Chapter 1: Introduction

The American Institutes for Research (AIR) conducted an evaluation to measure the impacts of week-long residential outdoor education programs for at-risk sixth graders in California. As described by California Assembly Bill (AB) Number 1330, Chapter 663, the Outdoor Environmental Education Program is designed to "foster stewardship of the environment and an appreciation of the importance of the wise use of natural resources." The program serves at-risk youth and underserved demographic groups. AB 1330 called for an independent evaluation of the program to be conducted by February 1, 2005 to examine the effects of outdoor experiences on students' behavior and learning.

The study focused on the impacts of three outdoor education programs (also referred to as outdoor science schools) on participating sixth-grade students. It was designed to determine if there were measurable changes in students' attitudes and behaviors in relation to the environment, their knowledge of science concepts taught during these programs, and their social and emotional skills (e.g., relations with peers, behavior, self-esteem). The study is unique in that it utilizes a "delayed treatment design", whereby assessments of students who participated in an outdoor education program (treatment group) are compared to assessments of students whose participation in the program had not yet occurred (control group). The study was conducted between July 1, 2004 and January 31, 2005, for the California Department of Education (CDE), with the support of private funding.

Background

Prior research studies have documented the benefits of outdoor education programs for students. A 2004 meta-analysis of 150 outdoor learning research studies conducted between 1993-2003 found that there was substantial research evidence to suggest that outdoor adventure programs are associated with positive outcomes for young people, including attitudes toward the environment, independence, confidence, self-esteem, locus of control, self-efficacy, personal effectiveness and coping strategies; and interpersonal and social skills, such as social effectiveness, communication skills, group cohesion and teamwork (Rickinson et al., 2004). A 1998 report conducted by the State Education and Environmental Roundtable (SEER)[1], indicated that programs which use the "Environment as the Integrating Context (EIC)" approach support higher outcomes for participating students, including higher grades and scores in reading, writing, and math (Lieberman & Hoody, 1998). According to the Roundtable, EIC programs are those that utilize a set of six best practices, one of which is to "develop knowledge, understanding, and appreciation of the environment, community, and natural surroundings".

Many studies of environmental education have focused on qualitative data collection and/or pre-post-measures to determine the impacts of such programs. This study used a randomized treatment and control design to determine the impacts of three one-week resident outdoor science school (ROSS) programs in California for participating at-risk sixth-grade students. The design provides a rigorous means of identifying the outcomes associated with participation in outdoor education programs.

[1] SEER is a cooperative endeavor of 16 state departments of education, including California, working to improve student learning by integrating the environment into K-12 curricula and school reform efforts.

Environmental Education in California

California outdoor science schools are "those in which learning experiences and activities in all subject matter areas are conducted in a relatively natural environment on an extended three- to five-day resident basis. Specialized instructors, in addition to the regular classroom teacher, are usually involved. Students have, through such programs, an opportunity to gain an understanding of their interaction and interdependence with the natural world, the urban-suburban world in which most of them live, as well as with each other and all human kind."[2] Outdoor science schools in California serve fourth- through eight-grade students, using curricula aligned with the California Science Content Standards.

The California Outdoor School Administrators (COSA) association collaborates with the California Department of Education to ensure that high quality residential outdoor environmental education programs are conducted throughout the state by implementing a rigorous ROSS certification procedure. The certification team is charged with the responsibility of making a thorough inspection of the site, its administration and staffing, and the overall program which serves the students. Steps in the process include: 1) a self-study and evaluation by the local site administrator and staff; 2) a two-day on-site study and review by an accreditation team consisting of COSA members who have demonstrated professional competency in outdoor school operation and administration, and 3) a final certification by the California Department of Education to properly complete the process. As of October of 2004, there were 29 ROSS-certified outdoor schools in California.

Each of the three outdoor education programs participating in this study has full ROSS certification, as recognized by the CDE. The following criteria must be met by a program to qualify for full ROSS status:[3]

- Its operation and/or administration must be by a Local Education Agency (LEA).
- It provides a written curriculum which helps students understand the interrelationships of the living and physical components of the environment and the role of humans as participators in the ecosystem.
- It has a written curriculum that develops skills, attitudes, knowledge, and commitment concerning the wise use of natural resources and the protection and enhancement of the environment.
- It is held at a site, away from the local community of service, at which a variety of environmental phenomena may be observed and studied firsthand.
- It has personnel, facilities, materials, and equipment to permit students to observe and study environmental phenomena and interrelationships to the best advantage.
- It provides appropriate facilities and staff for the feeding and lodging of students and teachers while in attendance at the site.

[2] See Johnson and Ivie (2003, page 74, Appendix B, "Resident Outdoor Education in California – A Historical Perspective").
[3] California Education Code, Article 5, section 8760-8773, Authorization – Article 13.5 Fees Section 35335; California Health and Safety Code, Division 13, Part 2.3, Section 18897.

- It is a program that requires student participation for at least three consecutive nights.
- The program primarily serves students in grades four through eight.

Evaluation Approach

The conceptual framework, or logic model, for the study is based on recent outdoor education research findings[4] and a series of discussions with key advisors from CDE and the three participating outdoor education programs, including program administrators and teaching staff. The logic model (Exhibit 1) shows the outdoor schools' inputs, activities/strategies, outputs, expected initial results, expected intermediate results, and expected long-term results. This type of model is used to provide an explicit statement of the hypothesized connections between the inputs, activities, and outputs of ROSS-certified programs and their outcomes or intended results. Most importantly, logic models have the capacity to illuminate indirect effects by distinguishing between initial, intermediate, and longer-term impacts.[5] The initial impact of a program is the immediate impact on the target group (e.g., increased student knowledge of scientific facts). This, in turn, is expected to lead to an intermediate impact (e.g., increased understanding of science and related academic concepts). The longer-term impacts are those that may be expected over a longer period of time (e.g., improved academic scores in science and other subjects). Although some or all of the hypothesized longer-term impacts are not measurable during the time frame for this evaluation, they are included in the model so as not to lose sight of the notion that intermediate impacts may lead to even more significant long-term results.

The research questions, performance indicators, and measurement methods for this study were thus based on the hypothesized relationships shown in the logic model. The study focused primarily on the expected impacts of outdoor education programs on students' social-emotional skills and environmentally responsible behavior. Furthermore, we examined impacts on students' knowledge and understanding of the science concepts that comprise the outdoor education program curriculum.

[4] We primarily used the following two studies: Lieberman, Hoody, and Lieberman (2000) and North American Association for Environmental Education, and National Environmental Education & Training Foundation (2001).

[5] United Way of America (1996).

Exhibit 1: Logic model for outdoor education programs

Inputs →	Activities/ Strategies →	Outputs →	Expected Initial Results →	Expected Intermediate Results →	Expected Long-term Results
What a program has to work with	*Processes it uses*	*What it produces*	*Initial impact on target group*	*Intermediate impact on target group*	*Benefit to students*
Program budget Facilities Staffing Curriculum/Field Guides	Teacher and student pre-session preparations Experiential (hands-on) learning Individual and group activities Paper/pencil tasks Social activities (e.g., cleaning up the bed, washing dishes, preparing meals)	One-week program for outdoor-based residential instruction tied to California K-12 content standards	Program participation increases the knowledge of facts and skills of students: - environmental ed - science - social studies - other Experiential and residential program increases students' personal and social skills (e.g., self-esteem, self-awareness, self-regulation, cooperation, respect, friendship, leadership, conflict resolution, independence, self-reliance)	Increased understanding of science and related academic concepts Increased appreciation for biodiversity, ecology of natural environments, and conservation Increased motivation to learn Increased levels of cooperation and friendship among peers Improved locus of control Improved attitude toward school • Improved student attendance • Decreased classroom/school disciplinary actions • Improved student teacher relationships.	Students show improved academic scores in science and other subjects. Students are motivated to pursue careers in science and related fields. Students demonstrate environmentally responsible behavior. Students show increased rate of high school completion. Students show increase in the number of science electives / AP classes taken.

Research Questions

The specific research questions addressed in this study are as follows:

1) How does participation in outdoor education programs impact students' personal and social skills (e.g., self-esteem, cooperation, teamwork)?

2) How does participation in outdoor education programs foster students' stewardship of the environment and their appreciation of the importance of the wise use of natural resources?

3) How does the science instruction received through the outdoor education program curriculum increase students' knowledge and understanding of science concepts?

Evaluation Design

This study focused on at-risk sixth-grade students from four elementary schools who attended three outdoor education programs between September and November of 2004. The evaluation utilized a "delayed treatment design." Within participating elementary schools, sixth-grade children were divided, by classroom, into two groups. Approximately half of each school's sixth grade (one or more classrooms) attended outdoor school between September and November of 2004 and served as the treatment group. The remaining sixth grade classrooms were scheduled to attend outdoor school after the study's data collection period ended in December 2004, thereby serving as the control group during the study period. In this manner, the study utilized a treatment and control design without denying any child the opportunity to attend outdoor science school. A full description of the study's methodological approach is included in Chapter 2. Findings, addressing each of the three research questions, are included in Chapter 3. Chapter 4 presents qualitative data gathered from elementary school teachers and outdoor education staff. Chapter 5 includes a summary of findings and conclusion.

Chapter 2: Methodology

This chapter describes the methodology employed during the study. It details the participating outdoor education programs and elementary schools, the various data collection strategies and tools, and the analyses that were carried out to address the research questions.

Participating Outdoor Education Programs

The CDE, in consultation with AIR, selected three ROSS-certified outdoor science schools as the target programs for the study. Geographically diverse, the schools are located in rural areas near Fresno, Los Angeles, and San Diego. The programs serve fourth- and sixth-grade students during week-long residential programs, and use curricula that align with the California State Science Framework and the California Academic Content Standards for science (see Appendix A for a list of the specific academic content standards that align with the outdoor school program curriculum). The hands-on, inquiry-based curriculum is designed to help students understand the environment and the role of humans as participants in ecosystems, as well as develop their skills, attitudes, knowledge and commitment concerning the natural world. While instructional activities vary somewhat across the outdoor education programs participating in the study, the content of the curricula is consistent, focusing primarily on ecology and earth science.

Across the three outdoor education programs, a total of approximately 31,000 children are served each year, including children in fourth- through sixth-grade. In a typical year, the three outdoor schools serve a combined total of approximately 19,000 sixth-grade students (two of the outdoor schools serve approximately 8,000 sixth-grade students each and the third outdoor school serves approximately 3,000 sixth-grade students). The outdoor science schools in this study do not maintain eligibility criteria for participating elementary schools. That is, the outdoor schools frequently serve elementary schools with at-risk student populations (such as those included in this study). However, elementary schools representing any socio-economic population have the opportunity to attend the programs.

Students arrive at the program on Monday and live on site, in cabin groups, until they depart on Friday. A typical day at outdoor school includes morning cabin chores, breakfast, a morning (or all day) “trail” involving science lessons/activities, lunch, an afternoon “trail” for additional science lessons/activities, dinner, cabin time, and evening activities (e.g., a night hike, social activity). Students are assigned chores and tasks throughout the week (e.g., setting up for meals, clean-up). With the help of their cabin leader, students are responsible for keeping their cabin neat and clean, setting and cleaning tables during meals, and working cooperatively with their cabin mates to accomplish the tasks of daily living.

Instruction at outdoor school typically takes place in small groups "on the trail". Concepts that are taught at the outdoor school are supported by hands-on experiences such as:

- observing and identifying birds with binoculars and a field guide manual,
- searching for and identifying aquatic insects in a stream or pond,
- identifying species of trees and drawing conclusions on the "health" of the immediate forest,
- hunting for wildlife clues such as animal tracks or scat,

- collecting mineral specimens and testing them for hardness, pH, and physical characteristics,
- looking for examples of natural recycling such as a decomposing log, a fungus or an animal serving as a decomposer,
- observing planets and distant galaxies through the telescope at the observatory, and
- viewing the night sky and learning about the constellations and the associated mythology.

Combined with these types of learning activities, outdoor science schools also offer students a range of social experiences. Students meet peers from different schools, communities, ethnicities, cultures and religions. Throughout the week, they work together as a team to problem solve, share meals and chores, and participate in evening social activities. Students take responsibility to dress, bathe, and keep themselves groomed without their parents' supervision. For many students, outdoor school is the first time they have been away from home for an extended period.

Outdoor school teaching staff have bachelor's degrees and many also maintain a California teaching credential, although it is not required by the programs. Elementary classroom teachers accompany their students to the program. In general, classrooms teachers join children on lessons and activities, assisting the lead outdoor school teacher when needed, meeting with children informally or during structured times, and attending meals and social activities.

Participating Elementary Schools

Four California elementary schools participated in the study. The original study design called for three elementary schools with four or more sixth-grade classrooms to participate, each school attending one of the three outdoor education programs. This was accomplished for two of the outdoor education programs. The third outdoor education program attempted to recruit an elementary school, located within their service area, with four sixth-grade classrooms. Because most elementary schools in the program's service area did not have a student population to fill four sixth-grade classrooms, two elementary schools (schools 3 and 4 in Table 1) were invited by the outdoor program to participate in the study. A total of 341 sixth-grade students currently attend the four participating elementary schools. All sixth-grade children (and one of their parents or guardians) at the four participating schools were asked to provide consent to participate in the study.

Characteristics of the four participating elementary schools are listed in Table 1. As shown, the four schools serve mostly Hispanic children (ranging from 69 percent to 89 percent of the student population) and have a high proportion of English Learners (32 percent to 66 percent of students). Eighty-one to 100 percent of the children in each school qualify for the free and reduced price lunch program.

Table 1. Elementary school characteristics (2003-2004 school year)

School	Total Enrollment and 6th Grade Enrollment*	Student Ethnicity**	English Learners	Free/Reduced Lunch Program	API State Rank
1	815 total students 111 6th grade students	Hispanic = 80% Filipino = 11% Multiple or no response = 4% White = 3% African American = 1% Asian = 1%	50%	100%	3
2	794 total students 110 6th grade students	Hispanic = 89% White = 2% African American = 2% Asian = 1% Filipino = 7% Pacific Islander = 1%	66%	100%	3
3	693 total students 70 6th grade students	Hispanic = 79% Asian = 20% Filipino = 1% White = 1%	62%	94%	3
4	432 students 50 6th grade students	Hispanic = 64% Asian = 26% White = 7% African American = 1% Filipino = 1% American Indian or Alaska Native = 1% Pacific Islander = 1%	32%	81%	4

Source: California Department of Education, 2003-2004 Data Quest
*Sixth-grade enrollment for the 2004-2005 school year, as reported by each school principal.
**Totals may not sum to 100 percent due to rounding error.

Data Collection Strategies

Data collection included the use of surveys and site visits between September and December of 2004. Data were only collected from children for whom informed consent had been granted (via signed consent forms) by the child and parent. Parents also provided their consent prior to completing the parent surveys. Participation in the evaluation did not impact students' opportunity to attend the outdoor school in any way.

Surveys. Students, parents, and teachers were surveyed. AIR staff administered three rounds of surveys: before the treatment group attended outdoor school (Round 1 pre-survey), immediately after the treatment group returned from outdoor school (Round 2 first post-survey), and six to ten weeks after the treatment group returned from outdoor school (Round 3 second post-survey)[6]. Students were surveyed in all three rounds, and parents and teachers were surveyed in Round 1 and Round 3. Student responses from Rounds 1 and 2 were used to determine the immediate impacts of participation in outdoor education, while student, parent, and teacher responses from Rounds 1 and 3 were analyzed to explore the longer-term impacts of the program.

[6] The Round 3 survey was administered to students in all schools during the same week, at the latest possible point in the study, in order to determine the longer-term impacts of program participation. Because schools attended the outdoor education programs at different times, the Round 3 survey was administered at a range of six to ten weeks following program participation.

Site Visits. Research staff conducted one-day site visits to each of the three outdoor schools during the same week the treatment group attended each program. Staff observed instructional activities while on-site and conducted in-person interviews or focus groups with the sixth-grade teachers of participating students. Teachers were asked to provide input regarding the perceived benefits of outdoor school for students, how the program impacted specific groups of students, and how the outdoor school experience was integrated into their classroom teaching. In addition, AIR staff interviewed the principals of the outdoor schools to gather descriptive information and solicit their input regarding the impacts of the program.

Data Collection Tools

Surveys were administered to students, parents, and elementary school teachers. Copies of the surveys are included in Appendix B[7].

Student Survey. The student survey was designed to collect information on five individual social-emotional scales, on three scales regarding attitudes toward the environment, and (for the treatment group only)[8] on overall knowledge of science-related topics that are taught at the outdoor schools. The social-emotional scales and two of the environmental scales were measured using an 11-point scale (0 Strongly Disagree – 10 Strongly Agree). For example, statements included "I feel good about myself" and "I like science." The third environmental scale utilized a two-point (yes/no) response option (e.g., "Do you separate things at home for recycling?). The science items were measured through a series of nine multiple-choice questions and one open-ended question. Students who attended outdoor school also responded to one open-ended question on the Round 3 survey to collect qualitative responses about the impact of outdoor school.

Parent Survey. The parent survey contained the same set of items and rating scales included in the student survey (revised to align with the parent's perspective), excluding the science-related items. Parent survey statements included "My child feels good about him/herself." and "My child likes science." The parent survey was available in English and Spanish.

Table 2 summarizes the scales (constructs) that were included in the student and parent surveys.

[7] Items in the surveys that related to the social-emotional and environmental scales were based on a review of existing tools used in environmental education research, primarily the Life Effectiveness Questionnaire (Neill & Richards, 2003).

[8] The science-related survey items were not administered to children who did not attend outdoor science school (the control group), due to the reality that control group children did not necessarily have the opportunity to learn the same academic (science) content during the week the treatment group students attended outdoor science school (or even during the six-week period following the treatment group's participation, after which the Round 3 surveys were administered to both groups). Thus, it would be unfair to compare treatment and control groups on the science content that was known to have been covered during outdoor school, but not necessarily covered by the control classrooms during the same week or in the six weeks following. In addition, the content of classroom instruction for children who did not attend outdoor education could not be rigorously controlled.

Table 2. Student and parent survey scales

Scales	Number of Survey Items	Survey Item Response Options
Social-Emotional Scales		
Self-esteem	5	11-point scale (strongly disagree to strongly agree)
Cooperation	2	
Leadership	1	
Conflict resolution	3	
Relationship to teacher	2	
Environmental Scales		
Concern about conservation	3	11-point scale (strongly disagree to strongly agree)
Attitude toward science	2	
Environmental behaviors	16	2-point scale (yes/no)
Science Knowledge Scale		
Total science score	10	Nine multiple choice items and one open-ended question, scored as "0", ".5", or "1" using a scoring rubric.[9] Maximum score = 19 points

We measured the internal consistencies of the five social and personal and the three environmental attitudes scales by Cronbach's alpha. Items included in the social and personal scales and two of the environmental scales were measured using an 11-point scale (0 Strongly Disagree – 10 Strongly Agree). Table 2 details the number of survey items used in each scale and a description of the response options. In sum, the numbers of individual survey items included in these scales are: self-esteem = 5, cooperation = 2, leadership = 1[10], conflict resolution = 3, relationship with teacher = 2, attitude toward science = 2, and concern about conservation = 3. The environmental behavior scale was composed of 16 dichotomous (yes/no) questions by counting the number of "yes" responses. In order to adjust the different numbers of items included in these scales, we report Standardized Cronbach's alpha in Appendix C. The "attitude toward science" construct had a relatively low alpha coefficient (.519) in the first round of survey data, however, this same construct shows higher coefficients in the two subsequent data collection rounds. All of the other constructs showed an acceptable level of reliability.

Teacher Survey. Teachers completed a short assessment of each child, using the 0 to 10 rating scale on eight constructs: self-esteem, relationships with peers, effective problem solving, conflict resolution, cooperation and teamwork, effective leadership, motivation to learn, and behavior in class. In the second teacher survey, teachers of the treatment group students also responded to open-ended questions regarding how the outdoor school program impacted their students.

[9] The open-ended question on the science section of the survey stated, "List two new ideas you can do to take care of the Earth." Student responses were scored using a "0", ".5", and "1" rating system, based on a scoring rubric. "0" responses were incomprehensible or nonapplicable. ".5" responses were applicable but nonspecific. "1" responses were applicable and included specific ways to take care of the Earth.

[10] The leadership scale originally included two items; however, one of the items used a reverse question, which caused inconsistency with the other item. Thus, we decided to drop the reverse question item and the leadership scale subsequently consisted of one item.

Survey Responses

Table 3 shows the number of students, parents, and teachers for whom we asked for consent to participate in the study, the number of consenting participants, and the number of surveys received from students, parents, and teachers in each round of data collection.

Table 3. Survey responses

Survey Respondents	Number of Participants	Number of Consenting Participants	Number of Surveys Received, by Data Collection Round		
			Round 1	Round 2	Round 3
Students	341	255	245	216	236
Parents	341	257	212	n/a*	193
Teachers	14	14	14	n/a*	14

*Parents and teachers were only surveyed in Round 1 and Round 3 of the study.

Table 4 reflects the number of treatment and control children in the study, by data collection round. In all but one school, children were randomly assigned to the treatment and control groups at the classroom level. In this school, three lead teachers taught two groups of sixth-grade children equally and the school did not consider the groups as separate classrooms. In this case, the school preferred to randomly select children on an individual level, rather than create artificial classroom groups.

Table 4. Number of treatment and control student surveys received, by data collection round

Student Group	Round 1	Round 2	Round 3
Treatment	125	127	119
Control	109	118	106
"Drop-outs" from Treatment Group*	0	10	11

*Some children originally assigned to the treatment group (attending outdoor school) did not participate in the program (e.g., they were ill, their parents decided to not send their child, etc.).

Data Analysis

The following section describes the strategies used to analyze the quantitative survey data and the qualitative interview and focus group information.

Quantitative Analysis. After data collection was completed, the survey results were recorded as electronic data files. Scales for five social and personal constructs, three environmental attitude scales, and an overall science score, were developed from individual survey items. The reliability of these constructs (scales) was assessed by calculating Cronbach's alpha, which measures the extent to which the scale items are measuring a common, underlying construct. Appendix C includes the exploratory analyses.

Based on an analysis plan developed for the study, two independent sample t-tests were used to detect statistically significant differences between various student groups and subgroups (e.g., treatment versus control groups, male versus female, Hispanic versus non-Hispanic students).

Paired-sample t-tests were employed to examine significant gain scores within groups. Similar analyses were conducted for survey data from parents and teachers. The criterion used for statistical significance was $p<.05$[11].

Qualitative Analysis. The qualitative data collected through the site visits, interviews, and surveys were reviewed and common themes were identified across respondents. The qualitative data are used primarily to provide context for the quantitative survey findings, presented in Chapter 3.

Generalizations from the Sample. This study focused on 255 students, from four elementary schools, attending three ROSS-certified outdoor education programs in California. It is important to note that the study sample was primarily composed of Hispanic children, a large minority of whom were English Learners. Given the scope of the study, research findings should not be generalized to all sixth-grade students who attend outdoor education programs in California, particularly given the fact that there are a range of outdoor education programs, privately and publicly funded, with different objectives and structure within the state. However, as described in the following chapter, findings from this study indicate positive outcomes for at-risk sixth-grade students who attend established, ROSS-certified outdoor education programs.

[11] Many of these analyses were intended to be exploratory in nature. For example, while our major interest was overall program impact, we also investigated whether the program might have differential impacts on certain subgroups (i.e., males versus females; Hispanics versus non-Hispanics). One often adjusts the alpha level downward to compensate for the increased probability of error when multiple statistical tests are performed on the same data. Since the objective of our exploratory analyses was the identification of possible effects (to enable further focused research rather than the scientific demonstration of these impacts, we did not adjust the statistical significance criterion to account for the number of statistical tests conducted. (See Pernerger, 1998, who further argues that, even when the use of such adjustments might be considered, the most common of these [such as the Bonferroni adjustment] are too conservative and increase the likelihood of Type II errors.) Nonetheless, when Bonferroni adjustments would result in findings being deemed non-statistically significant, these findings are footnoted.

Chapter 3: Research Findings

In this chapter, we present the study findings for each of the three research questions. Quantitative student, teacher, and parent survey data are used to address each research question. Qualitative information collected through the site visits, interviews, and open-ended survey responses is presented in Chapter 4, to help provide context for the findings.

For each research question, we present data from student, parent, and/or teacher surveys. Students, parents, and teachers were surveyed before the treatment group attended the outdoor science schools and then six to ten weeks after the treatment group's return. All students were also surveyed the week following the treatment group's program participation, in order to determine the more immediate student-level impacts of the program. Therefore, student survey responses are presented to explore both the immediate and longer-term impacts of program participation. Table 5 shows the types of survey data that were used to address each of the three research questions.

Table 5. Survey data used to address each research question

Research Question (RQ)	Data Source: Immediate Impacts (Round 1 and 2 Surveys)	Data Source: Longer-term Impacts (Round 1 and 3 Surveys)
RQ1: How does participation in outdoor education programs impact students' personal and social skills?	Student Survey Parent Survey Teacher Survey	Student Survey Parent Survey Teacher Survey
RQ2: How does participation in outdoor education programs foster students' stewardship of the environment and their appreciation of the importance of the wise use of natural resources?	Student Survey Parent Survey	Student Survey Parent Survey
RQ3: How does the science instruction received through the outdoor education program curriculum increase students' knowledge and understanding of science concepts?	Student Survey	Student Survey

Research Question #1: How does participation in outdoor education programs impact students' personal and social skills (e.g., self-esteem, cooperation, etc.)?

To determine the impact of outdoor education programs on students' personal and social skills, students and parents were surveyed on five constructs: self-esteem, leadership, cooperation, conflict resolution, and students' relationship with their teacher. Teachers provided a global rating (rather than responding to multiple survey items for each construct) for each child on self-esteem, relationships with peers, effective problem solving, conflict resolution, cooperation and teamwork, effective leadership, motivation to learn, and behavior in class.

Student Assessments

Immediate Impacts of Outdoor Education. Table 6 shows the student assessment scores from the pre-survey to the first post-survey (immediate impacts of program participation) for the treatment and control groups. It includes students' average pre-survey scores, average post-survey scores, the average gain, and percent gain. According to student data, children who participated in outdoor school showed positive gains on all five constructs: self-esteem, cooperation, leadership, conflict resolution, and relationship with teacher, immediately after program participation. In contrast, children who did not attend the outdoor school showed losses on two of the five constructs: cooperation and conflict resolution, although these losses were not statistically significant. The control group also showed significant gains in leadership ($p<.05$).

Of the five constructs in which children who attended outdoor school showed gains, one construct showed statistically significant gains: conflict resolution ($p<.05$). However, the difference between the treatment and control groups on conflict resolution was not statistically significant.

Table 6. Student assessments, (mean scores), pre-survey to first post-survey (immediate) gains in self-esteem, cooperation, leadership, conflict resolution, and relationship with teacher

Group	N	Pre-survey	Post-Survey	Gain	Pct Gain
Self Esteem					
Control	106	8.34	8.54	0.19	2.33%
Treatment	125	8.07	8.29	0.22	2.69%
Leadership					
Control	102	7.04	7.53	0.49!	6.96%
Treatment	118	6.61	7.11	0.50	7.56%
Relationship with Teacher					
Control	106	8.24	8.34	0.10	1.26%
Treatment	124	7.85	8.11	0.27	3.39%
Cooperation					
Control	106	8.13	8.00	-0.13	-1.57%
Treatment	125	7.68	7.75	0.08	0.99%
Conflict Resolution					
Control	106	7.70	7.61	-0.08	-1.08%
Treatment	125	7.08	7.48	0.41!	5.77%

Statistically significant changes in scores, within group, are indicated by exclamation points: !$p<.05$; !!$p<.01$; !!!$p<.001$.
Statistically significant differences between treatment and control group gain scores are indicated by asterisks: *$p<.05$; **$p<.01$; ***$p<.001$.

Longer-Term Impacts of Outdoor Education. Students completed the same survey six to ten weeks after the treatment group's program participation. Table 7 shows the student assessment scores from the pre-survey to the second post-survey (longer-term impacts of program participation) for the control and treatment groups. It includes students' average pre-survey scores, average second post-survey scores, the average gain, and percent gain.

Table 7. Student assessments, (mean scores), pre-survey to second post-survey (longer-term) gains in self-esteem, cooperation, leadership, conflict resolution, and relationship with teacher

Group	N	Pre-survey	2nd Post-Survey	Gain	Pct Gain
Self Esteem					
Control	102	8.42	8.45	0.03	0.34%
Treatment	110	8.04	8.15	0.11	1.38%
Leadership					
Control	101	7.11	7.27	0.16	2.23%
Treatment	103	6.41	6.99	0.58!	9.02%
Relationship with Teacher					
Control	102	8.09	8.09	0.00	0.06%
Treatment	110	7.86	8.19	0.32	4.10%
Cooperation					
Control	102	8.15	7.93	-0.23	-2.77%
Treatment	110	7.57	7.93	0.35*	4.68%
Conflict Resolution					
Control	102	7.87	7.21	-0.66!!	-8.33%
Treatment	110	7.06	7.52	0.46!***	6.50%

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001. Statistically significant differences between treatment and control group gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

Six to ten weeks following program participation, children who attended outdoor school showed significant positive gains on two of the five constructs: leadership (p<.05) and conflict resolution (p<.05). In contrast, the control group showed losses on two of the five constructs. One of these control group losses was significant (conflict resolution, p<.01).

Children who attended outdoor education had significantly higher gains in cooperation and conflict resolution, compared to children who did not participate in the program (p<.05 and p<.001, respectively). The treatment group showed its largest gain (9 percent) in the area of leadership.

In sum, according to student assessment data, there were no significant differences between children who attended outdoor science school and those who did not attend, immediately after program participation. However, six to ten weeks later, children who attended the program showed significantly higher gains in cooperation and conflict resolution, compared to children who did not participate.

Parent Reports

Parents completed surveys before the treatment group attended outdoor school and six to ten weeks later. Parent survey data are presented in Table 8. It includes average pre-survey scores, average post-survey scores, the gain, and percent gain.

Table 8. Parent reports, (mean ratings), pre-survey to post-survey gains in self-esteem, cooperation, leadership, conflict resolution, relationship with teacher

Group	N	Pre-survey	Post-Survey	Gain	Pct Gain
Self Esteem					
Control	69	8.46	8.51	0.05	0.57%
Treatment	92	8.35	8.34	-0.02	-0.23%
Leadership					
Control	68	7.80	7.67	-0.13	-1.70%
Treatment	92	7.27	7.49	0.22	3.03%
Relationship with Teacher					
Control	69	8.43	8.48	0.05	0.60%
Treatment	92	8.53	8.27	-0.26	-3.06%
Cooperation					
Control	68	8.47	8.40	-0.07	-0.83%
Treatment	92	8.45	8.35	-0.11	-1.25%
Conflict Resolution					
Control	69	7.84	7.98	0.14	1.79%
Treatment	92	7.76	7.95	0.19	2.43%

Parent ratings of their children did not reveal any significant differences in the five social-emotional constructs between children who attended outdoor school and those who did not. According to parent reports, children who attended outdoor school showed positive gains on two of the five constructs (leadership and conflict resolution), although these gains were not significant. In addition, the treatment group showed losses on three of the five constructs (self-esteem, relationship with teacher, and cooperation), yet none of these losses were statistically significant.

Teacher Reports

Teachers rated all children before the treatment group attended outdoor school and six to ten weeks later. Teacher survey data is presented in Table 9, which includes ratings on eight constructs for the control and treatment groups, with the average pre-survey rating, average post-survey rating, the average gain, and the percent gain.

Table 9: Teacher ratings, (mean ratings), pre-survey to post-survey gains in self-esteem, cooperation, leadership, conflict resolution, relationship with peers, problem solving, motivation to learn, and behavior in class

Group	N	Pre-survey	Post-Survey	Gain	Pct Gain
Self-Esteem					
Control	115	7.18	7.04	-0.14	-1.94%
Treatment	123	6.49	7.11	0.63***!!!	9.65%
Leadership					
Control	115	5.79	6.41	0.62!!	10.66%
Treatment	118	6.56	7.04	0.48!!	7.36%
Relationship with Peers					
Control	115	7.64	7.14	-0.50!!	-6.60%
Treatment	123	7.13	7.96	0.83***!!!	11.63%
Motivation to Learn					
Control	115	7.10	6.90	-0.20	-2.82%
Treatment	123	7.15	7.46	0.31*!	4.32%
Cooperation					
Control	115	7.17	7.17	-0.01	-0.12%
Treatment	123	7.40	7.76	0.37!	4.95%
Conflict Resolution					
Control	115	6.52	6.47	-0.05	-0.80%
Treatment	123	6.59	7.36	0.77***!!!	11.73%
Problem Solving					
Control	115	6.62	6.46	-0.16	-2.37%
Treatment	123	6.24	7.52	1.28***!!!	20.44%
Behavior in Class					
Control	108	7.31	7.10	-0.20	-2.79%
Treatment	123	7.66	7.92	0.26*!	3.40%

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001. Statistically significant differences between treatment and control group gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

Teacher ratings of students provide strong evidence of the positive outcomes associated with participation in outdoor education. Students who attended outdoor science school showed statistically significant positive gains on all eight constructs. In contrast, children who did not attend the program showed losses on seven of the eight constructs, with one of these losses significant (relationship with peers). The control group showed only one significant gain, in the area of leadership.

Children who attended outdoor science school showed gains in six constructs that were significantly larger than the gains shown by children who did not: self-esteem (p<.001), conflict resolution (p<.001), relationship with peers (p<.001), problem solving (p<.001), motivation to learn (p<.05), and behavior in class (p<.05). The largest gain for children who attended outdoor school (20 percent) was in the area of problem-solving.

Although the control group showed larger gains than the treatment group in leadership, the control group's pre-survey scores were significantly lower than the treatment group's pre-survey scores for that construct. It is reasonable to assume that the control group had more room to grow in this area, and that the gain differential is artificially large. Likewise, the treatment group showed significantly lower pre-survey scores in self-esteem and relationship to peers than the control group. However, the control group showed losses on these constructs.

It is important to point out that teacher ratings may have been affected by the teachers' knowledge of which children participated in the outdoor science school and which did not. It is possible that teachers generally have favorable attitudes towards programs such as the outdoor science schools their students attend. Thus, although teachers of students in both the treatment and control groups were scheduled to send their students to outdoor science school at some point during the 2004-2005 school year, the teacher ratings of students, indicating a number of positive outcomes associated with program participation, should be interpreted with this caveat in mind.

Personal and Social Skills Subgroup Analyses

Analyses were conducted on the student survey data to determine if there were significant differences between the participating elementary schools on the five social-emotional constructs. For the purposes of analysis, Schools 3 and 4 were combined and listed in the tables as School 3 (as noted in Chapter 2, Schools 3 and 4 were smaller schools that were recruited to attend the same outdoor education program). In addition, differential effects for subgroups within the treatment groups (EL status, gender, and race) were explored. In any construct where one group's gain was significantly larger than another group (e.g. male versus female, etc.), we tested the differences in the pre-survey scores. This would tell us whether or not one group has significantly more room to grow than another group, and whether it could be reasonable to assume that the demonstrated gain differential was artificially large. If we found the pre-survey scores to be significantly different, we ran a regression model controlling for the pre-survey scores.

Between-school Differences. Among the five social-emotional constructs, significant short-term between-school differences in gains were found in the construct of leadership, as shown in Table 10. Short-term gains by students at School 1 were significantly lower than gains by students at Schools 2 and 3, and pre-test scores across schools were not significantly different.

Table 10. Between-school differences in leadership, pre-survey to first post survey (short-term) gains, by school

	Leadership		
	Pre-survey	1st Post-Survey	**Gain**: Pre to 1st Post surveys
School 1 (N=35)	7.20	6.37	-0.83*
School 2 (N=33)	5.91	7.06	1.15
School 3 (N=50)	6.66	7.66	1.00!!

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001. Statistically significant differences between schools' gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

Significant long-term between-school differences in gains were found in the construct of self-esteem, as shown in Table 11. Long-term gains by students at School 1 were significantly lower than gains by students at Schools 2 and 3, and pre-test scores across schools were not significantly different.

Table 11. Between-school differences in self-esteem, pre-survey to second post survey (longer-term) gains, by school

Self Esteem			
	Pre-survey	2nd Post-Survey	**Gain**: Pre to 2nd Post surveys
School 1 (N=29)	8.24	7.56	-0.68*
School 2 (N=32)	7.72	8.08	0.36
School 3 (N=49)	8.13	8.54	0.42!

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001. Statistically significant differences between schools' gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

Subgroup Effects. Based on student reports, we did not detect any significant differences between EL students and non-EL students, male and female students, or race groups on any of the five social-emotional constructs.

We also examined teacher reports of EL students versus non-EL students to detect any subgroup differences. Among students who attended outdoor science school, data from teacher reports indicate that English Learner (EL) students benefited more than non-EL students in some areas. As shown in Table 12, EL students showed significant gains on all of the eight constructs that were measured, whereas non-EL students showed significant gains in two constructs (conflict resolution and problem solving). EL students demonstrated gains in cooperation, leadership, relationship with peers, and motivation to learn that were significantly larger than the gains shown by non-EL students in those constructs. Both EL and non-EL students showed their largest gains (22 percent and 15 percent, respectively) in the area of problem solving. In sum, among students who attend outdoor science school, these findings suggest the program is especially beneficial to EL students across a number of social and personal skills.

Table 12. Teacher reports, (mean ratings), English Learners (EL) versus Non-English Learners, (Non-EL) pre-survey to post-survey gains in self-esteem, cooperation, leadership, conflict resolution, relationship with peers, problem solving, motivation to learn, and behavior in class

Group	N	Pre-survey	Post-Survey	Gain	Pct Gain
Self-Esteem					
EL	87	6.39	7.09	0.70!!!	10.97%
Non-EL	33	6.67	7.06	0.39	5.91%
Leadership					
EL	82	6.54	7.23	0.70!!!*	10.63%
Non-EL	33	6.58	6.48	-0.09	-1.38%
Relationship with Peers					
EL	87	6.97	8.03	1.07!!!**	15.35%
Non-EL	33	7.39	7.58	0.18	2.46%
Motivation to Learn					
EL	87	7.17	7.76	0.59!!!**	8.17%
Non-EL	33	7.12	6.67	-0.45	-6.38%
Cooperation					
EL	87	7.36	7.93	0.57!!*	7.81%
Non-EL	33	7.42	7.24	-0.18	-2.45%
Conflict Resolution					
EL	87	6.62	7.43	0.80!!!	12.15%
Non-EL	33	6.33	7.06	0.73!!	11.48%
Problem Solving					
EL	87	6.23	7.61	1.38!!!	22.14%
Non-EL	33	6.24	7.18	0.94!!!	15.05%
Behavior in Class					
EL	87	7.70	8.05	0.34!!	4.48%
Non-EL	33	7.55	7.52	-0.03	-0.40%

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001. Statistically significant differences between EL and non-EL gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

Summary of Research Question #1 Findings. Participation in outdoor education was associated with significantly higher ratings of cooperation and conflict resolution (longer-term student assessments). According to teacher ratings, children who attended outdoor school showed gains in six of the eight constructs measured (self-esteem, conflict resolution, relationship with peers, problem solving, motivation to learn, and behavior in class) that were significantly larger than the gains shown by the control group. Parent data did not reveal any significant differences in the five social-emotional constructs between children who attended outdoor school and those who did not.[12]

[12] For the student data, if Bonferroni adjustments are applied, the significant differences between the treatment and control groups for the construct of cooperation become insignificant. For the teacher ratings of students, if Bonferroni adjustments are applied, the significant differences between the treatment and control groups for motivation to learn and behavior in class become insignificant. In addition, significant differences between EL and non-EL students for leadership, relationship with peers, motivation to learn, and cooperation become insignificant.

Research Question #2: How does participation in outdoor education programs foster students' stewardship of the environment and their appreciation of the importance of the wise use of natural resources?

Students and parents were surveyed to determine the impact of program participation on students' stewardship of the environment and their appreciation of the wise use of natural resources. Three scales were used to address this research question: concern about conservation, environmental behaviors, and attitude toward science. Following are some examples from the items that made up each of these constructs:

- **Concern about conservation**
  - It worries me when I see people use too much water.
  - It makes me happy when people recycle used bottles, cans, and paper.
- **Environmental behaviors**
  - Do you separate things at home for recycling?
  - Do you leave the refrigerator door open while you decide what food to take out of it?
- **Attitude toward science**
  - When I grow up, I want to be a scientist.
  - I like science.

Data from student and parent surveys are included below. Teachers did not rate their students on these constructs due to concern for balancing teachers' burden with maximizing their input on students' social and emotional skills, classroom behavior, and motivation toward learning. In addition, we would expect that students' appreciation of the environment and behaviors such as recycling and energy conservation would be observed and reported best by parents and students.

Student Assessments

Immediate Impacts of Program Participation. Table 13 shows students' gains from the pre-survey to the first post-survey on three scales: concern about conservation, environmental behaviors, and attitude toward science. The treatment group showed a significant gain in concern about conservation ($p<.05$), although it was not significantly higher than the control group. While participating students showed a greater gain in their attitude toward science (5.81 percent) compared to students who did not attend the program (.64 percent), the difference between the two groups was not statistically significant. In addition, while the treatment group showed a decrease in environmental behaviors, it was not statistically significant compared to the control group. Table 13 shows the average pre-survey and first post-survey rating, the average gain, and the percent gain for the treatment and control groups.

Table 13. Student assessments, (mean scores), pre-survey to first post-survey gains (immediate gains) in concern about conservation, attitude toward science, and environmental behaviors

Group	N	Pre-survey	Post-Survey	Gain	Pct Gain
Concern about Conservation					
Control	106	6.89	6.81	-0.08	-1.14%
Treatment	125	6.11	6.62	0.51!	8.28%
Attitude Toward Science					
Control	106	5.91	5.94	0.04	0.64%
Treatment	123	5.24	5.55	0.30	5.81%
Environmental Behaviors					
Control	105	9.13	8.73	-0.40	-4.38%
Treatment	125	8.84	8.74	-0.10	-1.18%

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001. Statistically significant differences between treatment and control group gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

Longer-Term Impacts. Students completed the same survey six to ten weeks later. Table 14 shows students' gains from the pre-survey to the second post-survey on three scales: concern about conservation, environmental behaviors, and attitude toward science. Six to ten weeks after program participation, students who attended outdoor school did not show any significant losses or gains in the three scales. In contrast, the control group showed significant losses on two of the three scales: attitude toward science and environmental behaviors.

Based on student assessments, these findings suggest that six to ten weeks following participation, outdoor science school did not result in significant gains for students. However, the losses observed among students who did not attend the program suggest outdoor school may have some effect on students' behaviors and attitudes related to the environment and science.

Table 14. Student assessments, (mean scores), pre-survey to second post-survey (longer-term) gains in concern about conservation, attitude toward science, and environmental behaviors

Group	N	Pre-survey	2nd Post-Survey	Gain	Pct Gain
Concern about Conservation					
Control	102	6.65	6.21	-0.44	-6.61%
Treatment	110	6.09	5.87	-0.22	-3.58%
Attitude Toward Science					
Control	102	6.05	5.25	-0.80!!!	-13.17%
Treatment	108	5.19	4.95	-0.25	-4.72%
Environmental Behaviors					
Control	102	9.09	8.44	-0.65!	-7.12%
Treatment	115	8.79	8.68	-0.11	-1.29%

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001.
Statistically significant differences between treatment and control group gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

Parent Reports

Parents rated their children on the same three scales used in the student survey: concern about conservation, attitude toward science, and environmental behaviors. Parent data are presented in Table 15.

Table 15. Parent reports, (mean ratings), pre-survey to post-survey gains in concern about conservation, attitude toward science, and environmental behaviors

Group	N	Pre-survey	Post-Survey	Gain	Pct Gain
Concern about Conservation					
Control	67	6.42	6.69	0.27	4.18%
Treatment	91	6.65	6.81	0.16	2.37%
Attitude Toward Science					
Control	69	6.43	6.00	-0.43	-6.76%
Treatment	92	5.89	5.96	0.07	1.11%
Environmental Behaviors					
Control	67	9.27	8.81	-0.46	-4.99%
Treatment	89	9.54	10.44	0.90!*	9.42%

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001.
Statistically significant differences between treatment and control group gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

According to parent reports, children who went to outdoor school showed positive gains in all three scales: their concern about conservation, attitude toward science, and environmental behaviors. Of these, students who participated in the program had significantly larger gains in environmental behaviors ($p<.05$), compared to children who did not attend the program.

Stewardship of the Environment Subgroup Analyses

Analyses were conducted on the student survey data to determine if there were significant differences across the participating elementary schools on the three environmental scales (concern about conservation, attitude toward science, and environmental behaviors). For the purposes of analysis, Schools 3 and 4 were combined and shown as School 3 in the tables. In addition, differential effects for subgroups within the treatment groups (EL status, gender, and race) were explored. In any construct where one group's gain was significantly larger than another group (e.g. male versus female, etc.), we tested the differences in the pre-survey scores. This would tell us whether or not one group has significantly more room to grow than another group, and whether it could be reasonable to assume that the demonstrated gain differential was artificially large. If we found the pre-survey scores to be significantly different, we ran a regression model controlling for the pre-survey scores. For these analyses, we include a table for any significant findings.

Between-school Differences. Students at School 1 gained significantly less long-term (six to ten weeks following program participation) than students at School 3 in concern about conservation. Student gains in School 2 were not significantly different from gains by students at other schools. These results are shown in Table 16.

Table 16. Between-school differences, pre-survey to second post-survey (longer-term) gains in concern about conservation, by school

Concern About Conservation			
	Pre-survey	2nd Post-Survey	**Gain**: Pre to 2nd Post surveys
School 1 (N=29)	5.66	4.40	-1.25*
School 2 (N=32)	6.30	5.67	-0.64
School 3 (N=49)	6.21	6.88	0.67*

* Difference between schools is significant at $p<.05$

In addition, School 1 showed a significant long-term loss (six to ten weeks following program participation) in environmental behaviors. Students at School 1 gained significantly less long-term in this construct than students at School 3. School 2 student gains in environmental behaviors were not significantly different from gains by students at other schools. These results are shown in Table 17.

Table 17. Between-school differences, pre-survey to second post-survey (longer-term) gains in environmental behaviors, by school

Environmental Behaviors			
	Pre-survey	2nd Post-Survey	**Gain**: Pre to 2nd Post surveys
School 1 (N=31)	7.61	5.87	-1.74!!*
School 2 (N=32)	8.97	9.09	0.13
School 3 (N=52)	9.38	10.10	0.71*

Statistically significant changes in scores, within school, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001.
Statistically significant differences between schools are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

Subgroup Effects. There were no significant differences between males and females on any of the three scales (concern about conservation, attitude toward science, and environmental behaviors). In regard to subgroup analyses for race, we found there was no significant difference in short-term gains between Hispanics and Non-Hispanics. However, Non-Hispanics gained significantly more than Hispanics in just one of the three areas assessed, concern about conservation, from the pre-survey to the second post-survey. These results are shown in Table 18.

Table 18. Student assessments, Hispanics versus Non-Hispanics, pre-survey to second post-survey gains in concern about conservation

	Pre-survey	2nd Post-Survey	**Gain**: Pre to 2nd Post surveys
Concern About Conservation			
Hispanic (N=75)	6.27	5.49	-0.77!
Non-Hispanic (N=33)	5.69	6.94	1.25!**

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001.
Statistically significant differences between Hispanic and Non-Hispanic gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

In regard to subgroup analyses for English Learner students versus non-English Learner students, we found that Non-English Learners gained significantly more, from the pre- to second-post survey, than English Learners in one scale: attitude toward science. These results are displayed in Table 19. There were no short-term (pre-survey to the first post-survey) differences between the two groups.

Table 19. Student assessments, non EL-students versus EL students, pre-survey to second post-survey gains in attitude toward science

	Pre-survey	2nd Post-Survey	**Gain**: Pre to 2nd Post surveys
Attitude Toward Science			
EL (N=78)	5.19	4.51	-0.68
Non-EL (N=29)	5.22	5.97	0.74*

Statistically significant changes in scores, within group, are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001.
Statistically significant differences between EL and Non-EL gain scores are indicated by asterisks: *p<.05; **p<.01; ***p<.001.

Summary of Research Question #2 Findings. According to student assessments, children who attended outdoor education showed a significant increase in concern about conservation,

immediately after program participation. However, this gain was not significantly different than the control group. Six to ten weeks following program participation, there were no significant differences between the treatment and control groups. The control group, at the six-to-ten week point, showed significant losses in two of the three constructs (attitude toward science and environmental behaviors), whereas the treatment group did not show any significant losses. Parent reports indicated that children who attended outdoor school showed significantly higher gains in environmental behaviors, compared to children who did not attend. In other words, parents of children who attended outdoor school observed children engaging in positive environmental behaviors (e.g., recycling, etc.) at home, whereas a statistically significant finding was not observed for parents of the control group[13].

Research Question #3: How does the science instruction received through the outdoor education program curriculum increase students' knowledge and understanding of science concepts?

Students who attended the outdoor science school were surveyed on a set of ten science-related questions. Survey items were adapted from existing assessment tools used by outdoor education programs and from assessment questions tied to *ACPE: A Child's Place in the Environment*, a series of six environmental education curriculum guides for elementary school teachers that integrates science, English-language arts, and selected children's literature, and that culminates with student projects which enhance their environment and provide experiences in service learning[14]. A copy of the student survey, including the ten science-related questions, is attached in Appendix B.

The science-related survey items were not administered to children who did not attend outdoor science school (the control group), due to the reality that control group children did not necessarily have the opportunity to learn the same academic (science) content during the week the treatment group students attended outdoor science school (or even during the six-week period following the treatment group's participation, after which the Round 3 surveys were administered to both groups). Thus, it would be unfair to compare treatment and control groups on the science content that was known to have been covered during outdoor school, but not necessarily covered by the control classrooms during the same week or in the six to ten weeks following.

In addition, the content of classroom instruction for children who did not attend outdoor education could not be rigorously controlled. In other words, it was beyond the scope of this evaluation to monitor classroom instruction during the week that the treatment group attended outdoor school or during the following six to ten weeks. For example, some control group students might have received instruction specifically focused on ecology, while others did not.

[13] If Bonferroni adjustments are applied to the student data, the significant differences between EL students and non-EL students for attitude toward science become insignificant. For the parent reports, the significant differences between the control and treatment groups for environmental behaviors become insignificant.

[14] ACPE and its assessment questions were developed by the Lake County Office of Education, with funding and support from the Office of Environmental Education within the CDE.

If the science items had been administered to the treatment and control groups within the parameters of this study and significant differences were found between the two groups, we could not have attributed those findings to program participation without additional controls. For example, if the treatment group showed a significant gain in science knowledge, compared to the control group, we would not be able to attribute those gains to participation in outdoor science school, without rigorously controlling for classroom instruction related to the science concepts assessed. Similarly, if there were no significant differences found between the two groups, we could not report that outdoor science school had no impact on students' science knowledge, given that the study did not control for classroom science instruction for both groups. Within these limitations, the approach we chose was to administer pre- and post-surveys to the treatment group, acknowledging that the findings would not be entirely conclusive with regard to the impact of the program on children's understanding and knowledge of science topics. Treatment group students were administered pre- and post-tests to determine gains (or losses) in their knowledge and understanding of the science concepts that were actually taught at the week-long outdoor school programs.

In addition, the same science test was administered to the treatment group before their participation in outdoor science school, immediately after they returned from the program, and six to ten weeks later. By the third administration of the science test, students may have become familiar with the survey items, which could have affected their science scores. These "practice effects" should also be considered as possible confounds in the interpretation of results.

Student Assessments

Immediate Impact of Program Participation. Table 20 shows the immediate impact of outdoor science schools for treatment group children on their knowledge and understanding of science concepts.

Table 20. Immediate gains (mean scores) in science knowledge for children who attended outdoor education programs

	Pre-survey	1st Post-Survey	Gain	Pct Gain
		Science Scores (N=125)		
Mean	10.6	13.5	2.9!!!	27.1%
Std Dev	3.3	2.9	3.5	--

Statistically significant changes in scores are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001.

The total science score is based on ten science-related questions in the student survey. Scores range from 0 to 19. Children who attended outdoor education programs improved their science scores significantly (p<.001) from the pre- to the first post-survey. The average immediate gain was about 3 points, or 27 percent.

Longer-term Impacts of Program Participation. Students completed the same science survey six to ten weeks after they participated in the outdoor education program. Results are displayed

in Table 21. Only children who completed all three student surveys were included for this analysis.[15]

Table 21. Immediate and longer-term gains (mean scores) in science knowledge for children who attended outdoor education programs

	Pre-survey	1st Post-Survey	2nd Post-survey	**Gain**: Pre- to 1st Post-surveys	**Gain**: Pre- to 2nd Post-surveys
			Science Scores (N=115)		
Mean	10.6	13.7	13.2	3.1!!!	2.6!!!
Std Dev	3.4	2.9	3.2	3.6	3.7

Statistically significant changes in scores are indicated by exclamation points: !p<.05; !!p<.01; !!!p<.001.

As shown in Table 20, the gain from the pre- to the first post-survey was statistically significant. Although the mean science score minimally reduced (-.05 points) from the first post-survey to the second post-survey, the reduction was not statistically significant. In other words, students maintained a significant gain in science scores from the pre-survey to the second post-survey, six to ten weeks following program participation.

Science Score Subgroup Analyses

Analyses were conducted to determine if there were significant differences between science scores across schools. In addition, differential effects for subgroups within the treatment groups (EL status, gender, and race) were explored. A table is included for any significant findings.

We examined differences in gain scores across schools and found no significant results. Difference in gains among the four schools was not statistically significant (by Analysis of Variance), meaning the degree of gain was about the same across all four schools. Among students who attended outdoor school, there was no significant difference in any of the gain scores for science (short-term and long-term) between male and female students or EL students and non-EL students.

Among students who attended outdoor school, Hispanic students increased their total science scores significantly more from the pre- to the first post-survey than non-Hispanic students. However, Hispanic student science scores decreased significantly more than non-Hispanic student scores from the pre- to second post-survey.

[15] In this case, the total sample size (N) is lower than what was used for the analyses of the immediate impacts of program participation because data for 10 children were missing (e.g., the child moved, did not respond to the survey, etc.). Using the sample size of 115 children, rather than 125, also slightly impacted the post-survey mean and the pre- to the first-post-survey gain in Table 15, compared to what is shown in Table 14.

Table 22. Science scores, (mean scores), Hispanic versus Non-Hispanic students

	Pre-survey	1st Post-Survey	2nd Post-survey	**Gain**: Pre- to 1st Post-surveys	**Gain**: Pre- to 2nd Post-surveys
Science Scores					
Hispanic (N=77)	10.5	14.1*	13.4	3.6* !!!	2.9 !!!
Non-Hispanic (N=35)	10.9	12.7	13.2	1.8 !!	2.3 !!

Statistically significant changes in scores, within group, are indicated by exclamation points: !$p<.05$; !!$p<.01$; !!!$p<.001$. Statistically significant differences between Hispanic and Non-Hispanic gain scores are indicated by asterisks: *$p<.05$; **$p<.01$; ***$p<.001$.

Summary of Research Question #3 Findings. Children who attended outdoor education programs improved their science scores significantly from the pre- to the first post-surveys. The average immediate gain was about 3 points, or 27 percent. Although the mean science score minimally reduced (-.05 points) from the first post-survey to the second post-survey, the reduction was not statistically significant. In other words, students maintained a significant gain in science scores from the pre-survey to the second post-survey, six to ten weeks following program participation.[16]

[16] If Bonferroni adjustments are applied to the student science data, the significant differences between Hispanic and non-Hispanic science scores become insignificant.

Chapter 4: Perceived Benefits of Outdoor Education: Feedback from Sixth Grade Teachers and Outdoor Education Staff

This section summarizes responses from teachers and outdoor education staff gathered through open-ended survey items and interviews. It provides a context through which to interpret the survey findings presented in Chapter 3.

Elementary school teachers described the benefits of participation in the outdoor education program for sixth-grade students, including the academic and social-emotional effects of program participation and its impact on children with disabilities and special needs. Outdoor school principals provided their perspectives regarding program characteristics which may contribute to positive outcomes for students.

Overwhelmingly, teachers emphasized the positive impacts of outdoor science school for their students. One sixth-grade teacher stated, "Outdoor school is priceless to a child's education. It supports our efforts to educate our students." Teachers and outdoor school staff reported that the program offered the first opportunity for many children to spend time in a natural environment. A teacher commented, "Many children have never seen a setting like outdoor school. [They] never get away from the concrete." Statements from other teachers echoed the same thought, "Most of my students have never been out of their neighborhood. Outdoor science school opens them up to the world outside. I have seen many of these students get excited about learning (discovering) after they attend outdoor science school." The following section summarizes comments from in-person discussions with teachers and from the thirteen teachers who responded to open-ended survey questions. Input gathered from three outdoor school principals also is provided.

Academic Impacts

According to elementary school teachers, outdoor science school provides an in-depth week of hands-on science instruction and a foundation to support subsequent classroom instruction. Teachers described the program as an effective means to motivate students and help them make connections between classroom learning and the real world. Twelve of the thirteen teachers[17] who provided responses on the teacher survey reported that the students learned science concepts while at the program. Comments from teachers included the following:

- "Students have a tangible science experience" and "explore nature and people in a different structural setting. It allows students to see education as something other than texts and tests."
- "It [outdoor school] provided language for my English Learners and reinforced vocabulary for other students."
- "Students are outdoors and doing physical as well as mental work. [The program is an] opportunity for them to shine."
- "Many students are auditory/verbal or kinesthetic learners. Many who do not do well in a classroom setting, excel at outdoor science school. They are able to gain a wealth of background knowledge we use for nearly every other academic area."

[17] One teacher reported that her students "did not learn enough science" during the one-week program.

Teachers reported using outdoor science school to leverage classroom instruction. One teacher described the program as a "jumping off point" for subsequent activities in the classroom, connecting outdoor school with writing projects, social studies, and science lessons. For example, children in her class write an adventure story, using their outdoor school experience as background and context. Similarly, a lesson in ancient history might include the question, "What do you think people need to live in this time?", building from students' understanding of what animals need to survive in their environment. One teacher commented, "It [outdoor school] aligns with the curriculum. It is an integral part of the curriculum."

Outdoor science school staff were asked to identify factors about the program which support student learning. They emphasized: 1) the novelty of the environment for students (56 percent of the students in the treatment group reported that outdoor school was the first time they spent time outdoors in a natural setting), 2) the high-interest, hands-on, inquiry-based nature of the curriculum, and 3) the wide range of opportunities students have for success at the program. According to one outdoor science school principal, "kids are being confronted with science curriculum that is hands-on and all around them and real. When we teach science in the classroom, a lot of it is video oriented, text oriented, but the student is not immersed in it. Just by virtue that they [the students] are living in the outdoors, which is the setting they are studying, they are embedded in the curriculum itself." Children spend a week learning to "observe, ask questions, look for details, look for evidence that supports their thinking, organizing – these are the fundamental scientific processes."

Outdoor school also is less prescriptive than a typical school setting. Because there is "no clock on the wall," outdoor teaching staff can extend activities based on children's interest and needs. While outdoor school teaching staff follow a schedule, it is somewhat less restrictive than that of the regular school day (e.g., outdoor staff can extend a lesson for an extra ten minutes if children are interested and, as one outdoor school principal described, "at that 'ah-ha' moment" of learning).

Social-Emotional Impacts

In addition to academic benefits, elementary school teachers described the social and emotional impacts of outdoor science school for their students. Overwhelmingly, teachers emphasized how the program supports students' feelings of self-esteem, fosters relationships among peers, and reduces behavior problems. Teachers also highlighted the benefits of the program for children with disabilities or special needs and for at-risk students.

Self-esteem. Teachers and outdoor education staff described how participation in the program helps to support students' self-esteem, by bolstering their independence and confidence, and by providing a wide range of opportunities for children to succeed. Outdoor school staff are trained to recognize students for their positive participation in activities and their accomplishments (small and large) throughout the day. Students' demonstration of respect toward one another, teaching staff, and the environment is also rewarded. One outdoor school principal stated, "The environment is set up for children to succeed and feel good about what they can do. The smaller teacher-student ratio definitely helps, children pick up on that and think 'hey this is an environment where everyone gets noticed, and I can shine here.' When [students] do something

right, they get recognized. One success builds on another...answering questions or making observations, exhibiting some good table manners at meal time, [and] helping their cabin mates score points."

Another outdoor school principal described how the program supports students' self-esteem and general social growth. The outdoor school uses an "ICARE" motto (Integrity, Cooperation, Attitude, Respect, and Esteem) throughout all aspects of the program. Outdoor school staff talk about these concepts every morning with the students and "ICARE" posters are posted throughout the outdoor school site. If a child has a behavior problem, staff use the "ICARE" concepts as a context to talk through the problem with the student.

Many of the teachers commented on the confidence they observed among their students. One teacher, referring to one of her students, stated, "[At the program] is the first time I saw him smile or raise his hand." The program provides "countless enrichment activities, and the opportunity to be independent, explore, and build self-esteem," stated another teacher. "Students find success possible at science school. They realize that they can be successful at 'smart' things so when they get back to school, their self-esteem is greater. They can handle things better."

Outdoor staff and elementary school teachers also described how student labels and stereotypes fade at the program. Each child is new to the outdoor school teaching staff; thus the staff do not know which student is regularly disciplined for behavior problems in the classroom or which child has an Individualized Education Program (IEP). Outdoor school staff and teachers repeatedly used the phrase "fresh start" to describe children's experience at outdoor school and upon their return to the classroom. "Children feel better about themselves because they know their teacher saw them at outdoor school doing well," said one outdoor science school principal.

Relationships among Peers. Students interact with one another throughout each day of the program, living, eating, socializing, and learning together. They are deliberately combined with students from other schools in a variety of small groups. In this manner, as one teacher characterized, "Pre-conceived notions [of children] are left behind – other children don't know each other." Other teachers talked about children who have difficulty creating positive peer relationships within the regular school setting. "It's like getting a second chance in making friends. A fresh start. [Students] build interdependence....with classmates they seldom interact with [in school]." For some children, "the first friend they ever make is at outdoor school."

Several teachers commented on the importance of exposing their students to other children from varying backgrounds. Children "have to get along with other children. Not just other children in their class but other children in their school and children from other schools. Sometimes that means children of different [socioeconomic backgrounds]". A teacher reported, "Students engage with other students from diverse communities. This enables them to be exposed to a variety of social settings. For some, it enables them to experience different emotions."

Behavior and Discipline. Teachers identified several characteristics of the outdoor school that may impact students' behavior. Respect for staff and other children is a priority of the program, and this message is articulated to students throughout the week. The three outdoor science schools in this study maintained a higher staff to child ratio than a typical sixth-grade classroom.

Program staff can interact with more children on an individual basis, and the smaller group sizes allow for close supervision. On average, learning groups at outdoor science school are composed of 15 to 17 children, led by an outdoor education teacher and assisted by a "cabin leader" (a high-school counselor who attended the program as a fifth- or sixth-grade student). In addition, an elementary school teacher often accompanies the group on their lessons.

The outdoor school schedule also helps to reduce behavior problems among students. According to teachers, many children lack a regular schedule at home (e.g., homework, bed times, chores). The outdoor science schools maintain specific standards of behavior that are expected from children (e.g., a "3 strikes" policy before parents are called and children have to leave), as well as a variety of chores that each child is expected to complete (e.g., cabin clean-up, helping with meals). One teacher stated, "The activities at outdoor school reinforced respect and responsibility."

Children with Disabilities and Special Needs and At-Risk Students. According to several teachers, the program puts children with disabilities and special needs on equal footing with their peers, leaving behind the classifications that can emerge within the classroom setting. During a focus group, one teacher challenged others to try to identify the special education students from other students, pointing out that the program works as an "equalizer." Teachers were asked to identify particular benefits of outdoor science school for at-risk children. The outdoor school provides "structure, discipline, motivation, and determination," and is a "positive experience for students who are at different levels of education." Echoing the comments regarding children with disabilities or special needs, one teacher reported that at-risk students are "not labeled or grouped the way they are in the regular school setting. They are able to shine."

In sum, elementary school teachers and outdoor school staff identified a range of positive outcomes they observed among students who attended the program. Many of these outcomes were measured as part of this study (e.g., relationship with peers, self-esteem) and the results are presented for the treatment and control groups in other sections of this report. Other outcomes, such as the specific impact of the program for children with disabilities or special needs, or concepts such as the "fresh start" afforded by outdoor school, were not directly measured, but program and elementary school staff alike repeatedly referred to these as important additional benefits for students. The overwhelming support by elementary school teachers for the program also corroborates the findings from this study that outdoor education programs are effective in multiple ways – for teaching science concepts, supporting positive social-emotional development, and motivating students to think and act more responsibly as stewards of the environment.

Chapter 5: Conclusions

This chapter summarizes the major research findings of the study.

Personal and Social Skills

- According to student assessments gathered immediately after program participation, children who attended outdoor science school showed significantly higher gains in conflict resolution. However, these gains were not significantly higher than the increases shown by the control group. Six to ten weeks later, children who attended the program showed gains in cooperation and conflict resolution that were significantly higher than the control group.
- Teacher ratings provide evidence of a wide range of positive outcomes related to participation in outdoor science school. Teachers rated all children before the treatment group attended outdoor school and six to ten weeks later. According to teacher ratings of each student, those children who attended outdoor science school showed statistically significant positive gains on all eight constructs on which they were rated. In contrast, the control group showed losses on seven of the eight constructs. Children who attended outdoor science school showed significantly larger gains than the control group in six of the eight constructs. These gains were observed in self-esteem, conflict resolution, relationship with peers, problem solving, motivation to learn, and behavior in class.
- Parent ratings of their children did not reveal any significant differences in the five social-emotional constructs between children who attended outdoor school and those who did not.

Stewardship of the Environment

- According to student assessments gathered immediately after program participation, children who attended outdoor school showed significant increases in one of the three constructs: concern about conservation. However, these increases were not significantly larger than those of the control group.
- At the six- to ten-week point, the control group showed significant losses in two of the three constructs (attitude toward science and environmental behaviors), whereas the treatment group did not show any significant losses.
- According to parent reports, students who participated in the program had significantly larger gains in environmental behaviors ($p<.05$), compared to children who did not attend the program. In other words, parents of children who attended outdoor school observed children engaging in positive environmental behaviors (e.g., recycling, etc.) at home, whereas a statistically significant finding was not observed for ratings by parents of children in the control group.

Knowledge and Understanding of Science Concepts

- Children who attended outdoor school significantly raised their science scores by 27 percent, as measured by a pre- and post-survey administered immediately upon their return to school.
- The increase in science knowledge was maintained six to ten weeks following program participation, with no significant loss in science scores.

Benefits for English Language Learners

- This study focused on 255 sixth-grade students, 58 percent of which were identified by teachers as English Learner (EL) students. According to teacher reports, among those students who attended the program, EL students demonstrated gains in cooperation, leadership, relationship with peers, and motivation to learn that were significantly larger than the gains shown by non-EL students for those constructs.

Other Perceived Impacts of the Program

Elementary school teachers and outdoor science school staff overwhelmingly emphasized the positive outcomes they observed among children who attended the program. These included increased confidence and self-esteem, positive relationships among students, and reduced discipline and behavior problems. Teachers reported that the program provided effective, hands-on science instruction which served as a foundation for subsequent classroom instruction. The program provided an "opportunity to shine" for all students, including those with disabilities, special needs, or other at-risk factors.

Students who attended outdoor school were asked if the experience changed them. Of the eighty-three students who provided a response, sixty-seven percent (56 students) reported a positive change in terms of science content learned, new friends, and appreciation for or stewardship of the environment. Typical responses from students included the following:

- "Yes, because I learned more. I like science a lot because it helped me to protect the environment even more."
- "I do more work on my own!"
- "Because I have a lot of friends now in other schools and I learned about nature more."
- "Yes, I recycle more because I realized how important it is. I also don't litter."
- "Yes, I try not to waste so much water and I try to recycle all the recyclable things. I also care more about nature than I did before."
- "I've changed by learning that soils have worms and plants give us oxygen. I've learned a lot at outdoor science school. I had fun and met new friends and I am kind of getting used to science."
- "I think I have changed after going to outdoor school. I felt less bored, learned a lot about science, and made more friends."

In sum, teachers, outdoor education staff, and participating students characterized outdoor science school as a positive social-emotional and learning experience, with impacts observed during the program week and subsequently in the classroom setting.

Recommendations

- **Outdoor science schools promote student learning in science and foster social-emotional skills which support learning across the curriculum**. The positive outcomes associated with students' participation in the five-day resident outdoor science school are impressive, especially given the relatively short timeframe of the program. In particular, the increase in students' science scores, as measured by a pre- and two post-surveys, was maintained six to ten weeks after children attended outdoor school. Measurable changes among participating children were also observed across a number of social-emotional domains. Most notably, teachers rated children who had attended the program significantly higher on six of eight domains, compared to the control group. These domains included self-esteem, conflict resolution, relationship with peers, problem solving, motivation to learn, and behavior in class. In addition to providing hands-on science instruction, outdoor school fosters social competencies among students which support learning across the curriculum. For example, the largest gain for children who attended outdoor school (20 percent) was in the area of problem-solving.

- **Outdoor science schools appear to be particularly beneficial for English Learner students**. This study focused on 255 sixth-grade students, 58 percent of which were identified by teachers as English Learners. Across the four participating elementary schools, 81 to 100 percent of the student population participates in the free/reduced price lunch program. Given that many of these students may be at-risk for school failure, outdoor science school offers students an opportunity to succeed across a range of outcomes. According to teacher reports, among those students who attended the program, EL students demonstrated gains in cooperation, leadership, relationship with peers, and motivation to learn that were significantly larger than the gains shown by non-EL students in those constructs.

- **Teachers perceive positive outcomes for students who attend outdoor science school, including a "fresh start" in the classroom**. Among other benefits, elementary school teachers and outdoor school staff repeatedly emphasized how outdoor science school provides a "fresh start" for students. While this study did not collect quantitative measures of this concept, feedback from teachers and staff suggest the program offers effective strategies for supporting children who may struggle with labels or stereotypes that might emerge within a regular school setting (e.g., children with special needs, children with classroom behavior problems, etc.).

- **The CDE, outdoor science schools, and elementary schools may wish to explore additional strategies to bolster the positive outcomes associated with participation in the program**. Given the relatively short length of the program (five days), schools and families play an important role in reinforcing outdoor science school instruction once children return to school and their homes. Research has clearly demonstrated the importance of family-school connections in supporting student learning. To extend the benefits of outdoor school, public schools might consider developing or building on existing strategies to integrate outdoor school curricula and teaching approaches into their classroom instruction. Family members also play a critical part in reinforcing the

lessons learned at outdoor school at home (e.g., conserving water, recycling, etc.). Strategies to create strong connections between families and outdoor school (e.g., family "environmental stewardship" action plans, parent handouts describing activities for families and children to do together at home, etc.) could help to bolster and sustain the impact of the five-day program.

- **This study suggests promising areas for future research regarding the benefits of outdoor learning experiences for at-risk students**. This study explored a wide range of possible benefits associated with participation in environmental education programs. Future, more targeted research that builds on the promising benefits found in this study, such as in the area of problem-solving skills, may yield more detailed information about the ways in which the specific outcomes associated with the program are best achieved. Other recommendations for future research include a longitudinal study, to examine the long-term impacts of participation in outdoor school for students. While the control group for this study will attend outdoor school in the winter or spring of the 2004-2005 school year (after this study is completed), possible longitudinal research strategies include tracking the sample of students over time (identifying a matched sample of children who never attended outdoor science school as a comparison group), or cost-effectiveness studies that compare varying approaches to the provision of outdoor school experiences over time. Indeed, findings from this study suggest that outdoor education programs may contribute to academic learning and social development for at-risk students in ways that cannot be duplicated within the classroom environment. The preliminary positive results from this study, along with the potential for long-term benefits for students and cost savings to the state, make a strong case for continued support, possible expansion, and further study of outdoor education programs for at-risk students.

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