals, outside and like fun stuff--swimming."
4	"Nature is everything that lives outside." "The forest. Anywhere you go to hike or ride bikes not near development."
5	"Trees, forests, animals, lakes, streams." "It's [nature's] what we usually do when we're outdoors."
6	"It is mostly living things like animals, trees, grass, etc."
7	"Gardens--it's natural because you grow things. Things you grow are natural."
8	"Nature means live things and some non-living things like streams and river rocks. Some wildlife, birds, squirrels, etc." "I like to garden. I like watching animals."
9	"Nature means trees, wildlife, and a place where no humans have constructed or built homes. Where the animals are free."
10	"You can camp in the woods, look out for animals."
11	"Plains and grass, little wild animals running around. Rivers, streams, peacefulness."
12	"[Nature] Reminds me of when my family goes on hikes in the forest."
13	When you're out in the forest, in nature, you're mostly likely to see [bugs, animals, trees, green, grass, leaves, twigs, branches, ponds, water, fish, fire]."
14	"Trees, poison oak. You're surrounded by the forest. Peace, no animals jump out at you."
15	"The word 'nature' looks like the whole environment."
16	"In nature not much is man-made. All animals living in a natural way. Trees growing without fertilizer."
17	"Forests, environment, animals, surviving, fun, interesting, learning pretty, relaxing, sounds."
18	"Flowers, trees, grass, outside, forests, sun."
19	"The environment and everyone who lives in it."
20	"To me nature means outdoors, birds, bugs, trees, water, beavers, caves, sounds of natural things and wild animals. Nothing man-made."
21	"Nature provides most everything from food to air, medication."
22	"Hiking through the forest, seeing animals."
23	"Flowers, green, trees, animals, wildlife, birds. Nature is green."
24	"Animals, habitat, land, forests, mountains, the sky, humans, anything that is not human-made."
25	"Undisturbed. . .environment, ecosystem. A place where you can walk and find animals. Places with food chains."
26	"Flowers, sun, sunlight, animals like deer, raccoons." "I'd like to get hands-on [with nature]."
27	"Plants, animals, trees, anything that's a growing thing."
28	"Area with not a lot of pollution. Lot of animals live there. Trees, plants."
29	"Earth is nature. Nature is trees, birds, animals, fish, grass, all the world."
30	"It [nature] means trees and rivers, animals and no machines."
31	"All rivers you play in. Types of homes, animals live in. Things you would eat if left alone in the forest."
32	"Something I can't explain--a feeling. Outside--nature is outside." "Camping, peaceful."
33	"Exciting, see new things. See different animals and have different studies. Animals in habitats."
34	"Outdoors, water, no pollution. Woods, fun, peace, gardens, environment, wildlife, wind."
35	"Every living animal out there."
36	"Plants, trees, things you'll see outside. Animals. Even dirt."
37	"fun, adventure, hiking, climbing, swimming, shade, trees, storms, oceans, plains, animals [etc.]"

Table 3: Supporting Quotes for Pre-Trip Typologies.

#	Key Post-trip quote(s)
1	"The food chain, it sorta helps everything survive." "Certain animals need certain climates--certain habitats to live in."
2	"In the lake there's fish and organisms and if that's their home I'm assuming the lake is part of nature--and raindrops make the lake--they're nature. And clouds make raindrops."
3	"I didn't know there were micro- and macro- scopic invertebrates before camp."
4	"Nature is a place where you go to see wildlife."
5	"I just like watching birds and fish when we go camping."
6	"When I used to think of nature I thought of animals but now I also think about trees, rocks, bushes and oceans, etc."
7	"There's more kinds of weather, animals, types of flowers, types of water--river, ponds, creeks, lakes. Plus forest, beach, you backyard--all types of nature."
8	"People go into nature and study it and understand it better."
9	"Weather, sky, space with planets, the ocean--because that's natural--humans didn't make it that way."
10	"Hiking, wetlands, bugs."
11	"People enjoying woods."
12	"Camping, campfire, roasting marshmallows."
13	"Camping is part of nature. It's relaxing to go on hikes."
14	"We had to go on all those hikes. I remember one type of tree that they taught me."
15	"I think of nature shows." "You can't kill everything because they're living creatures."
16	"Nature helps us to survive. Use it not wisely and it's gone."
17	"Always new things to see."
18	"I think of micro- and macro- things. What you can't see in the water and everything you can see."
19	"I just like to think...when I'm out in the woods and see the moon."
20	"Things grow on their own."
21	"Almost everything except watches, computers, cell phones are part of nature."
22	"We go hiking once every year with my family and a couple of friends." "It's [nature's] underwater; water creatures, they were freaky."
23	"Life, food, trees, new surroundings, erosion, rain, thunder, lightning, wet, sunny, cloudy, precipitation, wildlife."
24	"If endangered species is killed and they're another animal's prey then [consequences affect food chain]."
25	"A habitat and a niche where animals live in. Animals don't have to have small territory."
26	"Some animals have a low tolerance for pollution--that's how you could tell the water quality was good."
27	"Animals, everything that's out in the woods--not just little things."
28	"Nature could be in a small town. Probably wouldn't be a lot wildlife there and sometimes animals are afraid of humans." "Humans can protect nature."
29	"Everything that is living, not machines, computers, trains."
30	"It's [nature's] the undisturbed cycle of life."
31	"Squid live in the ocean, have their own habitats."
32	"I knew there were microscopic things but never thought of them before." "Fun, different kinds of weather, wildlife, plants, learning experience."
33	"You have to know how to survive to live out in nature, [know] what foods are edible. Adventure--you get to explore new things."
34	"We learned about pollution--it can make water really bad and kill insects and animals."
35	"Deer, birds, animals live everywhere."
36	"Wilderness, outside."
37	"All the habitats, the ocean, people need to preserve it, not build malls and houses and stores and stuff."

Table 4: Supporting Quotes for Post-Trip Typologies.

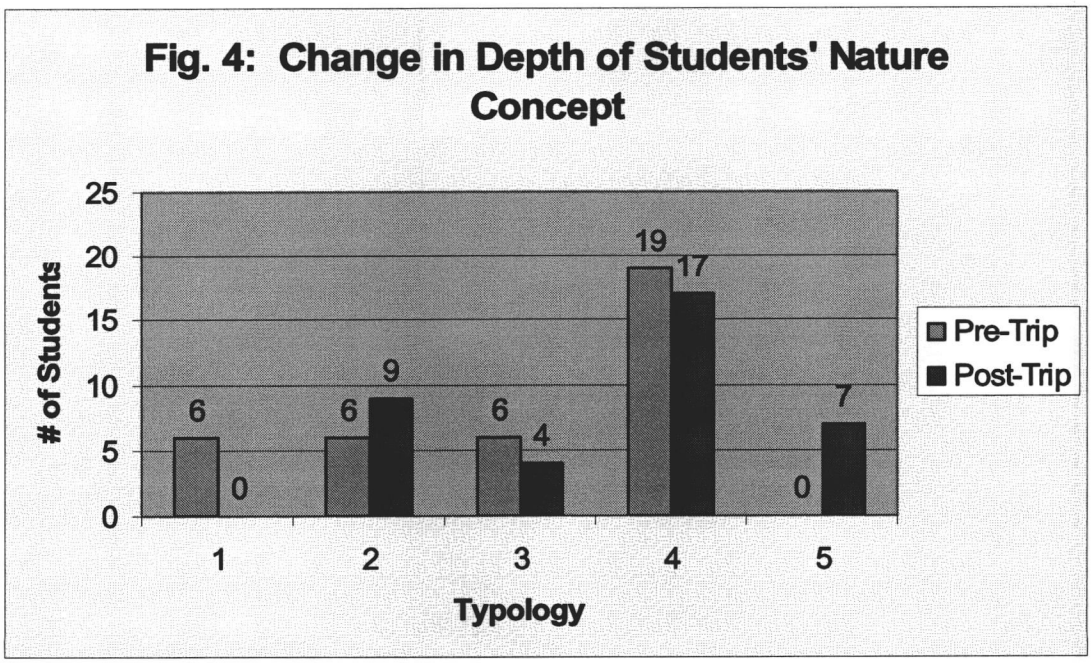
Students' responses which fit the third typology, nature as a place that contains living and non-living things and humans, contained common elements of the first two typologies, that is living and non-living things, but further included humans as part of nature. These responses, nevertheless, characterized nature as an object, or tangible thing identifiable by its physical components.

For students whose response fit the fourth typology ("nature benefits humans"), answers varied. These responses included all of the features of the less advanced typologies but also included references to the utility of nature for humans. For some participants, the utility of nature meant a place to find peace and relaxation whereas for others it meant a source of medicine. In order for a student to be classified with this depth of understanding about nature, these references to nature's utility had to offer sufficient detail to demonstrate the student's recognition of the value of nature to people. In other words, a simple comment such as "nature is fun" or "nature makes me think of camping," for example, would be insufficient evidence alone to elevate a student's classification from concept 2 or 3 to concept 4. Because these typologies represent depth of students' concepts, a discernable amount of depth of understanding had to be demonstrated to fit the identified typology. Therefore, this measure of learning defined as depth should not be confused with students' perceptions of nature, which are discussed below in the section entitled Themes and Theoretical Constructs and provides a larger context for interpreting students' thinking.

The fifth typology represents the most advanced conceptual thinking about nature demonstrated by any of the participants (and, therefore, does not necessarily represent the pinnacle of thinking about nature). In addition to including the central features of each of

the preceding typologies, students who fit this classification expressed some element of the need for human stewardship of nature. In some cases this concept was expressed as a need to protect endangered species while in other cases students discussed the impact of pollution and what people should do to mitigate their actions.

Based on pre-trip interviews, drawings, and writings, the average student concept level recorded was 3.0 with a median of 4. Based on post-trip data, the average student concept level improved to 3.6 while the median remained 4. Accounting for this improvement in average were thirteen students who showed gains in their conception of nature. A comparison of students' pre- and post-trip nature concepts is represented by Figure 4. Of note, all six students whose nature concept fell into the first typology (concept 1) showed gains. Also of note, prior to the Outdoor School trip, no students expressed an understanding of nature which indicated that people are part of nature and responsible for it whereas seven students demonstrated that level of understanding following the trip.



Individuals' pre- and post-trip typologies are represented in Table 5. Typologies 1 through 3 suggest a conception in which nature is characterized as an object, while typologies 4 and 5 suggest a human-nature relationship. Thus, Table 5 reveals that following their outdoor school experience most (twenty-four) students' view of nature might be characterized as a relationship whereas prior to the trip approximately half (eighteen) of the students' views of nature would best be characterized as an object. Furthermore, virtually all students' characterization of nature suggested a positive view (nature as "clean", for example), while for several students the prompt "nature" also brought to mind humans' negative impacts on nature, such as pollution and extinctions.

#	Pre-trip nature concept?	Post-trip nature concept?	Post-trip: Nature as object or relationship?	Nature good/clean or bad/polluted?
1	4	4	relationship	good
2	4	4	relationship	good
3	4	4	relationship	good
4	4	4	relationship	good
5	4	4	relationship	good
6	1	2	object	good
7	4	4	relationship	good
8	4	4	relationship	good--"untouched terrain"
9	2	2	object	good--but "we're building too much in animal habitat"
10	4	4	relationship	good--"you can enjoy it"
11	4	4	relationship	good
12	4	4	relationship	good--but "sometimes humans destruct [sic] nature"
13	4	4	relationship	good; fire threatens
14	2	2	object	good
15	3	3	object	good/clean--"you shouldn't mess it up."
16	2	5	relationship	good--use "wisely"
17	4	4	relationship	good
18	2	2	object	good
19	4	5	relationship	good--"we should take care of it"
20	2	2	object	good
21	4	4	relationship	good&bad
22	3	3	object	good
23	1	2	object	good
24	3	5	relationship	good--warns of destruction, pollutants
25	3	3	object	good--[should be] "not polluted"
26	2	5	relationship	good--"we should let it grow back"
27	1	2	object	humans causing extinctions
28	1	5	relationship	good--"humans can protect nature."
29	3	3	object	good
30	1	2	object	good
31	4	4	relationship	good
32	4	4	relationship	good
33	4	4	relationship	good
34	4	5	relationship	good&bad: "no pollution--it doesn't seem right what we do to [nature]"
35	1	2	object	good
36	3	4	relationship	good--"help put animals in better places, don't cause them to go extinct."
37	4	5	relationship	good--need to preserve

Table 5: Pre- and Post- Trip Typologies.

Themes and Theoretical Constructs

By grouping all the relevant text into repeating ideas (see Appendix H), four primary themes emerged as recurring ideas amongst many students' responses to the prompt "nature". These four themes represent the primary way in which these students frame their thinking about nature beyond simple descriptions of what is included in nature. The primary themes may be summarized by the following titles: (1) untouched terrain; (2) under threat; (3) recreation; (4) sensory. The first theme is characterized by a description of nature that is pristine and unaltered by human activity in any way. Typical participant ideas about nature falling into this theme use human-made structures as a contrast; in fact, many students employ the words "nature" and "man-made" as antonyms. Thus, nature may be defined by what it is not, that is, anything human-made. The second theme, nature as under threat, as the name suggests, is characterized by central elements concerning the loss of nature and natural areas due to human activity. The third primary theme to emerge, nature as a place for recreation, is characterized by descriptions of activities one can do "in nature", such as hiking and exploring. Finally, the fourth theme, nature as a place inextricably linked to the senses, is characterized by evocative memories or ideas about quiet, peace, smells or discomfort. Each of the above primary themes as well as emergent sub-themes are supported by archetypical quotes in Table 6.

Pervasive Theme	Highlight Quotes
Untouched Terrain/ Opposite human-made	"[Nature is] is untouched terrain." -8
	"Everything human-made is not nature." -37
	"It's the undisturbed cycle of life." -30
	"Things that haven't been tampered with by humans." -2
	"[Nature is] the opposite of the city." -16
Under Threat	"Use [nature] not wisely, and it's gone" -16
	"If we don't [protect nature] we won't be able to live much longer if we destroy it" -24
Recreation	"[Nature is] anywhere you go to hike or ride bikes, not near development." -4
	"Nature has lots of fun things to explore." -17
	"I didn't add 'relaxing' before because I didn't know about 'relaxing' because it's relaxing to go on hikes." -13
Sensory	"[Nature brings to mind] something else I can't explain—a feeling." -32
	"Some sounds are made by animals. I think sound is part of nature." -2
Sub-Themes	
Food/Medicine/Air Source	"In the beginning [food] comes from some kind of plant." -1
	"Nature provides most everything from food to air to medication." -21
Spiritual	"God's creation." -33
	"Nature is God!" -4

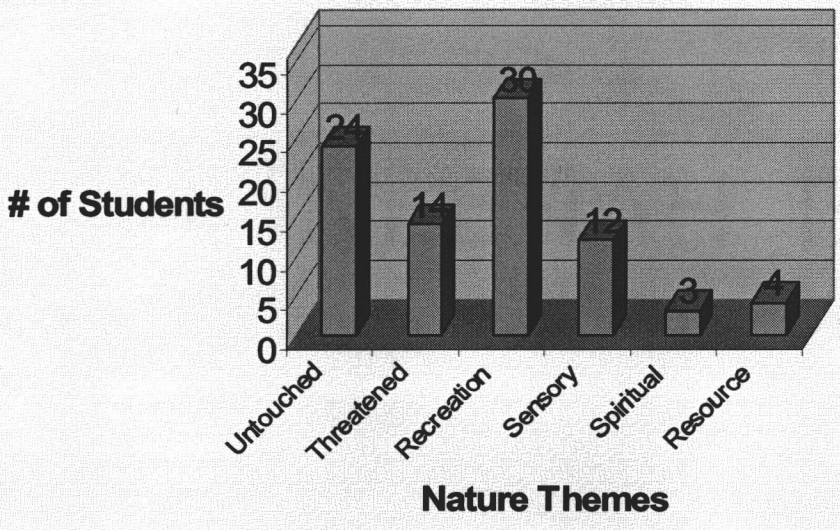
Table 6: Highlight Quotes Representing Themes.

The emergent sub-themes were classified as such due to their incompatibility with the above primary themes and their lesser degree of prominence among students' descriptions of nature. These sub-themes may be captured by the titles (1) spiritual; (2) resource. The first, spiritual, characterizes nature as a place either created by a higher power or a place where a higher power may be experienced. The second, resource, describes nature as a source of food, medicine, or air.

The number of students expressing each of the nature themes at some point during the data collection process is represented in Figure 5. The division between primary themes and sub-themes is notable; the first four categories of themes show twelve or more students employing each of these ways of discussing nature while the sub-theme

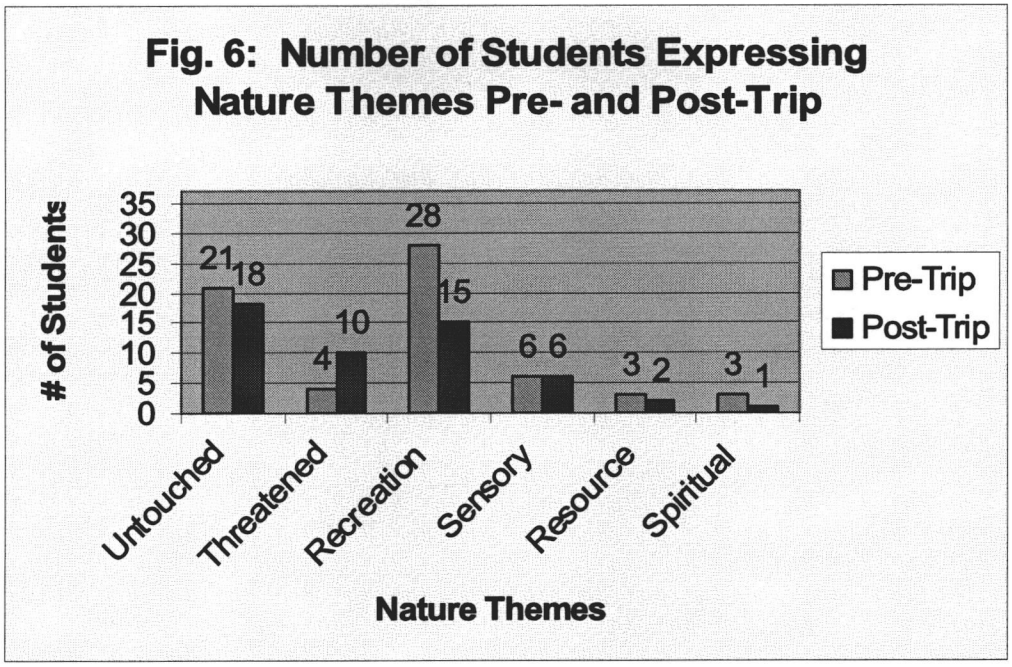
categories show no greater than four students employing each of these ideas. Two of the themes, untouched terrain and recreation, were expressed by a majority of participants. The average number of different themes utilized to discuss nature was 2.3 primary themes per student, or 2.5 per student including sub-themes. In other words, the typical student discussed nature using two or more of the four primary themes to describe nature. Only one student did not utilize any themes or sub-themes to frame her talk of nature, while twelve utilized only one primary theme. Of those twelve, five also utilized one of the sub-themes. Therefore, considering both primary and sub-themes, only seven students used but one.

Fig. 5: Number of Students Expressing Various Nature Themes



In another representation of themes, the number of students using each of the nature themes during the pre-trip and post-trip responses is presented in Figure 6. With

the exception of the theme threatened (or "nature under threat"), no themes were used by students more often in the post-trip responses to frame their interpretations of nature.



In order to glean deeper understanding of the emergent themes, the four themes and two sub-themes were organized into groups based on similarities, thereby creating theoretical constructs. The themes untouched terrain and under threat were grouped due to their common frame of reference to human materials and activities. The recreation and resource themes were grouped because of their similarities in defining human uses of nature. Finally, the themes sensory and spiritual were grouped stemming from their similarities in describing how nature is perceived and processed internally. The resulting theoretical constructs may be summarized as follows:

(1) Nature as something of value to humans
    (Themes: Untouched and Threatened)
(2) Nature as a special place incompatible with human activities

(Themes: Recreation and Resource)
(3) Nature as a place for personal exploration
(Themes: Sensory and Spiritual)

Considered in these more abstract groupings, at some point twenty-eight students described nature in terms of something of value to humans (theoretical construct 1), thirty described nature in terms of a special place incompatible with human activities (theoretical construct 2), and fifteen described nature in terms of a place for personal exploration (theoretical construct 3).

Additional Evidence of Learning

In students' post-trip interview response to the prompt "tide pools", twenty-eight participants discussed the various tidal zones: the splash zone, high, mid-, low, and sub-tide zones. No students discussed tidal zones in the pre-trip interview. The five different tide pool zones were presented in an interpretive slide show presented by OMSI staff and used as a basis for the structure of the information included about tide pools during the show. Moreover, students were exposed the various tidal zones and many of the unique organisms characteristic of each zone during their tide pool activity the following day. Finally, two pages of students' twelve page logbook/journal, which students were required to use and fill out, are dedicated to tide pools and discussing the tidal zonation.

Reacting only to the prompt "nature" during their post-trip interviews, one pair of students discussed how their learning from Outdoor School is connected to their every day life. Student 18 began this portion of the dialogue by mentioning when she thinks of nature "I think of micro- and macro-things, what you can't see in the water and everything you can see." Student 32 added "all the thingies you're drinking when drinking water. I knew there were microscopic things but I never thought of them

before." To this, student 32 replied "hopefully you have a tap. It's amazing how many tiny things a filter can catch!" Above there is clear evidence of students thinking about their learning experience and applying it to new and more familiar situations.

Finally, several example student drawings are presented in Appendix I. Pre-trip drawings were completed with a black pen, while post-trip additions and changes were done in blue. Among the most common additions were tide pools, the ocean, and organisms from this habitat, some of elements of which are included in each of the seven student drawings shown in Appendix I.

Factors Affecting Learning

Data collected about influences on students' learning from their Outdoor School experience includes four primary areas: (1) emergent misconceptions; (2) emergent influences discussed by students; (3) self-reported attitudes; and (4) independent variables derived from survey responses. Taken together, these data contextualize students' learning discussed above.

Misconceptions

Students' preconceived ideas are widely recognized to shape learning when new ideas are introduced (Driver & Bell, 1986). Table 7 highlights the misconceptions that emerged during pre- and post-trip interviews. Each misconception was categorized with a name; in some cases several students reiterated the same misconception as indicated by repetitious misconception names. A total of fourteen misconceptions were identified falling into nine categories and representing the misunderstandings of twelve individuals (see Table 8 below). Ten of these misconceptions were shared during pre-trip interviews,

while four were shared in post-trip interviews. The ten pre-trip misconceptions were expressed by ten different students and, among those ten, four revised their ideas when given the opportunity during post-trip interviews. Two of these four revisions completely corrected misconceived ideas. However, of the ten students given opportunities to revise their ideas in post-trip interviews, one student's misconception (on the topic of the ozone layer) was not covered in the Outdoor School curriculum while another student missed the activity best suited to address his misconception—exploring the tide pools—due to illness. Not surprisingly, neither of these students attempted to make revisions. Therefore, a better representation of these data is of the eight pre-trip misconceptions expressed by eight students dealing with topics covered in the curriculum, four addressed and revised their ideas. Of these four, two completely corrected their misconceptions.

Misconceptions	
Total	14
Categories	9
Individuals	12
Pre-Trip	10
# Revised	4
# Corrected	2
Post-Trip	4

Table 8: Misconceptions Totals.

Table 7: Misconceptions.

#	**Misconception**	**Quote**	**Comment** (Corrected if Pre-Trip Quote?)
2	friends	Pre: "[Tide pools are] one big place where everybody works together to keep it happening."	This student missed the tide pooling activity. This student clearly showed some in-depth knowledge of tide pools but the misconception here is one that indicates a idealized view of nature where no competition exists.
3	tide pool origin	Pre: "The ocean came during a storm. The waves that came were so big they filled the tide pools."	A subtle misconception because, of course, tide pools do fill with water when storms cause big waves. However, the misconception is that this is the *only* way tide pools collect water. No attempt to correct this in the post-interview, despite this student discussing the stormy weather.
8	tadpoles; sand	Pre: "I saw tadpole in one [tide pool]. I just saw things that look like tadpoles. I don't know if they were."; Pre: "I think of sand [when I think of tide pools]."	Post: Did not correct comment when recited. Like other students, tadpoles may be more familiar to this student than oceanic creatures, and the name 'tide pool' may recall 'tadpole'.; Post: Immediately corrected sand observation stating "there's no sand in [tide pools]."
9	tadpoles	Pre: "Tadpoles and some weeds [are found in tide pools]."	Post: Did not correct comment when recited. Asked directly: "Why did you say you saw tadpoles in tide pools?" Reply: "At the coast I saw them, in salt water, or maybe mutated bug larvae."
10	friends	Pre: "It's kind of like a little village for these animals because they get eaten in the ocean. Animals [in tide pools] don't bother each other. They're friends. They can give each other food."	Post: "It is really kind of a village, but only two hour one then they all go bye-bye. It's pretty sad." This student does not integrate competition ('war zones') ideas presented at Outdoor School. Similar to student 2, this student relates an idealized view of nature.
12	tadpoles	Pre: "Tadpoles--I found a tadpole in a tide pool once. I named it Gingerbear. We were playing in tide pools at the ocean."	Post: Did not correct comment when recited, but when asked directly "are tadpoles found in tide pools?" replied: "No, it just reminds me of tadpoles. [The thing I saw] was in rocks by a tide pole and the name reminds me." Note: the words 'tide pool' seem to suggest the word 'tadpole' to some students, perhaps not only due to the similar phonetics, but also the association of water.
16	decomposers	Post: Addition to picture shows slug labeled "decomposers".	Technically slugs are detritivores, although they play a role in decomposition. This appears to be repeated misinformation presented by OMSI staff.

Table 7: Misconceptions (continued).

21	ozone layer; decomposers	Pre: "If we didn't have cars we wouldn't have a problem with pollution--the ozone layer would form back together without cars." Post: "Without banana slugs we'd probably be standing in ankle high waste--they're decomposers."	Ozone: Student states valid scientific idea linking ozone layer depletion and cars, but oversimplifies the problem and mistakenly equates general air pollution and ozone layer depletion. Ozone not included in outdoor school curriculum and no follow-up. Decomposers: Same as student 21, technically slugs are detritivores, although they play a role in decomposition. This appears to be repeated misinformation presented by OMSI staff.
27	extinction	Post: "I heard at the zoo there's more extinct water animals than land animals. Over 100,000 water mammals die per year."	Student's experience at zoo clearly made an impression but somehow resulted in inflated idea regarding how many extinctions are occurring.
28	inland	Post: "Further inland I don't see as many micro- and macro-invertebrates as you would at the coast."	While not technically a misconception as spoken (saying "*I don't see. . .*"), this student suggests that invertebrates are less abundant inland. This interpretation probably stems from the fact that it was in this coastal environment that the student was first exposed to abundant invertebrates.
34	tide pool origin	Pre: "Other animals dug hole--water flowed up from rain or from other streams when flooded. Other rocks got dropped in by birds."	This student has never been to a tide pool before and weaves together several ideas (misconceptions) to explain how tide pools are formed. Like another student (35), this student postulates that flooding from rivers (something closer to home and therefore probably more familiar) cause tides that help form tide pools. Misconceptions addressed: "It's not a hole. . .I don't think rocks got dropped in by birds. They were there before. They were too big [for birds to drop them]. Water was there before, then animals came into it. Maybe people put animals in the tide pools. There was a lot of water there." This student revises mistaken ideas but doesn't have enough information to fully explain the origin of tide pools and, therefore, begins a new line of plausible but ultimately flawed reasoning (that people placed animals in tide pools).
35	snowmelt tides	Pre: "Water from the sea rises because of all the snow that comes from the mountains. All the heat melts it to go down in the rivers. In the morning the water is down. In the day the water rises, at night it goes back down.	Theory on cause of tides that, in turn, create tide pools. Appears to draw on more familiar knowledge of mountain/river environment and apply it to tides. Post: Does not correct theory but, rather, adds comments on moon causing the water to move. This student maintains two conflicting theories of tides.

Influences Discussed by Students

Television and Books

A number of influences on students' previous learning emerged during interviews. One prevalent influence was students' references to television and books. Each student who made a reference to television is quoted in Table 9 along with columns labeled "Pre- or Post- Reference & # Times," indicating when the remark(s) occurred, "Context," which indicates which question or prompt elicited the reference, and "Coding," which categorizes the various references into groups with similar content or themes using indicative names. Finally, in the column labeled "Comment" I offer further context and interpretation of each quote.

A total of sixteen separate television references emerged during the interview process, representing the comments of eleven individuals. Eight of the references to TV emerged in response to the prompt "nature" while an additional three references were made in response to questions about the student's interest or understanding of nature. Four additional references were made when the student was asked "what do you want to be when you grow up?" The last reference was made in answering a question about interest in Outdoor School. In sum, the majority of the references to TV occurred in the context of a prompt or question about nature.

The way in which references to television were employed varied. This is reflected in the number of categories (four) into which references could be grouped using the most parsimonious approach. Seven responses were grouped using the coding "nature on TV" because each of these references, in some manner, uses a description of a nature scene to relate some knowledge of nature. The coding "career idea" was used to

Table 9: TV References.

#	Pre- or Post-Reference & # times	Context(s)	Coding	Quote(s)	Comment
9	Post 1	grow up?	career idea	"[I want to be a] zoologist or animal cop from the TV show, or take care of animals and arrest people [for mistreating animals]."	TV show glorifies work of animal protection services and inspires student.
10	Post 1	grow up?	career idea	"Maybe [I want to be] an oceanographer because I like the ocean." *When did you decide that?* "Since I've been watching all the ocean shows on TV. They can go far down."	TV shows introduce and interest student in oceanography.
13	Pre 1	nature?	nature on TV	"Most animals die from forest fire. I watched lots of movies about Smokey the Bear in the 2nd grade. We talked about forest fire in school."	Relates nature learning from video seen in school.
14	Pre 1	nature?	nature on TV	"In Hawaii, forest, volcano--because I watch the news in the morning and saw an eruption."	Student's second thought that came to mind with 'nature' prompt.
15	Pre 1; Post 1	Pre: nature? Post: nature?	nature on TV; nature on TV	Pre: "TV, alright? A desert with owls. I think of TV because I've seen academic shows [about nature]." Post: "[When I think of nature, I think of] endangered species, birds like [my co-interviewee said]. Every time when I watch the news I see a lot. I think of nature shows"	Ideas about nature clearly informed by TV. Picture shows Mt. Everest, again, probably inspired by TV.
16	Post 2	Post 1: nature? Post 2: nature?	nature on TV; not all nature on TV	"The movie *Winged Migration* showed all kinds of birds, how they lived and adapted, how they swim. It showed nature right on. . . ."; "We don't get cable at my house--and we only watch movies because of all the trees around the house. Even if you're learning by watching TV, it's not nature."	In the first quote this student relates her knowledge of nature from a movie, then in the second quote suggests watching TV needs justification and there's no way TV can substitute for 'nature.'
23	Post 1	grow up?	career idea	"[I want to be a] paleontologist. I really like dinosaurs--ever since *Jurassic Park* movies four years ago."	Science fiction movie excites student about paleontology.

Table 9: TV References (continued).

25	Pre 1; Post 1	Pre: interest in nature? Post: Understanding of nature?	Pre: opposite nature Post: not all nature on TV	Pre: "I don't watch much TV. I only got a video game system this year and before I got the video game system I went out to watch birds get worms. I still do watch TV. I get limited time on the video game system." Post: "I like seeing different animals that aren't on TV or in pictures."	Pre: Defends his TV watching and video gaming (sense of guilt?) and contrasts it with watching things in nature, suggesting watching TV is the opposite or most removed activity from nature. Post: Suggest not everything in nature can be seen on TV; gives reason to explore nature.
26	Pre 1; Post 2	Pre: interest in nature? Post: nature?	Pre: nature on TV; Post 1: nature on TV; Post 2: opposite nature	Pre: "Sometimes frogs get in the house and we do 'wildlife rescues'--it comes from a show. . .I used to watch a good amount of nature shows"; Post1: "I've watched lots of nature shows that take you to places that haven't been touched by humans." Post2: "I saw a show comparing us to apes."; "I'm amazed how hooked on TV people are. I watch nature shows but we go two weeks in a trailer and live. We watch together as a family. [People] sit all day in front of TV or computers."	Student applies learning from a nature show to her behavior. Post1 quote again shows strong influence of TV. In the second post quote, we again see watching TV portrayed in a negative light and juxtaposed with time spent exploring nature.
28	Post 1	grow up?	career idea	"I want to go to a forensic college with forensic science classes. My grandma and I were watching *CSI*. I thought it was really cool. Even though it's fiction, it does teach a lot. The human has 206 bones."	TV show introduces and makes exciting a possible science career path and, as student notes, does inform.
36	Pre 1	interest in Outdoor School?	opposite nature	"It's fun to be in the wild, not to have technology and stuff because it's outside. There's no TV, no refrigeration to make your own food."	Technology, including TV, is described as the opposite of Outdoor School, which means "nature camp" to this student.

group the four references that cited TV shows as inspiration for future careers, all of which, notably, are science-based professions. "Not all nature on TV," which characterized two references, refers to students' comments that discuss the limitations of exploring nature by way of television watching. "Opposite nature," which characterized three references, groups comments that use TV as a contrast with nature (and, therefore, also fall into one of the aforementioned pervasive themes—"untouched terrain"—in which nature is characterized by students).

Each student who referenced books during interviews is quoted in Table 10 along with the same columns used in the previous figure. Four students made a total of seven separate references to books during the interviews. One student accounted for four of these references. The context of each student's references varied. Two students' book references were used to make the point that book learning, even about nature, is the opposite of Outdoor School learning, and therefore were grouped into "opposite Outdoor School learning." Two different students' book references suggest books are sources of information about nature, and therefore were grouped with the coding "nature info in books". Finally, student 16, who made a total of four separate book references throughout her interviews, used several book references to relate her understanding and expectations about nature derived from fictional novels employing a man versus nature theme.

Table 10: Book References.

#	Pre- or Post-Reference & # times	Context(s)	Coding	Quote(s)	Comment
1	Post 1	compare?	opposite Outdoor School learning	"If we were learning about plants we'd probably just look at them in books. In Outdoor School we get to see, feel, and smell them.	Keen contrast of learning in school versus outdoor school. This student recognizes the key benefit and inspiration for outdoor school programs.
16	Pre 3; Post 1	nature? (all 4)	fiction man v. nature; nature info in books	Pre: "We were assigned two books. In *Hatchet* animals didn't know humans except one animal. *Island of the Blue Dolphins* had a lot of synthetic things. In *Hatchet* [the protagonist] ate berries and didn't have things to survive. Others did in *Island*."; Pre: "I read books with pictures of nature."; Post: "So different from how we live now. You don't have tape or staplers in the forests--if we got stranded like *Hatchet*."	Fiction books treating a man versus nature theme inform this student's ideas and expectations about nature. This student keenly compares and contrasts the differences in the books mentioned, then relates experience of being in the woods at Outdoor School to one book in the post-interview.
18	Pre 1	understanding of nature?	nature info in books	"I don't spend that much time outside and don't read books about [nature]."	Suggests understanding of nature can come from time outside and/or books.
20	Pre 1	Outdoor School?	opposite Outdoor School learning	"[Outdoor School makes me think of] fun outside--not just books--hands-on experience. Nature as hands-on experience. Now social studies, math. Nature is used as a text book."	Suggests Outdoor School is the precise opposite of learning from books and, thereby, school learning.

Weather

Another emergent influence on students' learning appears to be related to the weather. In an average year, the Oregon coast receives about 100 inches of rain with an average of close to five inches in the month of May, the time of the participants' visit. Although rain is typical in Oregon's Willamette Valley where the participants live, this far exceeds the average rainfall of just over two inches, or less than half, for their home region. In addition, as one might expect, students spend considerably more time outdoors while on the trip than in a typical day. During the three days of their visit, the rainfall was considerable and included heavy downpours mixed with hail on the first day. Thus, in talking about their experience, fifteen students mentioned the rain in their post-trip interview and of those fifteen, nine students made references to the rain affecting their experience (Table 11). The comments by the eight students who mentioned the rain's impact summarily suggested that while the rain did not ruin their experience, they would have much preferred fairer weather and probably would have enjoyed the experience better had the weather been clearer.

#	Post-Trip Reference to Rain?	Reference to rain affecting experience?	Quote
1	Y	N	
2	Y	Y	It rained a lot there at camp.
3	Y	Y	[My interest in Outdoor School would be] high if the weather's nice. It was raining the whole time until the last day. It even hailed before it got sunny.
4	N	N	
5	Y	N	
6	N	N	
7	Y	N	
8	N	N	
9	Y	Y	I didn't want it to be raining.
10	Y	Y	It was raining all night--kind of annoying.
11	Y	N	
12	N	N	
13	N	N	
14	N	N	
15	N	N	
16	N	N	
17	N	N	
18	Y	N	
19	Y	N	It was raining almost the whole time.
20	N	N	
21	Y	Y	I wish there was little less rain and a little more sunshine.
22	Y	Y	[If I could, I'd return] if it wasn't raining so much.
23	Y	Y	[If I could, I'd return,] yes. It would be better in the summer.
24	Y	Y	[My interest in Outdoor School is] low because it wasn't that interesting and it was raining all the time.
25	Y	N	
26	N	N	
27	N	N	
28	N	N	
29	N	N	
30	N	N	
31	N	N	
32	Y	Y	"I went camping right after Camp Magruder and I was more prepared. I brought more rain gear, socks, and warmer clothes." "I added rain because it rained."
33	N	N	
34	N	N	
35	N	N	
36	N	N	
37	N	N	

Table 11: Rain References.

Self-Reported Attitudes

Toward the end of the post-trip interview students were asked to respond to the same three questions asked in the pre-trip interview regarding their interest in Outdoor School and nature, the results of which are displayed in Table 12. Furthermore, I used participants' response to the question "would you go back to Outdoor School if you could?" or "would you care if you missed Outdoor School?", as a basis for characterizing each student's experience as positive or negative. Students overwhelmingly agreed that their experience was a positive one. As shown, only one student unequivocally answered that he would not care if he missed the experience. All but three students reported an equal or higher interest in Outdoor School than prior to the trip. Twenty students reported an increased interest in nature as a result of Outdoor School while fourteen claimed their interest in nature remained equally "high." No students reported a decreased interest in nature as a result of their experience, and only one reported a low interest in nature before and after the trip. Twenty-seven students believed they increased their understanding of nature as a result of their experience. The final column of Table 12 offers insight into the activities or facets of the experience that most appealed to students. Notably, eleven students cited their visit to the tide pools as their favorite part of the experience, making the tide pools the most popular response.

#	Positive experience?	Self reported: Increased interest O.S.?	Self reported: Increased interest in nature?	Self reported: Increased understanding of nature?	Favorite part?
1	Yes	Yes	Yes	Yes	squid dissection
2	Yes	no/lower	Yes	Yes	pond/lake study
3	Yes	same/high	Yes	same/medium	squid dissection
4	Yes	same/medium	same/low	same/medium	campfire
5	Yes	Yes	Yes	Yes	nature walk
6	Yes	same/high	Yes/high	Yes	tide pools
7	Yes	Yes	Yes	Yes	tide pools
8	Yes	same/high	same/high	same/high	survival
9	Yes	Yes	Yes	Yes	tide pools
10	Yes	no/lower	same/high	same/high	tide pools
11	Yes	Yes	Yes	Yes	squid dissection
12	Yes	Yes	same/high	Yes	sand sea creature
13	Yes	Yes	same/high	Yes	food
14	Yes	Yes	same/medium	Yes	race to cabins
15	Yes	Yes	Yes	Yes	recreation time
16	Yes	same/high	same/high	same/high	early Oregon studies
17	Yes	same/high	Yes	Yes	tide pools
18	Yes	Yes	Yes	Yes	x
19	Yes	Yes	same/high	Yes	team challenge & survival
20	Yes	Yes	Yes	Yes	tide pools
21	Yes	Yes	Yes	Yes	early Oregon studies
22	Yes	Yes	Yes	Yes	sand sea creature
23	Yes	same/high	Yes	same/medium	squid dissection
24	Yes	same/medium	same/high	Yes	squid dissection
25	No	no/lower	same/high	Yes	tide pools
26	Yes	Yes	same/high	Yes	field studies
27	Yes	Yes/high	Yes	Yes	campfires
28	Yes	Yes	Yes	Yes	tide pools
29	Yes	same/high	Yes	same/medium	tide pools
30	Yes	same/medium	same/medium	no	tide pools
31	Yes	Yes	same/high	Yes	sand sea creature
32	Yes	Yes	Yes	Yes	x
33	Yes	Yes	Yes	Yes	sand sea creature
34	Yes	Yes	Yes	Yes	tide pools
35	Yes?	same/high	same/high	same/high	see ocean
36	Yes	same/high	same/high	same/low-med	being outside
37	Yes	Yes	Yes	Yes	sand sea creature

Table 12: Students' Self-Reported Interest.

When asked "how does Outdoor School compare with all the other things you remember about elementary school?" several participants made rather revealing comments regarding the import of their experience. Some of the most outstanding comments are quoted in Table 13.

#	Quote
1	"If we were learning about plants we'd probably just look at them in books. In Outdoor School we get to see, feel, and smell them. I won't forget about [my experience at Outdoor School]. It seems like you can learn a lot more about stuff that's nature related in less time. [It was the] best [activity] in all elementary school. I wouldn't want to miss it."
4	"One of the funnest things."
10	"[Outdoor School was] probably one of the best."
16	"I'll never forget it. We wrote a letter to ourselves [and have stuff] like OMSI's science book to remember [the experience], and even if it's recycled then we'll still remember it."
17	"[At Outdoor School they] have forest, tide pools, creatures. It's funner than what you've done in your life in school."
18	"Top. Best. It was more fun that I thought it would be: the counselors, with friends, going to the beach, the tide pools."
19	"I went to another outdoor camp before at a different school in New Zealand when I lived there and we went to tide pools, but this was better."
20	"[Outdoor School was] the best because we had the most responsibility in all grades."
21	"[Outdoor School was] probably the best thing we've ever done in elementary school."
23	"[Outdoor School was the] best so far in elementary school."
26	"Nature had always been open to me but now it's even more open—I've never seen those [by-the-wind-sailors] before."
27	"[Outdoor School] was the best. The most learning experience. This was for fun and learning so this was more fun. Usually field trips are just for fun."
31	"It was probably the best thing we did in elementary school."
32	"I learned a lot I will remember."
34	"[Outdoor School was] probably one of the most interesting things a teacher would let us do—that I've done."
37	"Outdoor School was probably the most fun."
	"You can learn more about nature [at Outdoor school] than in the middle of civilization. You can't really go in the woods when you're at school."
	"I'm never going to forget what I learned. I learned a lot [at Outdoor School]."
	"It was better than I expected. I didn't know we'd learn so many facts about trees."
	"Camp Magruder was better than I thought. I wish we had more time–an extra day or two. We could learn more and it was really fun."
	"I'll probably always remember sitting down in the campfire area where we saw the slide show."

Table 13: How does Outdoor School compare with everything else you've done in elementary school?

Independent Variables

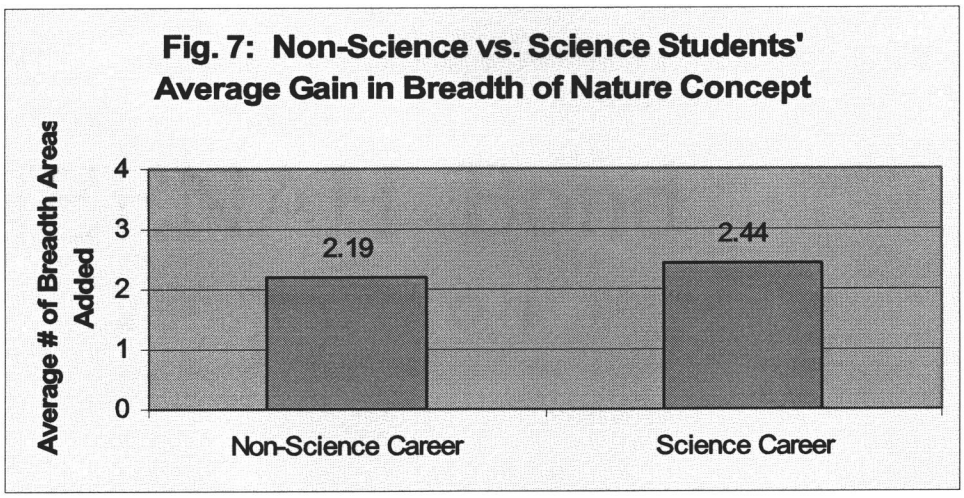
Although the study design for this research was to gather evidence regarding students' conceptual learning derived from their Outdoor School experience and to use this data to generate questions related to the way in which learning occurred (or did not occur) rather than attempt to correlate variables with students' learning, a minimal amount of data representing independent variables were collected. The data, shown in Table 14, summarizes the most useful of students' responses to survey questions as well as their responses to a closing post-trip interview question, "what do you want to be when you grow up?" As shown, sixteen students indicated they were interested in a science career of some sort.

#	Gender	Class Room	Career	Possible Science or Nature Career?
1	M	T	X-ray Tech or Veterinarian	Y
2	M	C	Sportscaster	N
3	M	C	?	?
4	F	T	Soccer player, coach	N
5	F	C	Zookeeper, Veterinarian	Y
6	M	T	Athlete or lawyer	N
7	F	C	Soccer player, own ice cream store	N
8	F	C	Zoologist	Y
9	F	C	Zoologist or animal cop	Y
10	M	C	Oceanographer	Y
11	M	C	Pro athlete	N
12	F	C	Food Science?	Y
13	M	T	?	?
14	M	C	Race car driver or computer engineer	N
15	M	T	Basketball player, rapper, actor	N
16	F	T	President	N
17	M	T	Basketball player	N
18	F	C	Veterinarian	Y
19	F	T	Lawyer, chef, gymnastics instructor, artist or detective	N
20	F	C	Teacher - 2nd grade	N
21	F	T	Photographer or Oceanographer	Y
22	F	T	Artist or pet shop	N
23	M	T	Paleontologist	Y
24	F	T	Veterinarian, Zoologist or musician	Y
25	M	C	Artist, Farmer or Potter	N
26	F	T	Oceanographer	Y
27	M	T	Lawyer	N
28	F	C	Forensic Science	Y
29	M	C	Archaeologist or Primatologist	Y
30	M	C	Fantasy Author	N
31	F	T	Veterinarian	Y
32	F	C	Lawyer	N
33	F	T	Veterinarian	Y
34	F	C	Veterinarian or horse racer	Y
35	M	C	Army	N
36	M	C	?	?
37	M	T	Athlete or computer engineer	N

Table 14: Independent Variables.

Correlations

Using the few explanatory variables gathered, two sets of suggestive correlations surfaced: one between students who said they were interested in a science related career and these students' gains in breadth and depth when compared with those students who indicated interest in non-science related careers, and one between females and gains in depth. Figure 7 reveals that, on average, the sixteen students with interest in a science career made more gains in the breadth of their nature concept than the twenty-one students with no stated interest in a science career. The students interested in science careers averaged 0.25 more breadth area additions (of a total of four possible) than those students interested in non-science careers. Figure 8 shows that, on average, students who said they were interested in science careers started with a deeper nature concept and ended with a deeper nature concept than their classmates. Moreover, these potentially science bound students showed greater gains in depth on average. The data show that students interested in science careers began with a pre-trip typology 0.18 higher than their classmates and ended with a post-trip typology 0.38 higher than their classmates. In other words, students who indicated an interest in a science related career improved the depth of their nature concept by 2.1 times that of their classmates.



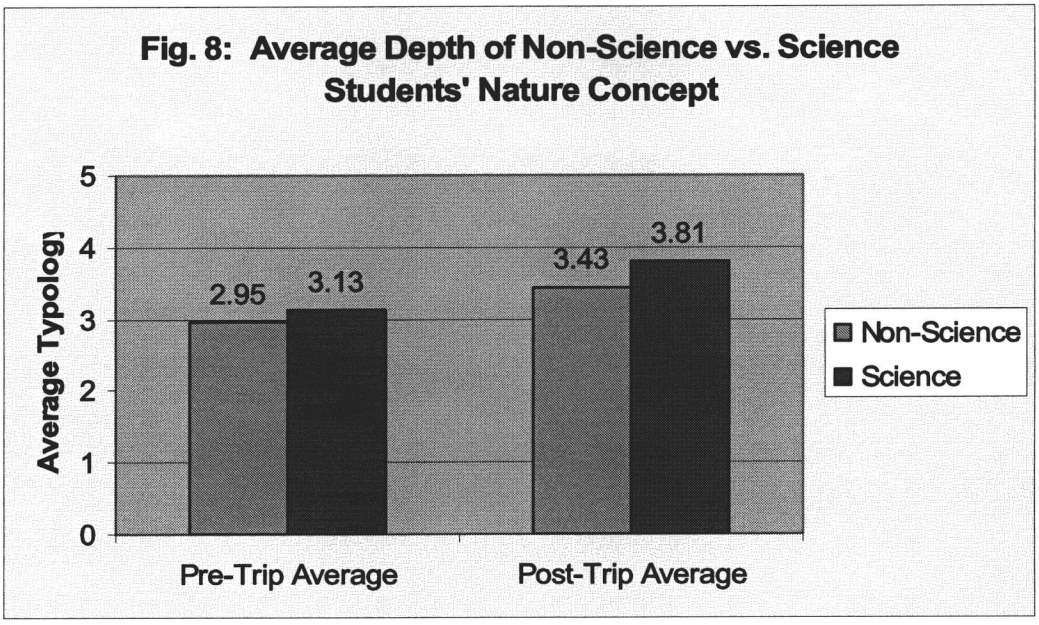


Figure 9 shows that male students exhibited slightly more gains in breadth of their nature concept on average. Figure 10 shows that female students began and ended with a deeper nature concept on average. Furthermore, females' made greater gains in depth on average. Female students began with a pre-trip typology 0.38 higher than the male students and ended with a post-trip typology 0.73 higher. Therefore, female students improved the depth of their nature concept by 1.92 times that of male students on average.

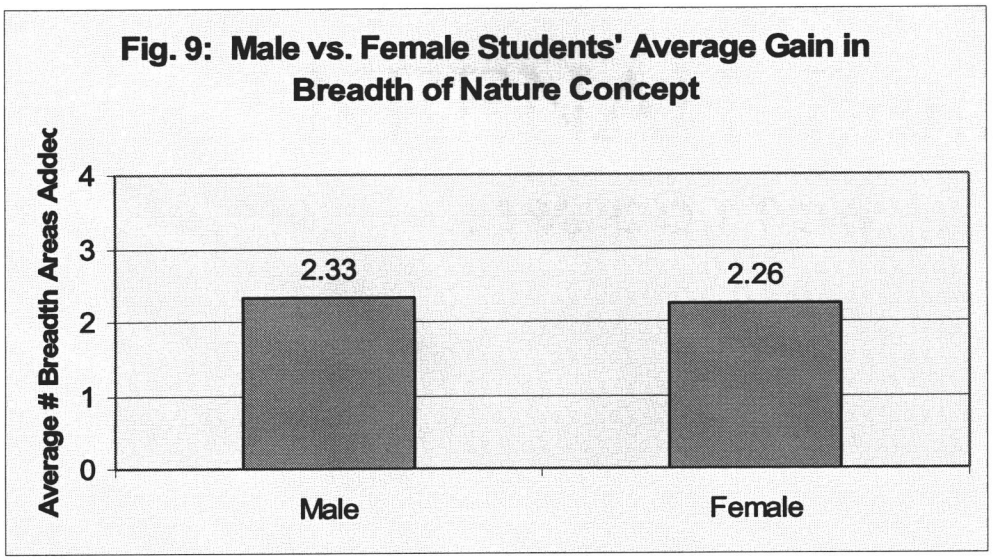


Fig. 9: Male vs. Female Students' Average Gain in Breadth of Nature Concept
Average # Breadth Areas Addec
4
3
2
1
0
2.33
2.26
Male
Female

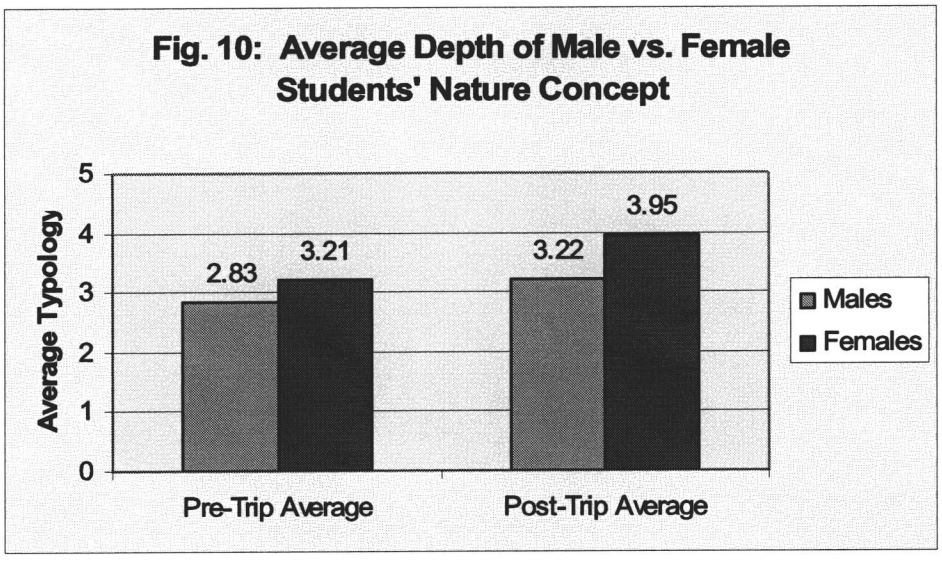


Fig. 10: Average Depth of Male vs. Female Students' Nature Concept
Average Typology
5
4
3
2
1
0
2.83
3.21
3.22
3.95
Pre-Trip Average
Post-Trip Average
Males
Females

DISCUSSION

The findings that best address the primary question of interest, that is, do students' experiences of an overnight environmental education program impart new environmental concepts, are represented by Figures 2 and 4. Looking at these two figures alone, it is evident that students made gains in both their breadth and depth of understanding about nature. The extent, context, and significance of these gains can be best understood in light of the additional results presented.

The implications of the gains in breadth represented in Figure 2 must be interpreted in the context of the methods used to gather these data. First, the four breadth categories were identified based on the range of vocabulary used by participants in responding to the prompt "nature". Therefore, these four measures of breadth do not necessarily represent the only categories that can or should be used to measure breadth of nature conceptions; rather, these categories represent the range of the types of ideas included in nature descriptions by this sample of participants. In other words, this population of students described nature using words which could be classified into one of the four broad categories shown. Hence, the evidence that this population of students thinks of nature in terms of these four identified categories represents a valuable finding unto itself.

Another aspect of interpreting the gains shown in Figure 2 that must be considered is that these gains were measured by repeating the same techniques to gather data before and after the Outdoor School trip. In each phase of post-trip data collection, each student's previous pre-trip responses to the very same prompts were presented to him or her and then he or she was given the opportunity to expand on these responses. If

the student was satisfied with his or her previous response, the student was instructed to indicate this, and in several cases students did so. Moreover, it should be noted that these data represent students' additions to their concept of "nature" and not Outdoor School. This point is worth underscoring because one would not expect students to possess much foreknowledge of Outdoor School whereas students' knowledge of nature presumably represents their lifetime of experiences. Therefore, the gains shown are best attributed to students' learning about nature from Outdoor School.

Given the above context, the fact that thirty-six out of the thirty-seven participants in the study showed gains in breadth of their nature concept should stand out. Moreover, the facts that most students showed breadth gains in at least two categories and over half of the students showed gains in three of the four emergent categories indicates that the experience of Outdoor School contributed in a dramatic way to this aspect of students' nature learning.

The representation of students' inclusion of one specific habitat, "tide pools" or the "ocean", in Figure 3 offers a more specific glimpse into students' gains in breadth. The ocean/tide pools is a central part of the curriculum and experience at Outdoor School. Only five students included the "ocean" or "tide pools" in their description of nature quite possibly because the students in this study live in an inland environment and typically interact with the ocean very little. In other words, prior to their trip to Outdoor School the ocean was not something associated with nature for most students in this population. Yet, following their trip twenty-two additional students made this association thereby indicating the impact of these students' experiences.

The significance of participants' inclusion of the ocean in their nature conceptions merits comment. By freely associating the ocean with nature without direct probing, participants reveal a line of conceptual thinking that suggests a closer connection with the ocean than participants who did not include the ocean in their nature conception. Although speculative at this point, it seems likely that habitats that people more immediately associate with nature, such as the ocean, would most likely factor into these people's decision making more prominently. There is evidence to suggest that environmental ideas are formed early in life and often change very little (Keliher, 1997). Further evidence indicates that visits to the ocean correlate with ocean literacy (Steel et al., 2005). Today many decisions that affect environments such as the ocean are made with little, if any, real contact or interaction with that environment. Therefore, the association and corresponding connection that young people make with a new habitat such as the ocean may be indicative of future behaviors.

Similar to the observed gains in breadth, the observed gains in depth must be considered in the context of the methods from which they were gathered. As detailed in the methodology, each student's individual typology was identified by considering all of the responses made by that student regarding nature. Because the typologies represent students' nature conceptions—something that is not easily elicited and not as succinctly expressed by participants as defined by the emergent typologies—multiple opportunities for students to elaborate on their ideas about nature were necessary to more fully capture their understandings of nature. Since each of the higher order typologies includes elements of the lower order typologies, large portions of students' responses often indicated lower typologies. In other words, often key quotes were identified which

offered insight into the depth of each student's thinking about nature beyond the level of understanding expressed otherwise (see Table 3 and Table 4). In many cases these quotes were taken from the interview response to the prompt "nature" while others were taken from student's writings about nature. Student drawings typically helped confirm each student's assigned typology but in some cases were also used to identify the appropriate typology. The image of a person mountain climbing in student 1's drawing (see Appendix I), for example, would suggest this student should be assigned a typology no lower than 3.

Just as in the technique described above for identifying students' breadth, the data used to characterize students' nature conceptions before and after their trip came from the very same prompts. Therefore, using this rather comprehensive methodology, the emergent typologies should be considered highly valid representations of not only the individual students' level of understanding but also the range of conceptions held by students in this population. Again similar to the identified areas of breadth of nature concepts, the emergent typologies identified in this population of students does not necessarily represent the entire range of possible conceptions of nature held by a broader population. However, the five typologies identified within this population stand alone as an important finding. Moreover, the finding that only typologies one through four were present before the Outdoor School trip and only typologies two through five were found after the trip indicates the impact of the experience on the populations'—not just the individuals'—depth of conceptual thinking about nature.

The pattern of gains in depth of nature concepts merits discussion. First, the number of individuals showing gains in depth (13) was considerably fewer than those

showing gains in breadth (36). Of those students who made gains in depth, almost half (6) exhibited the lowest typology during pre-trip responses thereby suggesting that individuals with the least profound conceptions of nature were most predisposed to this form of learning. Furthermore, the fact that no students expressed the idea that people are part of nature and responsible for it (typology 5) prior to the Outdoor School experience suggests the ability of this experience to elevate students' understandings in way that further expands their connection with nature. Approximately half (6) of the observed gains in depth represent a change in thinking of nature as an object to that of a relationship.

A universal pattern among students' description of nature was the inclusion of trees, hence the origin of the most basic nature concept, nature as a place that contains living things. The consistent association of nature and trees, although universal among this population, should not be presumed to be universal amongst all populations. Students' nature conceptions derive from personal experience (that is, learning) and trees are virtually ubiquitous in this populations' home environment, which most students have known as their only home. The inclusion of non-living things, such as water and rocks, was not universal amongst students' pre-trip responses, and no students mentioned non-living things without also discussing living things as part of nature. The significance of including non-living things in one's nature concept is not immediately apparent. However, when one considers the role of abiotic factors (that is, a subset of non-living things including things like water, oxygen, weather), geologic features and landscapes (including such things as rocks, mountains, deserts) and celestial bodies, such as the sun and moon, in determining the diverse environments and natural processes found

throughout the world, the higher level of understanding represented by the inclusion of non-living things becomes more evident. Students who discussed living and non-living things in discussing nature expressed, to some degree, an appreciation for the role of these non-living things, hence distinguishing themselves from students only referring to living things in discussing nature.

The distinction between the third typology, nature as a place that contains living things, non-living things, and humans, is more than just a semantic difference. Responses which included humans were qualitatively different because they represented the thinking of students who saw themselves as part of nature and, to a certain degree, governed by the same principles and processes that affect all nature. While these students still maintained an object view of nature, the ideological difference between people who include humans in their nature concept versus those who do not signifies potentially major differences in the way one makes decisions and interacts with the world.

The concept that nature benefits humans (the fourth typology) implies another ideological shift in students' thinking. Drawing on the elements contained within the three previous lower order nature concepts, students expressing this concept further recognize a relationship in which some of those elements benefit people. In this conception nature is perceived to have extrinsic value. The use of this conception would seem to suggest a certain degree of ambiguity regarding the inclusion of humans with nature because if something from nature helps people, the logic follows, humans must therefore be apart from it. This ambiguity was certainly perceptible among some responses and will be discussed below in light of the emergent themes. The structure of

phenomenology is such that the hierarchy of emergent conceptions is additive and does not represent such ambiguity well. Therefore, responses in this typology were classified based on the prevailing expression of nature demonstrating thinking consistent with the concept that nature benefits humans. Hence, it seems logical to conclude that someone who places value on nature—whatever their concept of nature should happen to include—would be inclined to make decisions about it accordingly.

Finally, the highest order concept observed in this population characterized by the typology "people are part of nature and are responsible for it" conveys an understanding of nature in which the individual not only describes a human-nature relationship but, moreover, an obligatory need for the stewardship of nature by people. While this concept of stewardship was expressed in a variety of ways by seven different students following the trip, each student indicated some sort of personal connection with nature. Therefore, one might predict students exhibiting this typology would be most likely to become actively involved in stewardship.

In summary, the five emergent typologies of nature conceptions are not arbitrary distinctions assigned based on the ease with which they could be distinguished in the data; rather, they represent qualitatively distinct ways in which individuals think about nature. And the ways in which an individual thinks about nature, that is the depth of the conceptual framework from which an individual operates, might be used to predict an individual's behavior with respect to the environment.

The emergent typologies used to group and characterize the depth of students' nature concepts should not be regarded as developmental stages. This explains how four students showed gains which elevated their depth of understanding by two or more

concept levels. Although there was no evidence that students who showed gains could revert to lower concept levels, this possibility should not be discounted. The long term effects of students' learning from Outdoor School are unknown. However, based on students' comments in Table 13, the experience is one they are not likely to soon forget. And the experience itself, rather than any particular lesson, appears to be the source of students' heightened nature conceptions. Notably, the message that humans are responsible for nature was never overtly presented at Outdoor School. The modest gains in depth may indicate that the relatively brief experience (approximately forty-eight hours) of Outdoor School may not be sufficient time for participants to greatly expand the depth of their nature concepts. However, for the students who showed no gains in depth, there appears to be evidence that these students reinforced their pre-existing nature conceptions. For example, several students used new examples based on their experiences to express their understanding of nature despite the fact that these new examples did not exemplify gains in depth. In one such example student 33 referred to the value of learning about edible plants in the post-trip interview. In another example student 8 referred to people going into nature to study it and better understand it. In both of these two cases, the source of the students' new ideas can be easily traced to their experience: instructors taught about edible plants and survival and much of the experience involved "going into nature to study it." Students' use of new examples to reinforce nature concepts might be considered yet a different measure of learning not considered in this study.

By contrast to the results of this study, Loughland et al. (2003, 2004) found that the vast majority of students view the environment as an object rather than as a relation

by using a similar phenomenological approach to classify responses. Although Loughland et al.'s study included an impressive sample size of 1734, another significant difference in methods was that the emergent typologies used were based on school children's response to the singular survey question "I think the term/word environment means. . . ." Some other differences in Loughland et al.'s methodology must be considered as well: the use of the word "environment" rather than "nature", the subjects included students from Australia in years 3, 6, 8, and 11, and no particular intervention or experience was involved. Nevertheless, some similarities in findings were found as well.

Loughland et al. (2003) identified six conceptions of the environment:

Object Focus

- Conception 1: The environment is a place.
- Conception 2: The environment is a place that contains living things.
- Conception 3: The environment is a place that contains living things and people.

Relation Focus

- Conception 4: The environment does something for people.
- Conception 5: People are part of the environment and are responsible for it.
- Conception 6: People and the environment are in a mutually sustaining relationship.

Supposing for a moment that "nature" and "environment" are interchangeable (an unresolved argument), four of the above conceptions equate with ones found in this study while the most outstanding differences in typologies are Loughland et al.'s findings of lower and higher conceptions. The lowest conception exhibited by students in this study would equate with conception 2 above. Meanwhile, the highest conception found in this study would equate with conception 5. The absence of nature/environment conceptions representing the extremes could be explained by the difference in sample sizes; this study including but thirty-seven subjects may have excluded students representing the tails of the curve of a normal distribution. However, this explanation does not thoroughly

account for the differences observed in which only 12% of students in Loughland et al.'s study showed a relation conception whereas 51% of the students (and 65% following Outdoor School) in this study can be characterized with such an understanding. While some of this disparity may be attributed to differences in populations examined, I submit that the difference primarily reflects the two unique methodologies.

In Loughland et al.'s study some students' conceptions were classified based solely on a one word response. By contrast, I classified students' conceptions based on data collected using three distinct techniques (drawing, definition, and interview) thus resulting in a relatively large and rich source of data for each student. Given the richness of this data, I found no evidence that any students conceived of nature as a place and nothing more. The richness of the data also most probably accounts for the difference in depth, or complexity, observed between the two studies. In other words, I suggest that Loughland et al.'s study significantly underrepresents the depth of students' conceptions of the environment. Given that this study showed students generally have more complex conceptions of nature, the absence of any conceptions equating with the most complex understanding above, conception 6, represented by 0.7% of students in Loughland et al.'s (2003) study, may be attributed to its apparent rarity. One other notable difference in typologies should be noted, and that is the emergence of the third typology described above and which does not equate with any of previously described conceptions.

In contrast to Loughland et al.'s findings and similar to findings reported by Sebba (1991) and Bonnett and Williams (1998), all students in this study expressed positive characterizations of nature. While students did discuss some negative human

impacts, these students did not characterize nature itself as negative. Again, this distinction was an affordance of the richness of the data.

In patterns that are not particularly surprising but certainly noteworthy, both female students and students with interest in a science career showed greater depth of nature conceptions and greater gains in depth, while only aspiring scientists also showed greater gains in breadth than their respective counterpart. Before proceeding with this discussion, a word of caution: these data, while empirical, are representations of qualitative findings which have been assigned to numerical categories (the hierarchical phenomenological scale) and averaged, thereby limiting the inferences one can draw. In other words, the data used to show differences between groups in both breadth and depth of nature conceptions were not collected with this purpose in mind because, after all, they are phenomenological findings intended to show the range of conception within a single group; however, these data are presented here because they are suggestive and relate to previous findings.

The finding showing a gender difference favoring females' environmental learning resulting from residential programs has also been reported by Burrus-Bammel and Bammel (1986) and finds particular accord with results presented by Loughland et al. (2003). The idea that nature is available for exploitation (elements of which may be contained within the fourth typology) tends be assumed by young boys whereas young girls tend to consider the rights or needs to utilize nature (Barron 1995), perhaps inclining girls toward the fifth typology. These preferences may reflect the way in which boys and girls are socialized. Tikka, Kuitunen, and Tynys (2000), who found in a study of college and vocational students that females show a more positive attitude toward nature and take

greater responsibility for nature in their actions, suggest this phenomenon might be attributed to underlying concepts of traditional gender roles in which females care for the environment in much the same way they care for a child. In considering the other correlation, interest in a science career may correspond with greater interest in nature, which is seen as related to science. Consequently, this interest translates into greater learning. Tikka et al. (2000) similarly found high correlations between biology students, interest in the environment, and knowledge. The association of nature with science is certainly perpetuated by many of the lessons included in the Outdoor School curriculum including Aquatic Ecology, Tide Pooling, and Sandy Beach. This association may also derive from the teachers' common emphasis on ecological concepts to teach EE lessons (Disinger & Roth, 1992).

Themes

The nature themes employed by students further help contextualize students' thinking and therefore offer insight on the breadth and depth data. When students employ any of the themes to describe nature, their descriptions are far from value-free. Thus, the use of descriptions which fall into any of the identified themes also indicate biases. These biases, or perspectives, derive from students' experiences with nature. Therefore, the most predominantly employed themes suggest students' own experiences and learning about nature. The data in Figure 5 which show recreation as the most utilized theme suggests that most students in this population have experienced nature through some form of recreation and, moreover, this experience comes to mind when they think about nature. Similarly, a large portion of the participants referred to nature as untouched terrain and used human-made materials and structures to contrast with nature.

Again, this suggests students' have experienced nature as an environment defined by what it lacks, that is, the absence of some of the most familiar things in their daily lives, and this is what comes to mind in considering nature. When using theoretical constructs to consider student perspectives on nature the larger abstraction, "nature as a special place incompatible with human activities" including the themes untouched terrain and under threat, was employed almost equally with the construct "something of value to humans" including the themes recreation and resource, while the construct "nature as a personal exploration" was utilized considerably less frequently. All of these observations shed light on students' nature concepts. When an individual exhibits gains in breadth by incorporating additional organisms, habitats, processes, or non-living things into his or her nature concept, these additions are processed through the lenses of various perspectives summarized by the identified themes. Similarly, when an individual exhibits gains in depth by expanding her or his conceptual paradigm for nature, this too must be processed through the individual's evolving perspective. In summary, students' use of theoretical concepts offers students a framework to process and assimilate new nature concepts.

As discussed above, the emergent themes identified from students' responses to nature reflect students' own experiences and learning about nature. However, the data showing the frequency with which students used the various themes (represented in Fig. 5) may not fully represent the frequency with which students use these perspectives to process new nature stimuli. One reason for this speculative suggestion is the somewhat surprising infrequency with which students used certain themes such as "sensory", "spiritual", and "resource". Following such an experience in which students were

immersed in a natural outdoor setting, one might expect more references to the affective qualities of nature, whether their experiences of nature were appealing or discomforting, yet the same number for students used the sensory theme before and after the trip (see Fig. 6). Reinforcing the idea that children would frequently employ a sensory theme when discussing nature, Sebba notes childhood is regarded as the "climax in all matters regarding sensory perception" (1991, p. 415).

Together the themes sensory and spiritual form the theoretical construct "nature as a personal exploration", so for some reason these similar perspectives were not as utilized as the other constructs. A number of possible explanations may account for this and I will consider five. First, the experience of Outdoor School would be better described as a structured class exploration than as a personal exploration, possibly accounting for some of the observed disuse of this construct. Second, instructors and their lessons do not emphasize personal exploration concepts (but do include some aspects of the theme nature as a resource). Furthermore, third, students of this age are likely still discovering their spirituality. But perhaps more significantly (fourth), the methodology used to elicit student thinking about nature may disfavor responses with these themes. Interviews took place in a school setting which could interfere with students' recall about how they feel while in a more natural environment. Fifth and finally, for many discussion of spirituality is a personal topic and one which is not readily shared. In fact, one student who included "God" in his initial writing crossed off the word during the post-trip drawing. When questioned why he did so during the post-trip interview, the student replied "I don't know", seemingly uninterested or unwilling to share any explanation. Notably, the existence of the theme nature as a spiritual place is

supported by nature drawing data reported by Rejeski (1982). With regard to nature as a resource, the above speculations are not particularly applicable, but perhaps nature as a resource is simply a view that requires greater experience and learning before students recognize the connection between everyday items and their origins. In any case, it should be remembered that the techniques used to gather students' ideas about nature involved relatively value-free prompts and did not involve probing to discover whether students ever utilized each of the identified themes, thereby mitigating the introduction of values and biases of the researcher. Therefore, the four primary themes and two sub-themes best represent the ways in which these students view nature on their own and without guidance or suggestion from outside sources.

The above discussion focuses on the surprisingly underutilized themes. Perhaps more surprising is the overall relative decline in themes utilized to frame discussions of nature during the post-trip data collection. In part, this may be an artifact of the methodology in which each student's previous responses were shared with him or her before he or she was given an opportunity to expand during post-trip data collection. As a consequence of this method, students tended not to repeat the same ideas expressed previously but reaffirmed them (by not changing them) if they were still consistent with his or her present thinking (and, therefore, unless spoken or indicated, reaffirmed ideas were not included in post-trip data). This being said, students nevertheless shared a considerable amount of data during the post-trip and yet, with the exception of the theme "threatened", did not utilize any themes more often than prior to the trip. Through various lessons, students learned such things as how local tide pools could fill in and disappear and, separately, how water quality could be monitored for signs of degradation.

These lessons are some of the ideas referenced by students who used the threatened theme, which may help explain the observed increase in the theme's use. The decline in the use of the recreation theme appears to be related to many students' emphasis on responses to the nature prompt which were particularly relevant to their Outdoor School experience which, evidently, was not interpreted to include recreational interactions with nature by most students. The slight decline in the use of the theme untouched terrain may be best attributed to students' expectations of Outdoor School as taking place in a truly remote wilderness. Bolstering this explanation were several students who commented about their surprise or disappointment with the setting. For example, the student (8) who used the phrase "untouched terrain" (thus providing the theme a succinct name) in her pre-trip response to the prompt "nature" did not use this theme in the post-trip. After the trip she remarked "I expected [Outdoor School] to be a lot more out of sight, way out in the wilderness. It was more near the highway and there weren't many trees."

The significance of the viewpoints represented by the various themes is that they may hold the key to understanding how students interpret their experiences with nature and therefore add, or choose not to add, to their nature conceptions. Of particular interest are the themes "untouched terrain" and "threatened" and the larger theoretical construct "nature as a special place incompatible with human activities" which these two themes support. By processing nature experiences from this construct's perspective, students may have experienced a strong degree of cognitive dissonance when they arrived at Outdoor School. As discussed above, many students had expectations of outdoor school taking place in nature as they had defined it. As detailed in the perspective offered by the theme untouched terrain, nature is described by the ontology of what it is not, that is, the

opposite of anything human-made. Therefore, when students' expectations were not met by the setting of Outdoor School, students were faced with using alternate themes to interpret nature or revising their definition of nature. Consequently, interpreting nature from the idealized perspective of "untouched terrain" or, more abstractly from the construct "a special place incompatible with human activities", may have interfered with these students' abilities to process and assimilate new nature stimuli which could contribute to achieving greater depth of their nature concepts. In short, nature themes may inhibit some forms of learning. This could explain why the use of the untouched terrain theme declined in use slightly following the trip while only modest gains in depth were observed.

The inner conflict for students reconciling their observations of Outdoor School's nature with their imagined view of nature may ultimately have several possible effects on learning, and this study provides some evidence for each of these effects. Students may discard their idealized view of nature and continue to learn with new information thereby adding to the complexity of their nature concept. Students may maintain a view of nature as untouched and cease to expand the depth of their nature concept. Or, it appears some students are able to maintain their idealized view of nature and expand their nature concept nevertheless. One such student (16) remarked Outdoor School was not what she expected because "it had a lot of synthetic things like a basketball court and heated cabins" but she still thought "Outdoor School did kind of show nature and kinda not—because we went into nature but also looked at it under microscopes and magnifying lenses—[that's] almost the opposite, doing science, studying it with technology."

In a study of children's conceptions of nature Payne (1998a) reported that sixth grade students maintained similar contradictory views of nature. On one hand, students described nature as pure and untouched but, on the other hand, their predominant experience with nature comes from the local environment which is considerably modified from its pristine form. Payne goes on to comment that the positive aspect of thinking in terms of an idealized nature is that it provides a benchmark for assessing change. Conversely, "despoiled nature experienced by children as relatively untouched or unmodified disguises the effects, historical and immediate, of people and culture" (p. 26). (As an aside, it is worth noting that much of what may be considered pristine wilderness today in the Pacific Northwest, for example, had already been greatly altered by native peoples centuries ago (Boyd, 1999).) From this standpoint, an idealized nature view aids in processing an understanding of nature. Certainly, children are quick to note things that are out of place, or "synthetic" as one student put it in the previous example, in nature. However, Payne's conclusion that as people separate themselves from the environment by using the term "nature" to refer to pristine (outer) nature, "individual and social accountability and responsibility for the environment/nature is jeopardised" (p. 26) encounters disconfirming evidence in this study in the form of students who articulated the seemingly incongruent ideas that humans are responsible for nature while simultaneously employing an idealized view of nature.

Theme Comparisons

The emergent themes discussed here bear comparison with those themes to emerge from similar studies of children's nature conceptions. In various forms, several researchers have reported clear distinctions made by students between natural areas and

human built areas corresponding with nature as untouched (e.g., Shepardson, 2004; Payne 1998a; Keliher, 1997; Rejeski, 1982). Wals (1994) identified a wide variety of themes which he arbitrarily labeled perceptions (or definitions) and experiences. A closer reading of Wals's themes and their descriptions reveals they might be condensed to less parsimonious groupings which find a great degree of accord with those themes described above, particularly with the themes untouched, recreation, and threatened. The only theme identified by Wals which stands apart because it did not emerge here is "nature as a threatening place," which characterizes nature as dangerous because of animals, the ease of getting lost, and threatening people there. The absence of this theme in the findings reported here can best be attributed to Wals's subjects: urban youths. Interestingly, this difference in findings indicates that students in this study have greater familiarity with and comfort in natural or wilderness settings. Another difference was the apparent absence in Wals's study of any themes related to spirituality and minimal evidence to indicate use of themes related to nature as a resource or as a sensory place. Again, this difference might be attributed to the children in this study who draw on greater life experiences interacting in natural settings.

Bonnett and Williams (1998) also identified main elements to emerge in children's conceptions of "nature" and "the environment". Their findings similarly suggest the use of untouched, threatened, and recreation themes, although they do not label them as such. Bonnett and Williams note that aesthetic qualities of nature were implied but often unspoken by children, confirming the pattern reported here in which the sensory theme appears to be underutilized. Unlike the results here, Bonnett and Williams did not report any evidence supporting a spiritual or resource theme, but their data do

suggest the possibility of two additional themes. One might be labeled "intrinsic worth" while the other could be "goody goodies". In support of the former, Bonnett and Williams describe an academic and abstract quality within their fifth and sixth year students' responses to interview questions and picture prompts which suggested the value of nature unto itself. With regard to the latter, the authors describe at least two students, in an act of mild protest, reacting to overly virtuous environmental messages with reservations and not wishing to conform.

The implication here is that certain nature themes appear to be universal while others appear to be limited to certain populations. The most pervasive nature themes correspond with the most prevalent in this study and they include: (1) nature as untouched, (2) nature as threatened, and (3) nature as a place for recreation, and, to a lesser degree, (4) nature as a stimulus for the senses. One of the sub-themes to emerge in this study, nature as a spiritual place, finds no support from the aforementioned studies, but is suggested by students' nature drawings in a study by Rejeski (1982). Therefore, it appears likely nature as a spiritual place stands alone as a theme by which some children process nature ideas. As discussed earlier, the spiritual theme may be considerably underrepresented and would be expected to emerge more prominently in unique populations. The sub-theme nature as a resource finds minimal support from the aforementioned studies, but did not stand out as a salient talking point for students. This should not be interpreted to mean that young people do not recognize the source of many common items but, rather, that they do not frequently view nature from this perspective. The additional existence of population-specific themes suggests the need for educators to elicit their students' views on nature in order to better comprehend how students make

sense of environmental education. Lijmbach, Margadant-Van Arken, Van Koppen, and Wals (2002) assert that diverging views of nature, such as those represented by the various themes discussed here, can be used to enrich environmental education by exploring these pluralistic views in a cyclical learning process of exploration, examination, confrontation, extrapolation, and retrospection. Hence, educators might endeavor to challenge their students by introducing alternate nature themes not employed by their students.

Dichotomous Theme

The phenomenon discussed above regarding students' use of the theme "untouched terrain" exemplifies a basic structure that underlies all cultural concepts, which incidentally helps explain its universality, and that is the use of binary opposites to interpret the world as first postulated by the structural anthropologist Levi-Strauss (1969). One of the pervasive binary pairs, Levi-Strauss argues, are words and ideas used to represent nature and culture, as suggested by the title of his 1969 book *The Raw and the Cooked.* Thus, students' characterization of nature as the opposite of human-made things, particularly new technology-related things, may find its roots in human nature. The use of binary opposites does not, however, suggest that contradictory ideas cannot be maintained simultaneously; quite to the contrary, Levi-Strauss discusses mechanisms (too lengthy to review here) by which contradictions, such as, in the case of this study, the way children may view themselves at once as removed from nature and as essential to its continued survival, may be overcome. Levi-Strauss (1976) further cautions against interpretations of ideas which are reduced to words alone because language has limitations. In other words, his argument follows, the use of phenomenology helps

understand students' thinking on one plane, but we must consider a higher unconscious plane at which these ideas are operating.

Kapyla (1998) discusses both the conscious and unconscious levels of meaning encapsulated in personal and social spheres of culture and applies this to environmental education. Learning, Kapyla asserts, occurs when an individual experiences a shift from unconscious to conscious. Kapyla further argues that culture and formal education often transmit ideas, particularly about the environment, without questioning them. Hence, by his definition, this is not learning. Therefore, Kapyla suggests environmental education must embrace lessons which open social meanings. Affirming this idea are models of environmental education which promote critical-thinking and open discourse, ideas which, not coincidentally, can be seen in various iterations of the U.S. EPA Office of Environmental Education publications (as cited in Disinger, 1998a). The implication for this study and environmental education in general is that students' increasing depth of learning, as demonstrated by means of phenomenography, merely suggests deeper unconscious processes resulting from lived experience. Therefore, in order to facilitate learning educators must strive to provide opportunities for students to reflect on their own underlying assumptions about the environment.

Misconceptions

Few commonly held misconceptions arose during interviews, as indicated by the nine categories used to label the fourteen recorded misconceptions. This fact alone signals the need for educators to uncover individual's misconceptions in order to address them. When misconceptions are addressed, the educator must strive to focus on the source of the misconception, such as misleading metaphors or misleading words,

particularly if the misconception does not represent a highly structured and articulated paradigm (Strike & Posner, 1992). Some misconceptions, however, may be successfully resolved through simple first-hand experience. This was the case for one student (8) who, without any prior first-hand knowledge, imagined tide pools to contain sand. After visiting tide pools at Outdoor School, this student immediately corrected her misconception. This sort of fundamental misconception and subsequent learning confirm the benefit of direct experience alone. However, several of the other identified misconceptions require more than direct experience in order to be dispelled and successfully corrected because they deal with processes or interactions rather than fundamental understandings. One example of this was student 34's confusion about the origin of tide pools. She recognized from direct experience that her previous idea was insufficient to explain the tide pools' origin, but she lacked an alternative explanation and was compelled to create a different possible story. In this case, interpretation, particularly at the site of the tide pools, would likely aide this student.

Two students' similar misconceptions, that animals in tide pools are friends, appear to stem from an idealized view of nature. Both students' misconception proved impervious to competition, or "war zones", ideas presented at Outdoor School during the slide show, although one student missed the tide pool visit due to illness. A more direct challenge of these students' ideas seems necessary, perhaps involving on-site interpretation showing evidence of competition.

For the three students with the fundamental misconception that tadpoles are part of tide pools, direct experience with tide pools did not successfully help revise their ideas. This phenomenon may be a result of the fact that there was no disconfirming evidence for

these students. That is, the lack of tadpoles somehow did not require these students to reconsider their misconceptions. To address fundamental misconceptions such as this one, educators could include more comparisons. For example, the slide show used to show what tide pools contain might also be used to show some things that they do not contain.

These students' inclusion of tadpoles in response to tide pools follows some logic because tadpoles are aquatic and often found in small pools of water. However, one student (12) corrected her response, but only did so when I asked specifically about her earlier response, rather than revising her idea when given the opportunity to do so when I recited all her pre-trip responses to tide pools. As student 12 suggested, the name "tide pools" recalls the phonetically similar word "tadpoles" and, also similarly, is associated with water. Because students were instructed to share all thoughts that come to mind upon hearing and seeing each prompt and, moreover, participants were advised that there are no wrong answers, it seems plausible that the students including "tadpoles" were aware that tadpoles are exclusively freshwater organisms. However, the other two students' post-trip responses to their earlier response belie this interpretation. Neither corrected their "tadpoles" responses and one (student 9) even confirmed her tadpole association with tide pools. Thus, while it is plausible that the misconception that tadpoles are found in tide pools may have arisen due to phonetics, these data suggest the initial misconception may perpetuate a deeper seeded misconception. Other factors may be involved as well. Tadpoles, for example, may be more familiar to students coming from inland regions than oceanic creatures, thus adding to students' insistence in maintaining the misconception.

Additional misconceptions also appear to draw on knowledge of more familiar environments. For example, one student (35) postulated that tide pools are formed when the sea rises as a result of snowmelt carried by rivers. Another student (28) remarked in the post-trip interview that micro- and macro-invertebrates are less abundant inland, that is, his home environment. Like the misconception about tadpoles, these ideas appear to stem from children's ideas about their local environments. Rivers, fresh water tadpoles, and an apparent lack of micro- and macro-invertebrates (without previously viewing them in his home environment) each represent students' knowledge of their local environment applied to new places.

Weather

Based on the number of references to the rain, it seems likely this is one of the aspects of the trip students are likely to remember. For most students, the amount of time spent outdoors, particularly in adverse conditions, during Outdoor School far exceeds their usual experience. Students' comments suggest that while better weather would have made the experience more enjoyable, they had a positive experience nevertheless. It seems that the rain made the biggest negative impact on those students who were least interested or least comfortable being outside in the elements. In other words, it seems that the weather has the potential to turn off or turn on students who were only marginally interested in nature and the outdoors in the first place. Finally, it should be noted that many of students' references to rain were made in response to the prompt "nature". This association of rain with nature suggests that students may think of nature as a distant place they visited far from home. Consequently, this association may perpetuate

students' personal disconnect with nature and may interfere with the transference of nature concepts to their home environments.

TV and Books

One of the most unexpected findings to emerge was the influence of TV on students' conceptions of nature. The suggestion that TV influences children's ideas is not new in common discourse and, although many speculative comments appear in the literature (e.g., Payne, 1998a, 1998b; Keliher, 1997; Wals, 1994), educational studies documenting TV's influence are rare (Wright, Anderson, Huston, Collins, Schmitt, & Linebarger, 2001). The evidence presented here that TV influences children's nature concepts would not be so unexpected had it been gathered using a different methodology. What makes the data particularly significant is that six children referred to TV eleven separate times when the only topic was nature. Put simply, when these children were asked to talk about nature, they talked about TV programs.

The four categories into which TV references were grouped help explain the different patterns in which students utilized their knowledge of TV. For review, these four categories, discussed in order below, are "nature on TV", "not all nature on TV", "opposite nature", and "career idea". The fact that seven of the sixteen total references made were used to relate some knowledge of nature derived from a nature scene viewed on TV speaks to TV's significant role in informing these children's ideas about nature. On the other hand, two students referred to TV to explain the limitations of what can be learned about nature by watching nature shows, thus demonstrating a rather advanced form of metacognition and furthermore indicating that their nature knowledge comes from a combination of TV and experience. Three different references more simply

contrasted TV-viewing with nature in a way that suggests TV-viewing is the most removed activity from experiencing nature. These "opposite nature" references describe TV-viewing with a negative tone; one of these references criticizes TV-viewing while another defends it. Finally, the four additional references were made by four different children who described TV shows as inspirational for a future career—and all four career ideas were science-based professions. While "career idea" references surfaced outside of prompts and questions specifically on the topic of nature, they nevertheless hint at the powerful influence of TV in channeling children's interests toward science and nature.

Students' conceptions of nature were also influenced by books, but to a lesser degree based on the number of students who made book references (four). Two of the four students used their book references to explain how learning at Outdoor School contrasts with learning from books, thus indicating their metacognition. Two more students used references to books to relate the idea that nature knowledge can be obtained by reading. However, only one student (16) used book references to demonstrate her knowledge of nature. In particular, this student discussed assigned readings dealing with a man versus nature theme, which clearly inform her ideas and expectations about nature. In light of the seven separate references made by five students who shared nature knowledge derived from TV-viewing, it is somewhat surprising that only one student made three references to nature knowledge learned from books. In summary, the evidence suggests that both TV and books influence students' conceptions of nature and TV appears to do so in more pervasive way. The explanation for why and the extent to which TV shapes children's thinking require further study. As to the former, multiple factors may be involved, including the amount of time children spend TV-viewing versus

reading and the powerful and captivating effects of visuals and accompanying dramatic sounds and music used by nature programs.

The implications of children's TV-viewing\

These findings regarding the influence of TV-viewing on children's interest and knowledge of nature demand educators' attention. For some students, it appears one of their first frames of reference for considering nature is television. The powerful influence of TV on children such as these, Chawla and Hart (1995) suggest, probably reflects their limited direct contact with nature. Therefore, one problem educators must confront when visiting natural areas with such students is false expectations created by TV nature programs that show highlights of natural phenomena not easily or immediately observed by the casual nature visitor (Wals, 1994). Furthermore, the idealized view of nature, espoused by many students in this study through their use of the "untouched terrain" theme, may result from TV's influence (Payne, 1998a). The "opposite nature" TV references provide evidence in support of Payne's idea. It appears that educators could harness this view by specifically encouraging students to compare and contrast TV with personal nature experiences. In doing so, educators would promote reflections similar to those expressed by the two students who discussed the limitations of TV in learning about nature. This proposed teaching strategy finds support in research: students who are aided to become aware of their own learning processes add to the depth of their understanding (Thomas & McRobbie, 2001). Since educational TV-viewing has been shown to correlate with a positive interest in science (Tamir, 1989) and with overall academic interest and success (Wright et al., 2001), it follows that educators could

cultivate their students' free-choice nature learning by specifically asking their students to refer to examples they discovered on a TV program.

Self-Reported Attitudes

The overwhelming agreement among students that Outdoor School was a positive experience is a testament to the social, affective, and academic appeal of such a trip. Students identified many various activities as their favorite part hence indicating the diverse appeal of the programs. Most students claimed their interest and understanding of nature increased as result of the experience. It therefore stands to reason that follow-up nature-related lessons would also appeal to students. The quotes in table 13 better capture students' feelings about Outdoor School than any survey could. A number of students claim Outdoor School was the highlight of their academic career. One outstanding aspect of students' quotes is that they often not only refer to how much fun they had but also how much they learned. As one student (27) put it, "this was for fun and learning so this was more fun. Usually field trips are just for fun."

Transference

Strike and Posner (1992) assert that students' new and revised concepts must make sense in many situations by use of practical reasoning. Relating this idea to students' learning on field trips, the suggestion is that although students may be introduced to the concept that people and their interactions with living and non-living things are included as part of the environment, they may discount this concept when they return from a field trip to the setting of their home. If this were indeed the case—the evidence presented suggests a certain disconnect in the application of students' learning

about nature to their immediate surrounding environment—the implication for educators would be a need to redesign teaching strategies in a way that better promotes transference.

In the case of the students participating in this study, no classroom activities were specifically designed to link lessons and experiences from Outdoor School to classroom lessons. This study was not designed to measure students' transference of knowledge, although a fair amount of confirming evidence as well as one piece of disconfirming evidence for transference may be extrapolated from the data presented here. With regards to confirming evidence, the fact that twenty-two students added the ocean or tide pools to their nature response indicates a broader perspective on nature areas despite the lack of these habitats near their homes. Moreover, the unprompted connections quoted in "additional evidence of learning" made by two students indicate applied learning. In this instance, the students considering "nature" made the connection between the water they examined under a microscope while at Outdoor School and the water they drink at home and, consequently, recognized the value of filtered water. On the other hand, another student (28) provided disconfirming evidence for transference of learning when he made the conclusion that the micro- and macro-invertebrates he observed at Outdoor School would not be found in such abundance near his home (classified as a misconception in Table 7). Without follow-up activities and further explanation, both conclusions regarding aquatic organisms agree with Strike and Posner's assertion in one sense; that is, both conclusions make sense to the students in their home environment. However, Strike and Posner's implication that learning derived from an unfamiliar setting requires guidance to be successfully processed and accepted is only supported by the student with

the misconception. This student who said he would not see many micro- and macro-invertebrates further inland (such as near his home) most likely made his conclusion based on the fact that he first saw these organisms in the unfamiliar coastal environment and therefore associated these equally unfamiliar organisms with this unfamiliar place. The broader indication, however, is that follow-up lessons would serve to reinforce learning, help correct misconceptions and, furthermore, might facilitate additional environmental learning, such as helping students recognize the way students directly and indirectly interact with nature every day.

Emergent Questions

Some of the questions to emerge from this study include:

- Are there additional breadth categories used by other populations, particularly older students?
- How do emergent breadth categories and typologies and corresponding gains compare with other populations and other environmental experiences?
- Are higher order typologies associated with responsible environmental behavior?
- Does inclusion of the ocean in an individual's nature concept positively influence behavior which impacts the ocean?
- What factors are associated with gains in breadth and depth or, conversely, why do some students show minimal or no gains in breadth and depth?
- What are the long term effects of such an experience on students' learning? Or interest in nature or science?
- Do conceptual gains correlate with other cognitive gains as measured by surveys?
- What is the impact of follow-up classroom lessons on students' learning?

Implications and Recommendations for Further Research

Although interviews in combination with other qualitative measures have been used to document changes in students' environmental conceptions (e.g., Emmons, 1997; Shepardson, 2004), the use of open-ended interviews in a phenomenological approach is a somewhat new methodology when applied to the exploration of environmental learning attributed to a specific experience, particularly with regard to residential environmental education center experiences. For the data regarding depth of students' nature concepts, the application of similar analytic methods developed and described by Loughland, Reid and Petocz (2002) and Loughland, Reid, Walker, and Petocz (2003) in which students' responses to open-ended questions are classified into distinct hierarchical categories for analysis, offers new insight into change in students' environmental conceptions. By drawing on multiple sources of data obtained through participant writings, drawings, and interviews in a manner which introduces limited biases (employing techniques drawn heavily from Falk's 2003 and Adams, Falk, and Dierking's 2004 work on Personal Meaning Mapping), this study demonstrates the potential for the richness of phenomenological study and, additionally, opens the door to a new line of inquiry centering on conceptual learning.

The strength of this methodology derives from the loose structure of questioning and prompts which allows participants' own ideas to emerge reflecting their own contextualized experiences of learning. This methodology also results in the collection of large quantities of data which contribute to our understanding of the depth and breadth of participants' conceptions. Large quantities of data drawn from multiple sources further contribute to the researcher's confidence in his ability to fairly characterize and

categorize each participant's conceptual understanding. One of the primary drawbacks is, of course, the time required to collect and analyze such voluminous data. However, utilizing this sort of phenomenological methodology helps ensure the validity of the findings. Moreover, this approach accounts for preconceived ideas and begins to respond to Payne's (1998b) call to close the theory-practice gap in which "childrens' [sic] conceptions of nature and the environment remain undescribed and unexplained in environmental education" (p. 209).

Of note, this methodology resulted in ancillary benefits for the participants as well. Similar to Adams *et al.* (2004) findings, participants, once made to feel comfortable, expressed interest and enthusiasm in sharing their knowledge and experiences with a willing listener. Moreover, the pre-trip interviews served as a sort of expectation defining time and the post-trip interviews, drawings, and writings served as reflection time for students. Reflections, as most educators agree, are a valuable learning tool.

This study provides a logical complement to studies of students' learning resulting from field trips that focus on cognitive gains. The need for further environmental education research that utilizes phenomenological approaches should be self-evident; any suggestion that the impact on students' conceptual learning (as measured through qualitative methods) and students' cognitive learning (as measured by surveys) differs has important implication for educators. As discussed earlier, conceptual gains are a measure of the most important type of learning environmental center experiences offer, yet research in the area of environmental experiences has traditionally drawn greater attention to factual cognitive gains by means of surveys. There is some

evidence that the length of stay and the size of the facility visited have a positive correlation with cognitive gains (Gilbertson, 1990). Do the same factors that influence cognitive gains also influence conceptual gains? Hopefully future research can help bridge the gap between studies of conceptual and cognitive gains. If cognitive gains measured by surveys were found to predict conceptual gains, then past studies would take on more significance and perhaps lead to the development of tools which infer conceptual learning without requiring extensive data collection and analysis.

Similar lines of inquiry used in research of environmental literacy, attitudes and outcomes merit phenomenological inquiry as well. For example, there is great interest in demonstrating long term benefits derived from environmental experiences. Are conceptual gains long lasting? This question is far beyond academic due to the greater implications of how one perceives the environment and how one acts. As Wals (1994) put it:

> To say that nature only exists independently of us, is to say that it is impossible for humans to protect or conserve nature, of the mere act would transform nature as a result of our intervention. To define nature as a physical entity might have political and management uses in that it gives legislators, interest groups, civil engineers, and like a common frame of reference. (p.179)

Another line of inquiry that merits inquiry is the potentially variable impact of an environmental center experience. Both Kostka (1976) and Williams and McCrorie (1990) offer some evidence that rural and urban students show different attitudes with regard to a nature center visit. Is there also a difference in the nature conceptions students derive from an environmental center? If so, educators need to consider how programs might be adjusted to better fit each group's needs. Results from this study suggest students with interest in science careers have a greater affinity for learning nature

concepts than their classmates. Is this a consistent pattern? If so, perhaps educators can capitalize on this finding by grouping science oriented students for more advanced lessons. For the non-science oriented students, educators could attempt to pique their interest by integrating more non-science lessons of the environmental education curriculum into their program.

Ultimately, for the findings of studies such as this one to make an impact on the way educators design and use environmental experiences, researchers must offer realistic and pragmatic suggestions about the ways in which environmental curricula might be enhanced. Perhaps the most immediate way in which this study might be applied by classroom teachers is by making use of the student and writing protocol. Although students' written descriptions and drawings of nature and their subsequent revisions only represent a portion of the data collected for this study, they did offer real insight into students' understandings and learning *upon first glimpse*, as well as give students time to reflect. The methodology for using student writings and drawings is simple and requires minimal preparation and class time. Teachers should consider using this method to evaluate the breadth and depth of their students' understanding of nature. Rather than formally categorizing each student's response, the teacher might group students into less and more advanced groups or simply take note of any glaring patterns among responses, such as the absence of any indicators to suggest students think of nature in terms of a relationship. Teachers could use this information to guide their pre- and post-activities surrounding a field trip. In addition, information about students' prior knowledge would be useful to environmental center program staff in their preparations to ideally suit each group's needs.

Ninety-three percent of new elementary school teachers in the United States agree that science should be taught in a hands-on, inquiry based way in accordance with the National Science Education Standards (J. Payne, 2004). While environmental education includes more than science, the hands-on, inquiry, and experiential model is what has driven environmental education efforts and inspired the creation of environmental learning centers worldwide. Not surprisingly, environmental centers have generated wide support among educators, parents, and students corresponding with the shift toward inquiry in science education. If environmental centers are going to continue to thrive, the most outstanding challenge they face is their need to demonstrate efficacy in areas otherwise unachievable in the classroom alone. Considering the high value teachers place on stimulating awareness and appreciation of the environment on field trips, and considering the potentially life-changing aspects of such an experience, it is hard to overstate the importance of studies that use creative phenomenological or otherwise qualitative approaches to investigate students' learning attributed to environmental center experiences.

Concluding Remarks

This study presents new measures of learning—breadth and depth of conceptions—attributed to an environmental center experience and considerable context in which to interpret students' learning. The results offer insight into social and affective domains of learning by presenting students' own words and characterizing student perspectives in terms of themes. The methodology used here breaks from traditional approaches to studying environmental learning in order to study the sort of learning environmental centers set out to facilitate from the outset. Different types of learning

require different tools for recording learning. This study introduces some of those tools that better capture the learning and the experience of learning. Overall, the evidence suggests a successful learning experience which might be used in part to justify continued programs, but the evidence also further suggests room for further gains. Many new questions regarding the nature of learning emerge as a result of this exploratory study. The future of environmental center programs depends on their ability to offer learning opportunities otherwise unattainable in a traditional classroom. Therefore, ongoing research should endeavor to record and measure the affective, social and conceptual learning these programs facilitate so that these programs may continue to evolve and thrive.

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APPENDICES

Appendix A: Letter to Parents.

Science & Mathematics Education
College of Science
Oregon State University
239 Weniger Hall
Corvallis, Oregon 97331-6508

April 28, 2004

Dear parent or guardian,

Your child will soon have the opportunity to attend an OMSI Outdoor School. In an effort to learn more about children's learning from Outdoor School, your child also has the opportunity to participate in a research study. The purpose of this research study is to characterize students' understanding of the environment before and after a visit to OMSI's Outdoor Science School.

Enclosed is an informed consent form for you to review. It should help you decide if you want your child to participate in this study. **Participation in the research study is voluntary.** Whether or not your child participates in the research study will not affect his or her participation in Outdoor School or other school and classroom activities. You or your child can stop your child's participation at any time.

If your child participates in the study, s/he will be asked to respond to a word or sentence related to Outdoor Science School before the trip in the form of a drawing. In addition, a researcher will ask each student open-ended questions and take notes on his/her response. After the trip, your child will participate in a similar interview in which s/he can revise her/his drawing and response. All personal information will remain confidential.

Results of this study may help clarify the impact of such a trip on students' learning. Findings will be shared with educators from your child's school, OMSI, Oregon State University, and will be submitted for publication in a professional journal. This study may help OMSI and teachers enhance their program for future students.

If you have any questions, you are encouraged to contact me by e-mail at rebarb@onid.orst.edu or by phone at (541) 753 7375. If you have questions about your child's rights as a participant in this research project, please contact the Oregon State University Institutional Review Board (IRB) Human Protections Administrator at (541) 737-3437 or by e-mail at IRB@oregonstate.edu.

Thank you for considering your child's participation.

Sincerely,

Bryan Rebar
Oregon State University
Environmental Sciences
M.S. candidate

Appendix B: Informed Consent Document.

Science & Mathematics Education
College of Science
Oregon State University
239 Weniger Hall
Corvallis, Oregon 97331-6508

INFORMED CONSENT DOCUMENT

Project Title: **Students' Environmental Learning from Outdoor Science School**
Principal Investigator: **Larry Enochs, Science & Mathematics Education**
Research Staff: **Bryan Rebar, master's candidate in Environmental Sciences**

PURPOSE

This is a research study. The purpose of this research study is to characterize students' understanding of the environment before and after a visit to OMSI's Outdoor Science School. Results of this study may help clarify the impact of such trip on students' learning. Findings will be shared with educators from the school, OMSI, Oregon State University, and will be submitted for publication in a professional journal. The purpose of this consent form is to give you the information you will need to help you decide whether to be in the study or not. Please read the form carefully. You may ask any questions about the research, what you will be asked to do, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When all of your questions have been answered, you can decide if you want to be in this study or not. This process is called "informed consent". You will be given a copy of this form for your records.

We are inviting your child to participate in this research study because he or she has an opportunity to attend OMSI's Outdoor Science School.

PROCEDURES

If you agree to allow your child to participate, your child's involvement will last for one hour, once shortly before and once soon after the Outdoor Science School trip.

The following procedures are involved in this study.

Assent
Students will be introduced to the research study with an assent form that explains the purpose and design of the study in simple language. The form will be read aloud and students will be given an opportunity to ask questions about it. At this time students will be verbally asked if they wish to participate or not.

One to Two weeks prior to Outdoor Science School visit
The researcher will visit the school and be introduced by the teacher to the class. All participating students will be asked to draw a picture. Then, in small groups, the researcher will meet with students. Students will be asked to share as many words, ideas, images, phrases or thoughts as come to mind related to a specific

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Approval Expiration Date: 03-29-05

word or phrase. When they are done, the researcher will encourage each student to explain why he or she responded the way he or she did and to expand his or her thoughts. The researcher will take notes on all student responses.

One to Two weeks after Outdoor Science School visit
The researcher will again visit the school and be introduced to the class by the teacher. All participating students will be given a chance to add to their original picture. Again in small groups, the researcher will meet with students. Your child will participate in a similar interview in which s/he can revise her/his response. The researcher will again ask students to explain their responses. Finally, students will be asked to answer a few questions about where they have lived and traveled in the past.

Debriefing
The researcher will review the purpose of the study with students, allow for any other questions, and thank students for participating.

RISKS

There are no foreseen risks to participants.

BENEFITS

The procedure described above is based on a method called Personal Meaning Mapping. In past studies using Personal Meaning Mapping many participants reported thoroughly enjoying the experience. Because students are asked to give further thought to subjects related to the Outdoor Science School curriculum, participants are expected to learn through their responses which are, effectively, reflections. Personal Meaning Mapping has been conducted with 5th and 6th grade students previously.

The results of this study may be used by both science school staff (at OMSI and elsewhere) and teachers to enhance students' learning from such trips.

CONFIDENTIALITY

Records of participation in this research project will be kept confidential to the extent permitted by law. However, federal government regulatory agencies and the Oregon State University Institutional Review Board (a committee that reviews and approves research studies involving human subjects) may inspect and copy records pertaining to this research. It is possible that these records could contain information that personally identifies your child. In the event of any report or publication from this study, your child's identity will not be disclosed. Results will be reported in a summarized manner in such a way your child cannot be identified.

VOLUNTARY PARTICIPATION

Taking part in this research study is voluntary. You may choose for your child not to take part at all. If you agree to allow your child to participate in this study, you may stop his or her participating at any time. Students are allowed to skip any question they prefer not to answer. If you decide for your child not to take part, or if your child stops participating at any time, the decision will not result in any penalty. Any data collected from students who choose to stop participating will not be included in the study.

QUESTIONS

Questions are encouraged. If you have any questions about this research project, please contact:

Bryan Rebar
541 753 7375
rebarb@onid.orst.edu

Larry Enochs
541 737 1305
enochsl@onid.orst.edu

If you have questions about your rights as a participant, please contact the Oregon State University Institutional Review Board (IRB) Human Protections Administrator, at (541) 737-3437 or by e-mail at IRB@oregonstate.edu.

If you check YES and sign below, this indicates that this research study has been explained to you, that your questions have been answered, and that you agree to allow your child to take part in this study. If you check NO, your child will not be included in this study. You will receive a copy of this form if you check yes.

I allow my child to take part in this study: ☐ YES ☐ NO

Participant's Name (printed): _____

_____ _____
(Signature of Parent/Guardian or Legally Authorized Representative) (Date)

RESEARCHER STATEMENT

I have discussed the above points with the participant or, where appropriate, with the participant's legally authorized representative, using a translator when necessary. It is my opinion that the participant understands the risks, benefits, and procedures involved with participation in this research study.

_____ _____
(Signature of Researcher) (Date)

OSU IRB Approval Date: 05-02-04
Approval Expiration Date: 03-29-05

Appendix C: Letter to Principal.

Science & Mathematics Education
College of Science
Oregon State University
239 Weniger Hall
Corvallis, Oregon 97331-6508

April 6, 2004

To the principal:

I would like to invite your school to participate in a research study. The purpose of this research study is to characterize students' understanding of the environment before and after a visit to OMSI's Outdoor School. This study may help OMSI enhance their program for future students.

Children who participate in this study will be asked to respond to a sentence or picture related to Outdoor School before the trip. After the trip, children will participate in another interview in which they can revise their original response. These open-ended responses must be conducted in small groups and will require about 15 minutes of participating students' time on two occasions. Because of the impact on teachers' time with students, I encourage you to discuss this matter with affected teachers before agreeing to this study. All personal information about students will remain confidential.

Results of this study may help clarify the impact of such a trip on students' learning and suggest ways to enhance students' understanding. Findings will be shared with your school's staff, OMSI's staff, Oregon State University, and will be submitted for publication in a professional journal. OMSI is especially interested in using these findings to improve their program.

Oregon State University's Institutional Review Board (IRB) has approved this study. **Participation in this study is voluntary.** Should you approve of the study, I will need an email stating your approval. If approved, parents will be asked in writing if they wish their children to participate. Each student must give their assent to participate as well. Any parent or student who chooses for their child or for themselves not to participate will not be included. At any time, students can stop participating.

If you have any questions, I encourage you to contact me by e-mail at rebarb@onid.orst.edu or by phone at (541) 753 7375. If you have questions about your students' rights as participants in this research project, please contact the Oregon State University Institutional Review Board Human Protections Administrator at (541) 737-3437 or by e-mail at IRB@oregonstate.edu.

Thank you for considering your school's participation in this study.

Sincerely,
Bryan Rebar
Environmental Sciences
M.S. Candidate

Appendix D: Oregon State University Institutional Review Board Approval.

INSTITUTIONAL REVIEW BOARD

OREGON STATE UNIVERSITY

Office of Sponsored Programs and Research Compliance
312 Kerr Administration Bldg.
Corvallis, Oregon
97331-2140

Telephone
541-737-3437

FAX
541-737-3093

Email
IRB@oregonstate.edu

TO: Larry Enochs,
Science and Mathematics Education

RE: Students' Environmental Learning from Outdoor Science School
(Student Researcher: Bryan Rebar)

IRB Protocol No. 2504

The referenced project was reviewed under the guidelines of Oregon State University's Institutional Review Board (IRB). The IRB has **approved** the application. This approval will expire on 3/29/2005. This modification request was reviewed at the Expedited level. A copy of this information will be provided to the full IRB committee.

Enclosed with this letter please find the approved informed consent documents for this project, which have received the IRB stamp. This information has been stamped to ensure that only current, approved informed consent forms are used to enroll participants in this study. All participants must receive the appropriate IRB-stamped informed consent document.

- Any proposed change to the approved protocol, informed consent form(s), or testing instrument(s) must be submitted using the MODIFICATION REQUEST FORM. Allow sufficient time for review and approval by the committee before any changes are implemented. Immediate action may be taken where necessary to eliminate apparent hazards to subjects, but this modification to the approved project must be reported immediately to the IRB.
- In the event that a human participant in this study experiences an outcome that is not expected and routine and that results in bodily injury and/or psychological, emotional, or physical harm or stress, it must be reported to the IRB Human Protections Administrator within three days of the occurrence using the ADVERSE EVENT FORM.
- If a complaint from a participant is received, you will be contacted for further information.
- Please go to the IRB web site at: http://osu.orst.edu/research/RegulatoryCompliance/HumanSubjects.html to access the MODIFICATION REQUEST FORM and the ADVERSE EVENT FORM as needed.

Before the expiration date noted above, a Status Report will be sent to either close or renew this project. It is imperative that the Status Report is completed and submitted by the due date indicated or the project must be suspended to be compliant with federal policies.

If you have any questions, please contact the IRB Human Protections Administrator at IRB@oregonstate.edu or by phone at (541) 737-3437.

for Laura K. Simon Date: 5/2/04

Drs. Courtney Campbell and Wayne Kradjan
Institutional Review Board Co-Chairs

pc: 2504 file

Appendix E: Participant Survey.

Science & Mathematics Education
College of Science
Oregon State University
239 Weniger Hall
Corvallis, Oregon 97331-6508

STUDENT QUESTIONNAIRE

Name:_____

Please answer the following questions by circling your response.

Please circle one: I am a boy. I am a girl.

Before Outdoor Science School, had you ever been to the ocean? YES NO

About how many times?
1
2
3
4
more than 4

How long have you lived where you live today?
1 year or less
1-2 years
2-3 years
As long as I can remember

Have you traveled with your family to new places for vacations? YES NO

How often do you travel with your family to new places?
I don't
Once a year
More than once a year

Have you ever traveled by plane? YES NO

Please return the survey to the researcher. Thank you!

Appendix F: Writing and Drawing Protocol.

PICTURE PROTOCOL
Students' Environmental Learning from Outdoor Science School

Greeting
On the first visit to the classroom allow the teacher to introduce the researcher. S/he should explain that the researcher is a graduate student from Oregon State University who is trying to learn more about what you [students] think. Some students whose parents agreed have the choice to volunteer for interviews with the researcher. Participation in the interviews is voluntary.

Pre-Activity
Researcher explains the following:
I am doing a research study. A research study is a special way to find out about something. We are trying to find out what students know and learn about the environment before and after a trip to OMSI's Outdoor Science School. I am telling you this so you can learn about the study and decide if you want to be in the study or not. You can ask any questions. After all of your questions have been answered, you can decide if you want to be in this study or not.

If you decide that you want to be in this study, I will ask you to do several things. You will be asked to share what you know about a word or picture. You will also be asked to tell me why you answered the way did. At another time after your trip to Outdoor Science School, you will be given a chance to talk more about the same word or picture. Then you will be asked why you made the changes or additions you did. You will be given up to an hour to share your answer.

If you decide to be in this study, some good things might happen to you. You could enjoy writing and drawing your reaction and explaining it. You might also learn about yourself and your knowledge of the environment. But I don't know for sure that these things will happen. I might also find out things that will help other children some day.

When we are done with the study, I will write a report about what I found out. I won't use your name in the report.

You don't have to be in this study. It's up to you. If you say okay now, but you want to stop later, that's okay too. All you have to do is tell me or your teacher.

Answer any questions students have.

Procedures
Give every student a blank piece of paper and a black pen. Ask them to first write their name on the top of the paper. Then ask them to write everything the word <u>nature</u> means. When done, ask them to turn over their papers.

Now ask them to draw a picture that shows everything that is part of nature. After students have been drawing for a few minutes, ask them to write the names on the important things in their picture.

Appendix G: Interview Protocol.

INTERVIEW PROTOCOL
Students' Environmental Learning from Outdoor Science School

Greeting
On the first visit to the classroom allow the teacher to introduce the researcher. S/he should explain that the researcher is a graduate student from Oregon State University who is trying to learn more about students who attend Outdoor School. Some students whose parents agreed have the choice to volunteer for interviews with the researcher. Participation in the interviews is voluntary.

Pre-Interview
Interviewer: begin with an introduction—your name. Then explain the following:

I am doing a research study. A research study is a special way to find out about something. We are trying to find out what students know and learn about the environment before and after a trip to OMSI's Outdoor Science School. I am telling you this so you can learn about the study and decide if you want to be in the study or not. You can ask any questions. After all of your questions have been answered, you can decide if you want to be in this study or not.

If you decide that you want to be in this study, I will ask you to do several things. You will be asked to share what you know about a word or picture. You will also be asked to tell me why you answered the way did. At another time after your trip to Outdoor Science School, you will be given a chance to talk more about the same word or picture. Then you will be asked why you made the changes or additions you did. You will be given up to an hour to share your answer.

If you decide to be in this study, some good things might happen to you. You could enjoy writing and drawing your reaction and explaining it. You might also learn about yourself and your knowledge of the environment. But I don't know for sure that these things will happen. I might also find out things that will help other children some day.

When we are done with the study, I will write a report about what I found out. I won't use your name in the report.

You don't have to be in this study. It's up to you. If you say okay now, but you want to stop later, that's okay too. All you have to do is tell me or your teacher.

Answer any questions students have.

Name
Ask each participant for their name. (Note: names are used only to match pre- and post-interview responses and will not be used in any other way.)

Interview Part 1
Show student a sheet with the words Outdoor School in the middle.

Question: What comes to mind when you see the words "Outdoor School"?

Probe: Could you explain a bit more about what you are thinking when you said X.

Interview Part 2
Show students a sheet with the word "nature" in the middle.

Question: What comes to mind when you see the word "nature"?

Probe: Could you explain a bit more about what you are thinking when you said Y.

Interview Part 3
Show participants a picture of the tidepools.

Question: What comes to mind when you see the picture?

Probe: Could you explain a bit more about what you are thinking when you said Z.

Interview Part 4
How would you rate your interest in Outdoor School: Low, Medium, or High?

How would you rate you interest in the nature: Low, Medium, High?

How would you rate you understanding of the nature: Low, Medium, High?

Questionnaire: After follow-up interview (interview #2), have participants complete one-page questionnaire.

Thank you very much for answering my questions. Enjoy your trip to Outdoor School! If you are still willing to participate, I will be back after your trip to ask you some more questions.

Appendix H: Repeating Ideas Grouped Into Themes

Repeating Idea: 'man-made' technology contrasted with nature; "<u>untouched</u> terrain"

2
Pre: "'Things that haven't been tampered with by humans.'"
Post: "Non-artificial—not man-made."

4
Pre: "[Nature is] the forest, anywhere you go to hike or ride bikes, not near development. A place not man-made. A place that was always there—the woods."
Pre: "[Nature is] everything outside away from a town or a city."
Post: "[Nature is] a place where there's nothing that—no electricity, gas stations."
Post: "There's a lot of wildlife not where there's a lot of traffic lights."

6
Pre: "[Nature is] in the country, not in the city. It's quiet because it's not like the city where people are making buildings and stuff—there's animals."

7
Pre: "No electrical things, or man-made things like cameras or like Gameboys."
Post: "Ocean life, the ocean. Because there's life in the ocean. Animals and plants that grow in the ocean are not man-made."

8
Pre: "Mostly life cycle of animals, plants. Untouched terrain. No human activity that can hurt the plants or animals."

9
Pre: "Where animals, not humans, live. Where we [humans] haven't built yet."
Pre: "Nature means trees, wildlife, and a place where no humans have constructed or built homes."
Post: "Weather." *Why did you say 'weather'?* "Because that's natural—humans didn't make it that way."

11
Pre: "Rivers, streams, peacefulness."
Post: "Tents are not [part of nature] because you have to bring them—they're not right there."

12
Post: "If cabins are rusty, no air conditioner—sometimes they're part of nature then. Our house wouldn't be part of nature—it's too high-tech."

Post: "When we go to outdoor school, then we are part of nature. We were away from most electronics—don't really use high tech stuff [there]."

15
Post: "I crossed off cities [from my picture of nature] because cities are dirty. I thought they were part of nature. I changed my mind because I saw the news and I've been to Portland."

16
Pre: "Nature means something that is not man made, like a tree." [from writing]
Pre: "[Nature means] more things that are not synthetic. Synthetic means man-made. In nature, not much is man-made."
Pre: "Over here yards are mowed and trimmed. Over there [at outdoor school] they're wild—almost untouched by humans."
Post: "If I had an analogy [to nature], it's the opposite of a city."
Post: "Outdoor school did kind of show nature and kinda not—because we went into nature but also looked at it under microscopes, magnifying lenses. That's almost the opposite: doing science, studying it with technology."

17
Pre: "[Nature] is where—a different place—where we [us, people] wouldn't normally live."

19
Pre: "[Nature means] undisturbed parts of the earth." [from writing]

20
Pre: "[Nature is] nothing man-made. Things grown on their own—no fertilizer, outside."
Post: "Nature is natural. Nature should be natural. [Nature is] nothing man-made like I said before."

21
Pre-response to 'nature': "If you didn't have electricity you could still live—not as well."
Post-response to 'nature': "You wouldn't need anything you have in modern days. At Camp Magruder you'd build shelters. [Things you wouldn't need include] cell phones or computers. You can live without them."
Description of picture of nature: "Almost everything except watches, computers, and cell phones are part of nature." Post

24
Pre: "Anything that is non-human made."
Post: "[Nature is] pretty much everything here before humans came."

25
Pre: "[Nature is] undisturbed. Things that are natural, things that are wild."

Why did you say 'undisturbed'? "Because when I think of nature I think of things that are like aren't in town in the forests in jungles and places where there aren't a lot of factories, not a lot of cities."
Pre: "Nature has not been disturbed by humans."
Post: "Clean, not polluted."

26
Post: "We called where my grandma lived 'concrete jungle' because so few living things there. The only animals that adapt to the city is [sic] basically birds."
Post: "I've watched lot of nature shows that take you to places that haven't been touched by humans."

28
Pre: "[Nature is] an area with not a lot of pollution."
Post: "Nature could be in a small town [because there] probably wouldn't be a lot of wildlife there and sometimes animals are afraid of humans."
Post: "I was thinking 'nature is where there aren't a lot of people.'"

29
Pre: "Nature is trees, animals, birds, fish, flowers, grass, all the world (but not that people created)." [from writing]
Post: "Nature is everything that is living, not machines, computers, trains." [from writing]

30
Pre: "No construction—no roads, no houses with running water in them. There usually aren't humans in nature."
Post: "[Nature means] things that happen without help from humans. It means trees and rivers, animals and plants and no machines. It's the undisturbed cycle of life."

32
Pre: "Nature is outside. You can't have it in your house. You can have plants in the house but not nature because it's [the house is] man-made."

33
"God—because he created [nature]." Pre
"Different than house because there's roads." Pre
"God's creation" Post

34
Pre: "[Nature is] outdoors, water, no pollution."
Post: "[Nature is] quiet. It shouldn't be really loud because what makes it loud are people doing construction."

36
Pre: "It's fun to be in the wild, not to have technology and stuff. Because [Outdoor School is] outside, there's no TV, no refrigeration to make your own food."

Pre: "[My interest in nature is] high because I get to see other things like animals, how they eat and live and survive without all the things we have today, like heating.

37
Pre: "Pretty much everything that's not human made. Everything human made is not nature."
Post: "All the habitats, the ocean. People need to preserve it, not build malls and houses and stores and stuff."

Repeating Idea: Nature as under <u>threat</u>

1
Post: "The food chain, it sorta helps everything survive. If any one of those things go missing then everything up form that would die."

3
Pre: "Cars and big semi trucks give off a lot of exhaust which is basically steam that kills stuff."

7
Post: "When we destroy a habitat, we're killing animals faster."

12
Post: "Sometimes humans destruct nature."

15
Post: "[When I think of nature, I think of] the endangered species."
Post: "I learned a lot about nature. You can't mess it up. You can't kill everything because they're living creatures."

16
Post: "Some things are going away faster and faster, like endangered animals. We're making it go away, making fur coats. Use [nature] not wisely, and it's gone."
Post: "These days a family will have three cars. They're wrecking nature."

21
Pre: "If we didn't have cars we wouldn't have a problem with pollution—the ozone layer would form back together without cars."

24
Post: "If we don't [protect nature] we won't be able to live much longer if we destroy it."

26

Post: "The gas price is going up and up and it's not renewable. The president wants to drill a hole in Alaska. You see more and more hybrid cars so the consumption of gas is not as great."
Post: "Humans hunted otters to local extinction."
Post: "Pollution is important—some animals have low tolerance for pollution. That's how you could tell water quality was good [in the lake sampled at outdoor school]."

27
Post: "Most people kill sharks but it's—they're part of nature. It'd be like killing a human but not for the same reason—for food and stuff. Most people kill animals. There'd be so many animals if they weren't extinct or killed. I heard at the zoo there's more extinct water animals than land animals—over 100,000 water mammals die per year."

28
Pre: "[Nature is] an area with not many people because if there's a lot of people, more people will come and litter and turn it into a small town or city."

34
Pre: "[Nature makes me think of] outdoors, water, no pollution. Pollution is not natural. It's what we do to it. It doesn't seem right."
Post: "Pollution can make water really bad and kill insects and animals. If animals get sick, it could hurt other animals."

37
Post: "[When I think of nature, I think of] all the habitats, the ocean. People need to preserve it not build malls and houses and stores and stuff, keep habitats, forests, oceans, ozone layer so animals don't become extinct."
Post: "Gas from highways can get in lakes and can make water quality more acidic or basic and not many animals can live in bad water quality."

Repeating Idea: Nature as a place for <u>recreation</u>

1
Pre: "Sometimes I sit in the window and spot everything or go catch bugs and frogs."
Pre: [Picture shows person atop a mountain.]

2
Post: "Fun" [part of writing]

3
Pre: "[Nature makes me think of] trees, grass, water, plants, animals, outside and, like, fun stuff—swimming."

4
Pre: "[Nature is] anywhere you go to hike or ride bikes, not near development. I think of my mom. She's always going on hikes."

5
Pre: "[My family and I] got to lakes a lot. We usually swim and we let the dogs run free."
Post: "[Nature] reminds me of camping. I go to lots of different places. I like just watching birds and fish when we go camping."

6
Post: "Hikers." [included in picture and writing]

7
Pre: "Trails aren't paved when you go on hikes [in nature]."

8
Pre: "I like to garden. I like watching animals, seeing what they do. I spend the whole summer watching. I like watching how plants grow."

9
Pre: "I like nature and I like camping. I like being outside and never get bored."

10
Pre: "You can camp in the woods, look out for animals. It's kind of what you do in nature—you enjoy it."
Pre: "Fresh air, camping, hikes." [from writing; picture shows person beside tent]
Post: "Hiking, wetlands, bugs. Because you have to hike to wetlands, there's bugs."

11
Pre: "Peacefulness, adventures." [Included in writing]
Pre: "Cabins, peacefulness [pointing to person on watercraft]" [Included in drawing]
Pre: "[Nature makes me think of] peacefulness, because you're surrounded by a world where there's nothing to be afraid of."
Post: "[Nature makes me think of] cabins where people stay for a while. People enjoying the woods."

12
Pre: "[Nature] reminds me of when my family goes on hikes in the forest and look for mushrooms."
Post: "[Nature reminds me of] camping, campfire, roasting marshmallows, getting cold in the night in our tents and it rains, beaches, playing in the sand."

13
Pre: "I like exploring, looking at trees and stuff."

14
Pre: "You're surrounded by [nature] in the forest. Peace, no animals jump out at you."

16
Pre: "Hiking in the mountains is a good way to experience nature because of the many plants and animals." [from writing]
Post: "If we did nature on the beach, then you can do it with your family. Nature is there even if you're not in outdoor school. You can pick up sand fleas, whatever."

17
Pre: "Fun, interesting, learning, pretty, relaxing." [from writing]
Pre: "Nature has lots of fun things to explore."
Post: "Nature has things you couldn't do in regular life, in regular civilization—it has trails and things you couldn't do. There's always new things to see."

18
Pre: "[Nature makes me think about] outside, flowers, hiking, Bald Hill [a local park]."

19
Pre: "Peace, hiking in natural surroundings" [from writing; picture shows person hiking with binoculars and kayaker with word "adventures"]
Pre: "My family always took hikes and got interested in nature. When my sister and I were little we'd always go on hikes. Dad pointed out mushrooms."
Post: "I just like to think about [the sun and moon, planets, comets, galaxies, rainbows and clouds] when I'm out in the woods and see the moon. You go hiking in nature a lot and see those celestial things."

21
Pre: "Hikers" [included in picture]

22
Pre: "Hiking through the forest, seeing animals. [Nature] reminds me of nature hikes."
Post: "[Nature makes me think] sit around campfire and camp in a tent. That's what you have to do if you're going on nature hike."

25
Pre: "I like going out and watching animals do stuff."

26
Pre: "We had this area that attracted snakes. I'd hold them. I like picking up snakes." "We have a bird feeder." "I'd like to get hands-on [with nature]."
Post: "Where I was born up in Turner, Oregon I could hold snakes in my lap. That's where I learned to like nature."
Post: "This summer we're going to Arches National Park. We always go to some place new. There's always something to do at the ocean."

30
Pre: "[Nature is] fun to explore. It gets tiring to walk. I've gone on lots of hikes. I always read the signs."

31
Pre: "[Nature makes me think of] waterfalls, one particular one me and my grandma always go to."

32
Pre: "Camping, peacefulness." [included in writing]
Post: "Fun, learning experience." [included in writing]

33
Pre: "[Nature is] exciting, see new things."
Pre: "Excitement, life, passion, hiking, beautiful." [included in writing]
Post: "Adventure—you get to explore new things."

34
Pre: "Peace, gardens" [included in writing]

35
Pre: "I go in animals' territory all the time. I want to make my own house with sticks."

36
Pre: "Nature to me means forest and jungles and stuff. Nature also means to me outside and to do what you want to."
Post: "I don't really see much nature except when camping."

37
Pre: "Fun, excitement, adventure, hiking, climbing, laughing, playing, swimming, enjoyable." [from writing]
Pre: "[I have 'medium' interest in nature] when I go and play outside sports."
Post: "It's more fun to be outdoors because there's more stuff than I realized. I notice more things. [Now my interest in nature is] HIGH."

Repeating Idea: Nature as <u>sensory</u> place

2
Post: "Some sounds are made by animals. Sound is an attribute. I think sound is part of nature."

6
Pre: "Quiet, because it's not like the city where people are making buildings and stuff."

12

Post: "Getting cold in the night in our tents and it rains."

12
Pre: "Smell." [definition]

13
Pre: "If you get poison oak it's irritating and you have to take a shower if you scratch too much."

16
Post: "[Nature is] too quiet for someone from the city."

17
Pre: "Relaxing, sounds." [definition]

19
Post: "Peace." [definition]
Post: "Smells."

20
Pre: "Natural sounds." [definition]

24
Post: "Sounds, there's lots of sounds in nature. Colors."

32
Pre: "[Nature brings to mind] something else I can't explain—a feeling."

34
Post: "Quiet, it shouldn't be really loud."

Repeating Idea: Nature as a <u>spiritual</u> place

4
Pre: "Nature is God!"

15
Pre: "God." [definition]

33
Pre: "God—because he created [nature]."
Post: "God's creation." [from definition]

Repeating Idea: Nature as a <u>resource</u> for food, medicine, air

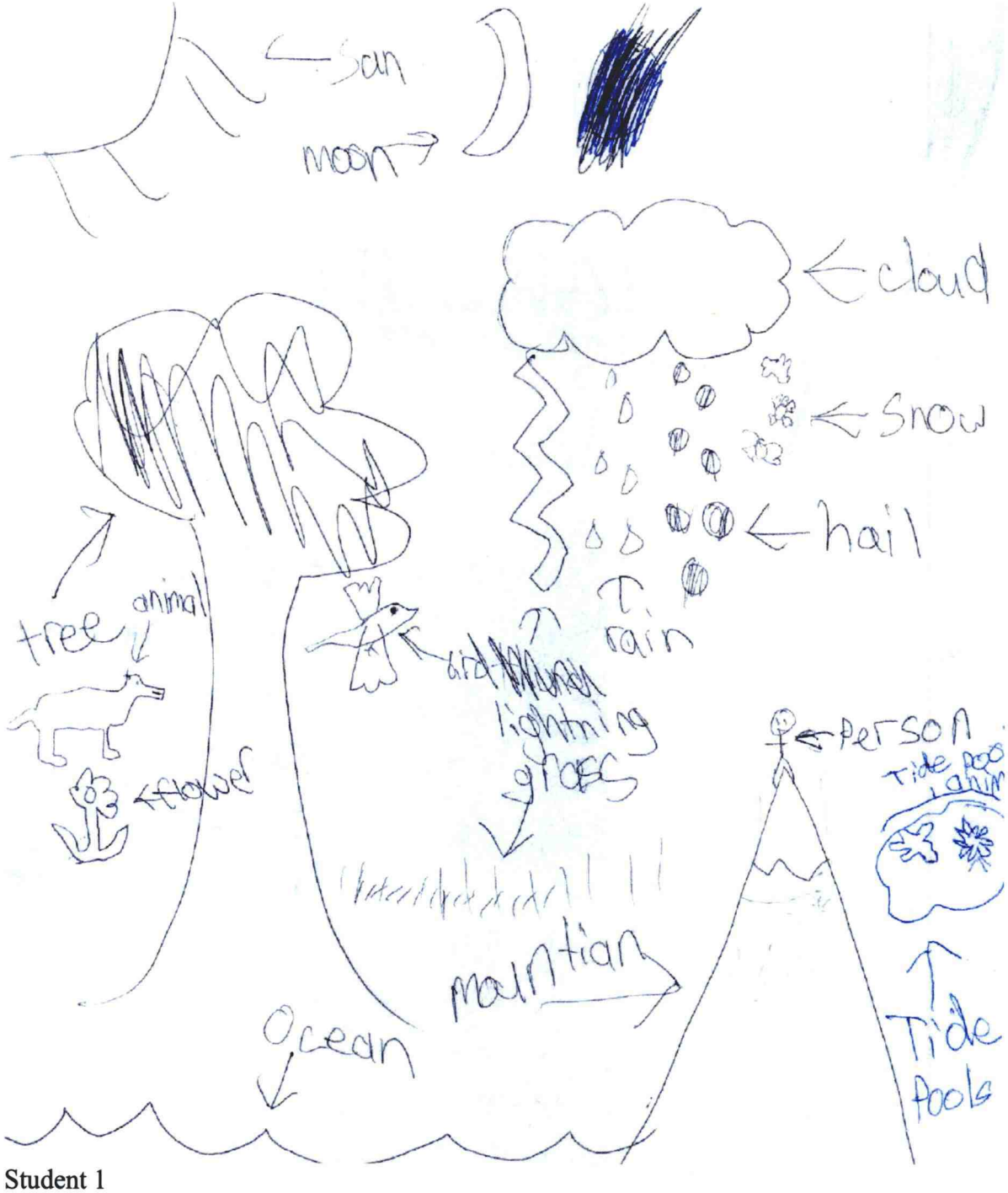
1
Pre: "[Nature is] where all our food comes from and stuff. In the beginning [food] comes from some kind of plant. Usually food starts out as some kind of plant until it reaches the store."
Pre: "We need [nature] to live, like air."

2
Pre: "Trees—air for us to breathe."

21
Pre: "Nature provides most everything from food to air, medication."
Pre: "Some plants provide medicine like aloe."
Post: "You can hunt food [in nature]. You don't need stores."
Post: "Without trees we wouldn't have air to breathe. Without rivers we wouldn't have any water. Without the sun we wouldn't be here. Without animals and bushes with food we'd have no food and we'd starve."

33
Post: "You have to know how to survive to live out in nature, [know] what foods are edible."

Appendix I: Student Drawings of Nature



Student 1

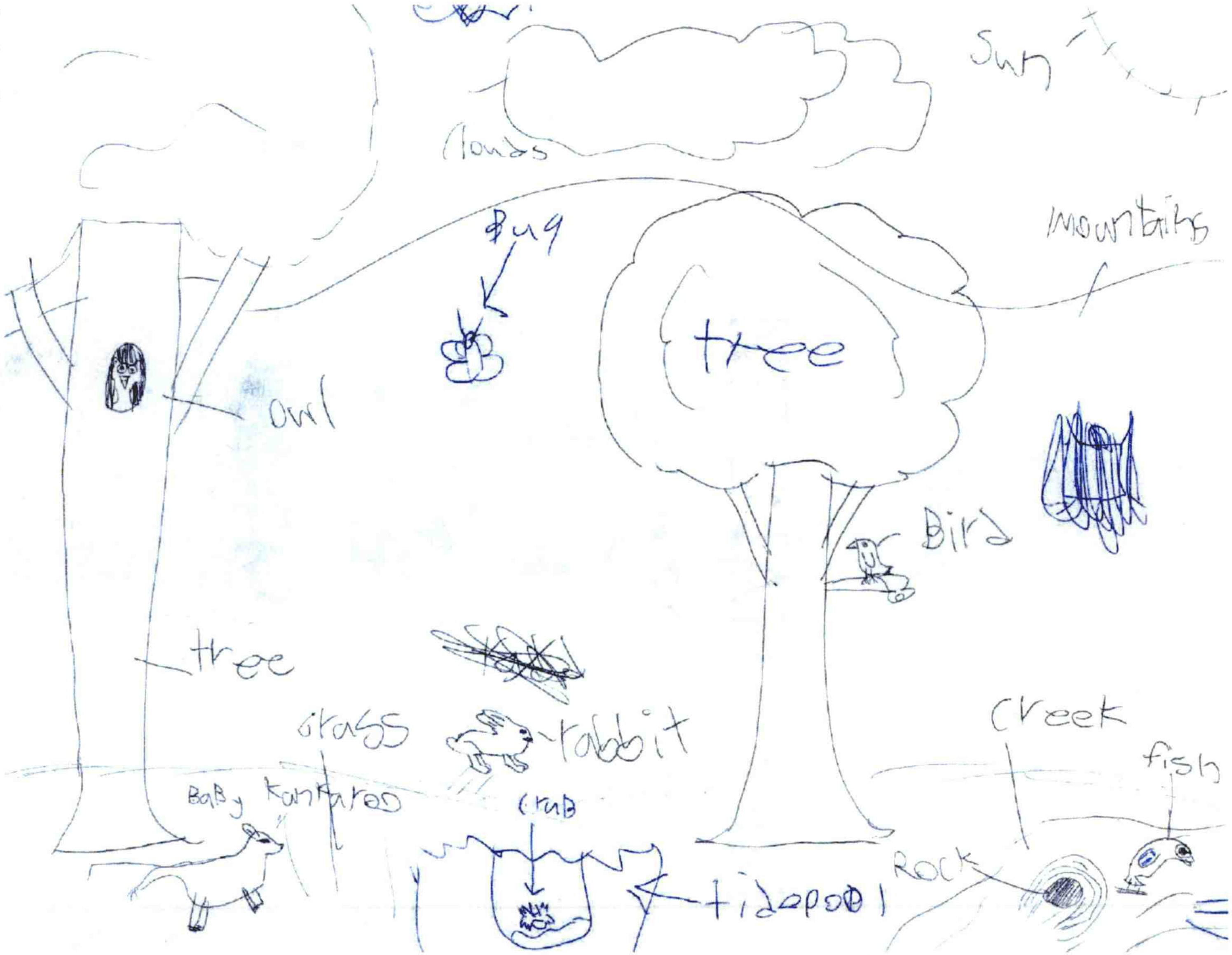
Student 7


stars (at night)
sky
sun
Thunder/ lighting
wheather
snow
or
outdoo
rain
stormy or lite clouds
clouds
birds
animal (Bird)
fruit
tree's
Leaves
birds
bugs
birds
animals (rabbit)
bark on trees
Animal (Squirrel)
power
ground
grass
animals
fowers
plants
grass
pond
dirt
grass


cloud
Sword Grass
Birds
Rocks
Squirrel
Bush
Capered
Sitca Spruce
Mountains
Tree
Flower
Stream

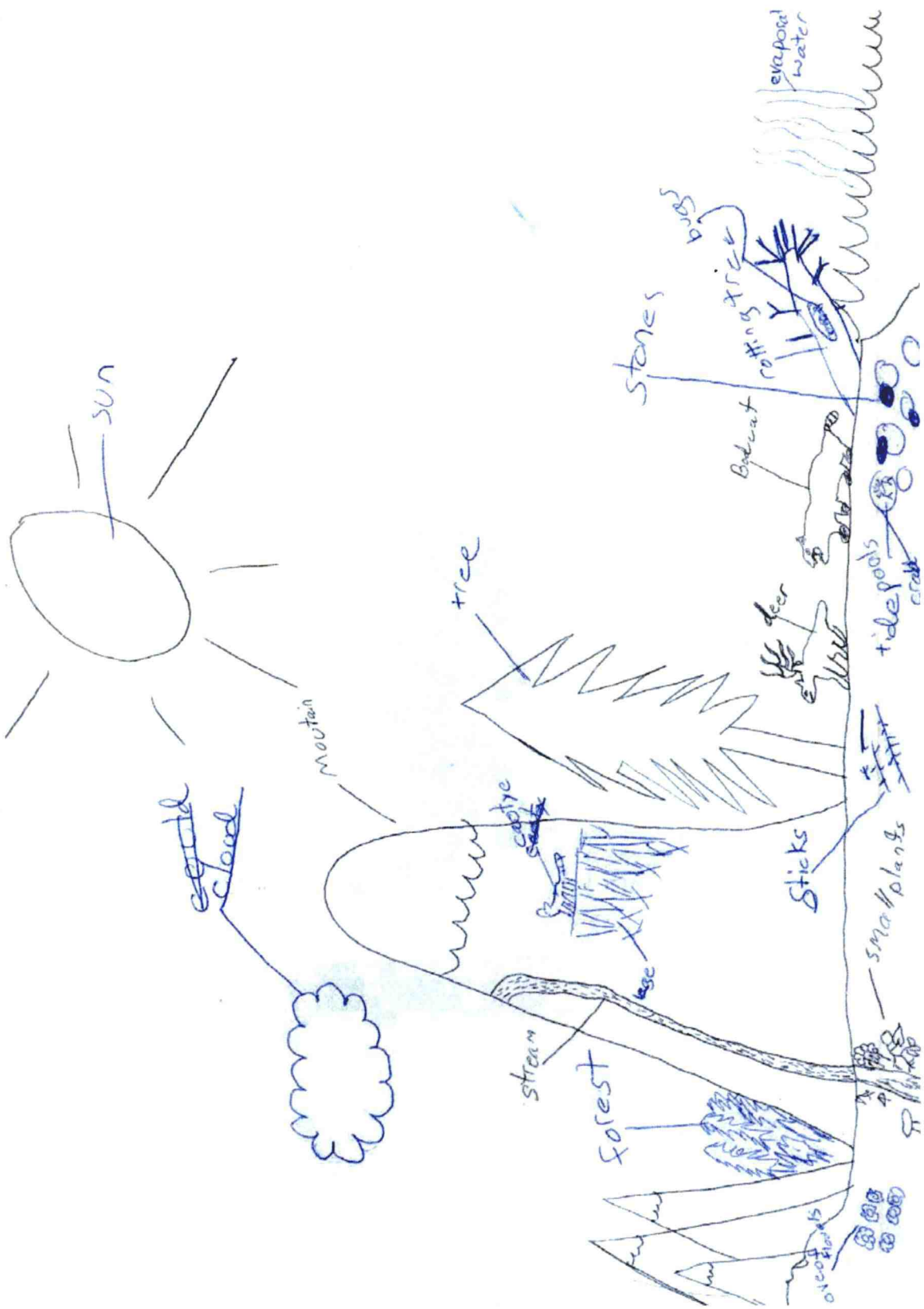
Student 8

Student 9


Sun
Clouds
mountains
Bug
tree
Owl
Bird
tree
grass
rabbit
Creek
fish
CraB
tidepool
Rock

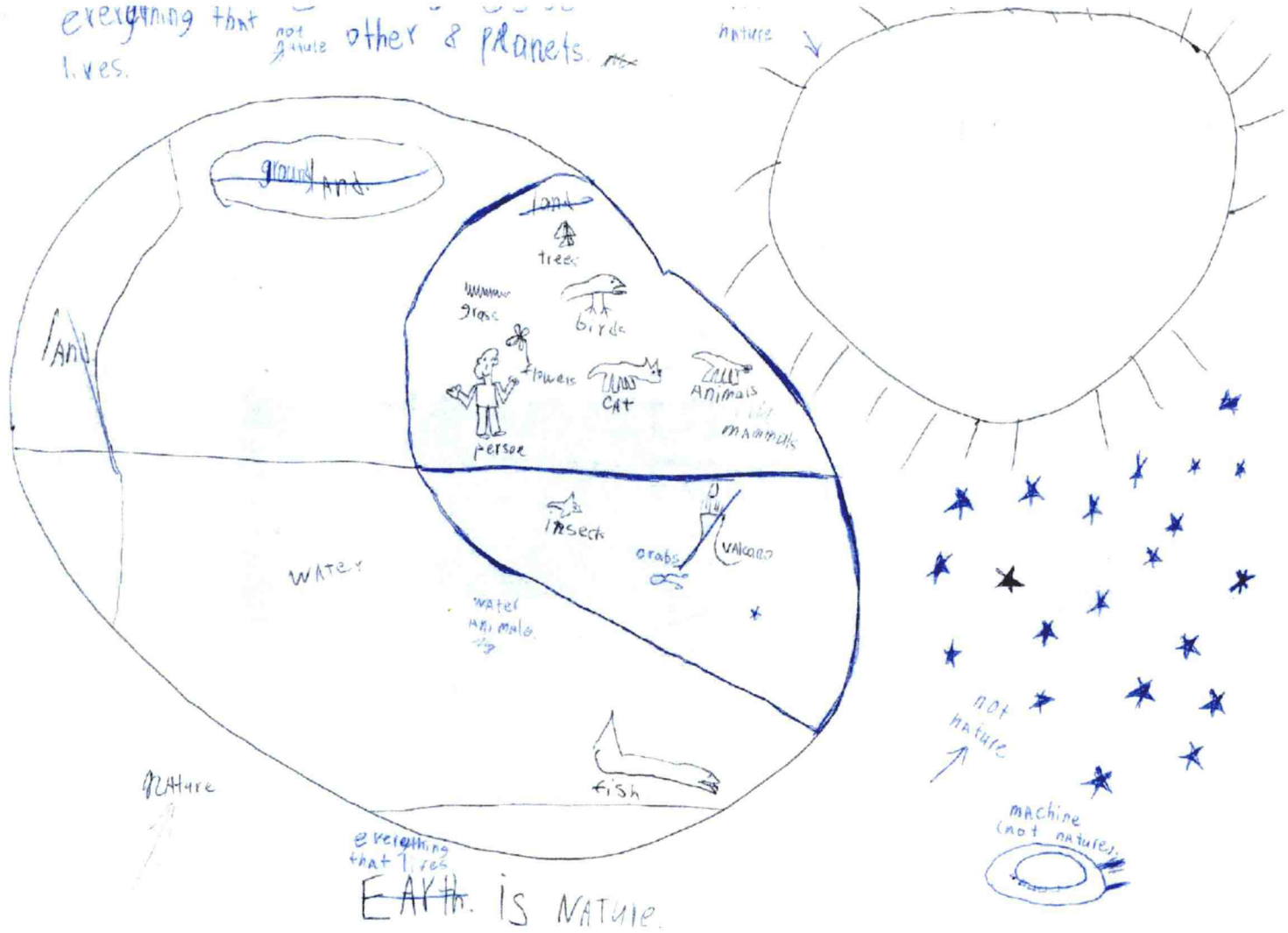
Student 12

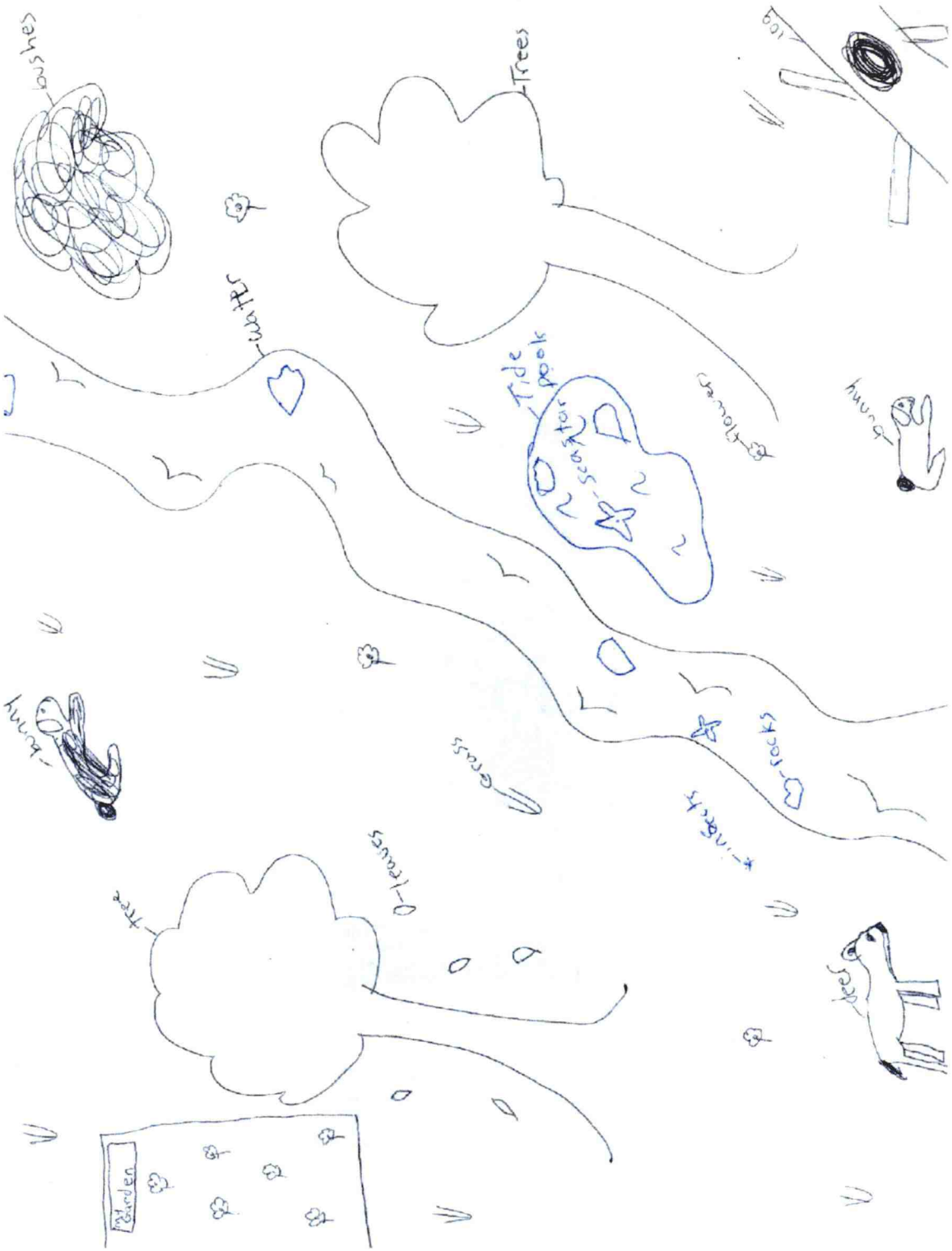

Forest
trees
bugs
plants
bushes
flowers
land
micro scopic animals
tide pools
plancton
crabs
crab
Ocean
zooplancton
fish
phydoplankton
Stream
brook
beach
lake animals
land
lake
dirt
sand


sun
cloud
mountain
tree
stream
forest
stones
birds
evaporat water
deer
tidepools
sticks

Student 25

Student 29


everything that lives
not nature other & planets.
nature
ground
land
trees
grass
birds
flowers
person
CAT
Animals
mammals
LAND
insects
crabs
VOLCANO
WATER
water animals
fish
nature
everything that lives
EARTH. IS NATURE.
not nature
MACHINE (not nature)


bushes
Trees
log
water
Tide pools
sea star
flowers
bunny
bunny
grass
rocks
rocks
tree
flowers
bed
garden

Student 34