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BEETLES: Better Environmental Education, Teaching, Learning, and Expertise Sharing

Final Evaluation Report

A Summary of Findings for Years 2- 4: 2013-2015

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BACKGROUND

Residential outdoor science (ROS) programs have a tremendous but largely unrecognized capacity to play a pivotal role in science education reform by providing informal science learning experiences that engage youth with the natural world in ways that cannot be replicated in formal science settings. ROS programs typically conduct two to five-day programs that are centered on learning science outdoors by engaging youth with the natural world. Youth participants take part in field experiences such as hikes (i.e., instructor-guided experiences on trails through which students engage in environmental- and science-education experiences), data collection, and other nature studies, specifically intended to improve science and environmental literacy.

Funded by the Stephen D. Bechtel, Jr. Foundation, **Better Environmental Education, Teaching, Learning, and Expertise Sharing (BEETLES)** project is managed by the Lawrence Hall of Science at UC Berkeley. The BEETLES project team creates and implements professional learning experiences for outdoor/environmental education program leaders to deliver to their staff teacher-naturalists, who then implement BEETLES activities and instructional practices with their students. The project aimed to improve the quality of instruction and learning in Residential Outdoor Science (ROS) programs nationally, and across the field of environmental education in general. Research on professional learning and development for ROS educators is limited so the design of BEETLES professional learning opportunities primarily drew from research on informal and formal science educators (e.g. Darling-Hammond, Wei, Andree, Richardson & Orphanos, 2009; Gess-Newsome, Blocher, Clark, Menasco & Willis, 2003; Tran & King, 2009; Tran, Werner-Avidon & Newton, 2013).

The BEETLES Professional Learning Model includes a variety of resources and materials that help leaders facilitate reflection on practice through ongoing follow-up with staff and the incorporation of teaching observations as part of instructional improvement at their site (i.e., 11 professional learning sessions; 27 student activities; 16 "how-to" videos; 2 instructional observation protocols). BEETLES has also developed other tools and resources, and will be developing an implementation guide to support program leaders and field instructors put these strategies in practice. The four primary design elements of the BEETLES model are learning cycle-based instruction[1], learner-centered discussion practices, scientific habits of mind, and nature-centered science instruction.

Led by Bernadette Chi, Ph.D. and Valeria Romero, M.A., a team from The Research Group at the Lawrence Hall of Science at University of California, Berkeley conducted the BEETLES project evaluation. The Research Group leads numerous research and evaluation studies across educational settings including formal (e.g., schools and districts), out-of-school (e.g.,

[1] The learning cycle is a model for instruction that takes into account the learner's prior understandings and recognizes their need for firsthand experiences. This model takes place in specific phases– invitation, exploration, concept invention, application, and reflection—which eventually lead the learner to begin the cycle once again. For more information, see beetlesproject.org (BEETLES at the Lawrence Hall of Science, "Teaching and Learning", 2015)

afterschool and camps), and informal (e.g., science centers and home). The Research Group provides leadership and contributes to excellence, equity, and innovation in science, technology, engineering, and mathematics (STEM) by conducting applied research studies, evaluating the quality and impact of educational materials and programs, and developing assessments that measure STEM learning.

The informed consent of participants was obtained for collection of evaluation data, and the evaluation conduct adheres to the *Guiding Principles of the American Evaluation Association* and *The Program Evaluation Standards*. To protect participant confidentiality, the names of evaluation participants were not used in data analysis or reporting; a master code list is stored separately from the de-identified data.

The purpose of this report is to summarize various evaluation reports and memos that were provided to the BEETLES project team, and to share major findings from the cumulative data collection and analyses.

EVALUATION DESIGN AND METHODS

The design for the four-year BEETLES evaluation was multi-phase and utilized different frameworks for each phase. During the planning and development phase of the BEETLES project, in 2012-2013, the evaluation team used a developmental evaluation framework (Patton, 1994, 2010) with a focus on contributing to the project development, utilizing pre-formative evaluation strategies. By documenting, monitoring, and providing rapid, real-time feedback to emerging ideas and visionary hopes in a period of exploration, the intent was to provide feedback to shape ideas into a potential model that is more fully conceptualized, potentially scalable innovation. Another goal for this phase was to identify benchmarks and indicators for pilot efforts and formative evaluation. In Year 2, the evaluation team shifted its focus to outcomes-based evaluation to examine the impacts and efficacy of project goals objectives, and products with primary focus on outcomes in relation to the mission of developing innovative resources and their contribution to the EE field.

Evaluation Activities

Evaluation activities during Years 2-4 for the outcomes-based evaluation were embedded in project activities to the greatest extent possible and as deemed appropriate by the external evaluation team in collaboration with the project team. As the project continues, evaluation activities align with key project activities. Data were collected using the following well-established inquiry methods:

Document analysis of project tracking, planning, and PL documents to organize and triangulate emergent data themes related to the BEETLES project goals. Examples of project documents used to produce this report included PL session materials, lesson write-ups, Activity and Resource matrix, NLI applications, NLI participant selection criteria, and project planning meeting notes.

Observation of BEETLES planning meetings, field observations of PL sessions and site activities, and the National Leadership Institute to provide insight and understanding into the project decisions, execution, and participant experiences. Observations were unstructured to avoid unintentional narrowing of focus to pre-specified foci.[2]

Program Leader Surveys: Pre-Institute, Post-Institute, and End of Field Test/End of Year: A survey was created to document changes in attitudes of CLI and NLI program leader participants from 69 programs (n=136) containing three factors: *Instructor-Centered Pedagogy, Student-Centered Pedagogy, and Preparedness to Teach Field Instructors*. The survey contained both open-ended and closed-ended items and was administered prior to the start of the summer Institute, at the end of the Institute and at the end of the school year for each year that the Institute was provided. Responses were de-identified using unique codes for individual respondents who completed questionnaires. Quantitative and qualitative data from the surveys were analyzed and are summarized in this report.

Program Leader Interviews: Phone interviews were conducted with Institute participants at the end of each program year in May or June. Interviews took approximately one hour.

Field Instructor Surveys: Field Instructor surveys were designed to collect feedback from field instructors after each PL session presented by their program leaders. 1,576 field instructor surveys were returned from CLI and NLI field test sites containing feedback that was directly analyzed by the BEETLES team to revise the PL sessions and BEETLES materials.

Case Site Visits (CLI 1 and NLI 1 cohorts): Site visits were conducted at a total of four sites in California and three sites across the country. Visits included observations of field instructors and activities; focus groups with field instructors; and interviews with program leaders.

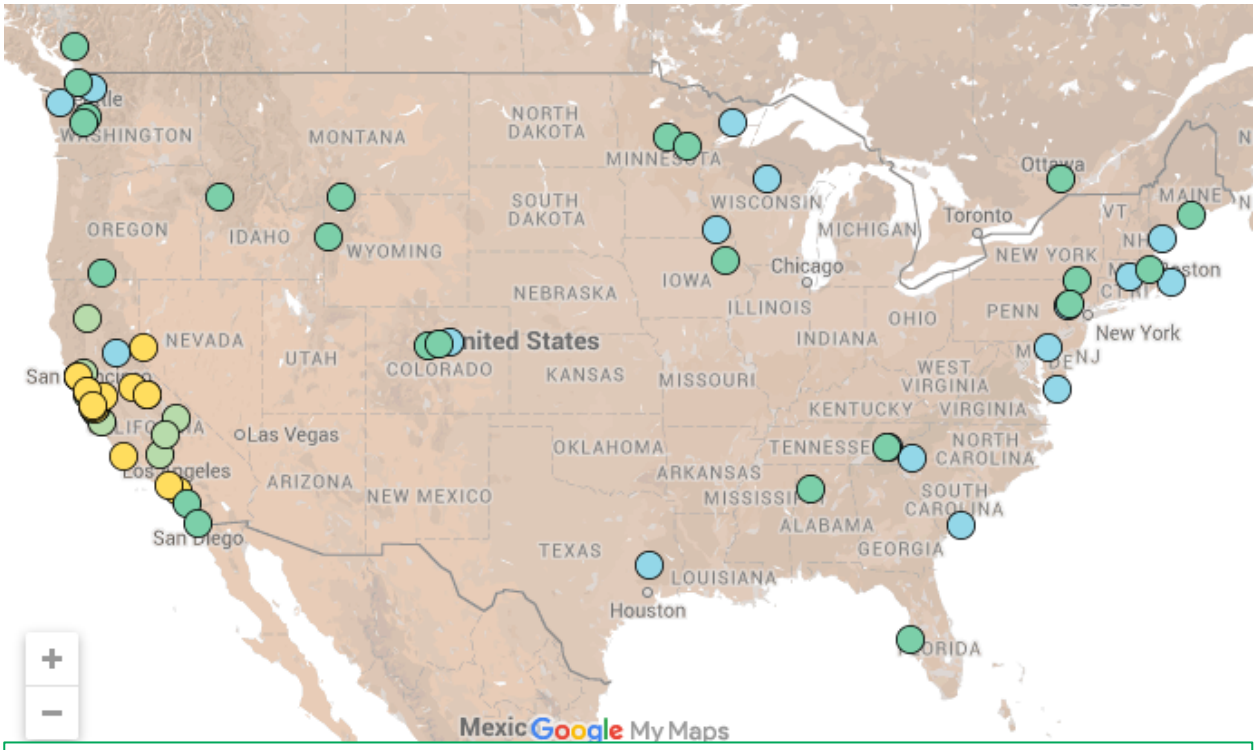
National Needs Assessment: An online survey containing contained both open-ended and closed-ended items was designed to gain insight into the landscape of ROSs to inform the continued development and refinement of BEETLES. Invitations were sent to 291 sites and 92 completed the survey.

Pre-/Post Youth Surveys: Youth data (n=278) were collected in 2014 from four ROS sites using BEETLES materials that operated three to five day residential programs. The surveys contained *Measuring Activation* (MA) scales (Fascination, Values Science, Competency Beliefs, Sensemaking and Environmental Literacy) based on the work of the *Science Learning Activation Lab.* Each site collected data before and after the residential programs from a minimum of 50 youth per site.

[2] Mabry, 1998, 2001, 2003.

The map below indicates the locations of the participating ROS programs over the last three years.

Figure 1. Distribution of BEETLES Program Participants



Key:
Yellow: CLI 1 program sites
Blue: NLI 2014 program sites
Light Green: CLI2 program sites
Darker Green: NLI 2014 program sites

Quantitative Data Analysis

Two sets of analyses were conducted with the quantitative data yielded from the surveys. *Confirmatory Factor Analysis.* First, confirmatory factor analysis was conducted to examine scales of attitudinal items to measure *Instructor-Centered Pedagogy, Student-Centered Pedagogy* and *Preparedness in Teaching Field Instructors*. All factor analyses were conducted using Mplus (v. 7.11) utilizing the mean- and variance-adjusted weighted least square (WLSMV) estimator (to account for the ordinal nature of the variables), then compared using the resulting scree plot and rotated factor loadings (via the GEOMIN oblique rotation). CFA models were produced iteratively, using fit statistics, factor loadings, and modification indices to inform the next iteration until a well-fitting model was produced. The fit statistics used were 1) the chi-square test of model fit (i.e., must be non-significant using a=.05), 2) the comparative fit index (CFI; must be greater than 0.9), 3) the Tucker-Lewis Index (TLI; must be greater than 0.9), and 4) the root mean square error of approximation (RMSEA; must be less than 0.06). Given the relatively low sample size for each analysis, future analyses with different samples may result in factor structures that do not replicate the results of the current set of analyses. Factor scores were generated for

each factor using a simple average of the items comprising each factor (provided that the participant did not omit more than 50% of the items in the factor).

Table 1. Items for Factor Analysis	
Item	Text
D01	If people are presented with a clear, coherent explanation of a concept, they will learn the concept.
D02	When designing an educational activity, one should assume that most of the learners have little useful knowledge of the topics to be covered.
D04	When learners ask questions, they should be given the answers.
D05	Learners need time to discuss concepts.
D07	Listening to presentations is a good way for people to learn the concepts.
D09	Learners should be asked questions about their ideas.
D11	In order to teach well, it is important to consider what students already know about a subject.
C03	I feel very comfortable leading a discussion with field instructors.
C05	I feel well prepared to teach field instructors about how to make observations about the natural world.
C06	I feel well prepared to teach field instructors about asking questions about the natural world.
Note: All items had the following response options: 1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Somewhat Agree, 5=Agree, 6=Strongly Agree ("Not Sure" was considered an omission)	

The resulting set of set of items exhibited satisfactory model fit for both the PRE ($X^2(df=32)=31.69$, $p>.05$; RMSEA=0.00; CFI=1.00; TLI=1.00) and POST ($X^2(df=32)=33.71$, $p>.05$; RMSEA=0.02; CFI=0.99; TLI=0.99) administrations (see Table 2). It is notable that the correlation between Factor 1 and Factor 2 was -0.56 during the PRE, but was -0.23 at the POST, while the correlation between Factor 2 and Factor 3 was 0.59 during the POST, but was -0.07 during the PRE.

Table 2. Confirmatory Factory Analysis Results						
Item	PRE			POST		
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
D01	0.616	.	.	0.794	.	.
D02	0.328	.	.	0.325	.	.
D04	0.769	.	.	0.682	.	.
D07	0.438	.	.	0.685	.	.
D05	.	0.381	.	.	0.707	.
D09	.	0.500	.	.	0.863	.
D11	.	0.480	.	.	0.616	.
C03	.	.	0.521	.	.	0.599
C05	.	.	0.889	.	.	0.822
C06	.	.	0.971	.	.	1.014

The descriptive statistics for the resulting factor scores are shown on Table 3 below.

Table 3. Descriptive Statistics

Group	*Construct*	*Admin.*	*N*	*Mean*	*SD*
CLI	*Factor 1*	*PRE*	*45*	*3.13*	*0.749*
		POST	*47*	*2.74*	*0.786*
		EFT	*9*	*2.97*	*1.003*
		FUP	*9*	*3.00*	*0.599*
	Factor 2	PRE	44	5.67	0.301
		POST	46	5.82	0.322
		EFT	9	5.85	0.176
		FUP	9	5.85	0.242
	Factor 3	PRE	19	4.72	0.756
		POST	25	5.19	0.733
NLI	*Factor 1*	PRE	86	3.36	0.739
		POST	81	3.01	0.783
		EFT	16	3.15	0.952
		FUP	0	.	.
	Factor 2	PRE	85	5.61	0.37
		POST	80	5.74	0.436
		EFT	16	5.68	0.415
		FUP	0	.	.
	Factor 3	PRE	86	5.01	0.711
		POST	81	5.42	0.576

Tests of Significance. In addition, two sets of analyses for tests of significance were completed using the factor scores. First, a series of comparisons between groups (NLI vs. CLI) were completed using repeated-measures analysis of variance (ANOVA) using only the PRE and POST administrations (i.e., main effect of time, main effect of group, and time*group interaction). Secondly, a series of repeated-measures ANOVAs were used to examine across PRE, POST, and EFT (i.e., main effect of time) administrations without a comparison between groups (due to low sample size).

Qualitative Data Analysis

Data analysis and interpretation used the constant-comparative method[3] and will occur as data collection is ongoing, i.e., field test, site visits, and advisory meetings. Following each data-collection event, initial data analyses are conducted according to the type of data collected (e.g., descriptive and correlational statistics for survey results, thematic analysis for interview data). Data are grouped according to context, input, process, and product for a second phase of analysis, and then emergent themes are identified. Around each theme, data are grouped for further analysis.

[3] Glaser & Strauss, 1967.

Study Questions

Previous reports have summarized in more detail to what extend the BEETLES project was implemented the last three years. This report summarizes findings from those reports related to BEETLES implementation, but primarily focuses on the impact of the project, addressing the following evaluation questions:

1. How did participation in the BEETLES project influence program leaders' attitudes, interests and strategies for implementing professional learning opportunities about teaching and learning science outdoors?
2. In what ways, if any, did program leader participation in BEETLES influence ROS sites (e.g., instructional strategies, curriculum, professional learning opportunities for staff)?
3. To what extent did ROS sites using BEETLES influence youth participants' fascination with science, competency beliefs and environmental literacy?

SECTION 1. SUMMARY OF BEETLES IMPLEMENTATION

This section summarizes the design and implementation of the BEETLES professional learning opportunities, state and national field test processes, and national needs assessment that have been reported earlier[4].

Summer Institutes

Over the course of the four year project, the BEETLES staff organized and implemented four week-long Institutes serving a total of 136 program leaders from 69 program sites. The first Institute in 2013 was held at Walker Creek Ranch in Petaluma, CA and served program leaders of California ROS programs to prepare them for conducting a field test of the professional learning (PL) sessions and activities developed by the BEETLES staff. The intent of the field test was to provide feedback to the BEETLES development team to improve the PL sessions and activities. The second Institute in 2014 was held in Black Mountain Retreat Center in Cazadero, CA and recruited program leaders of ROS programs across the country to conduct a second field test of revised PL sessions and activities. The third Institute in December 2014 was held at Shady Creek Outdoor School in Nevada City (California-focused) and fourth Institute in August 2015 was held at UC Santa Cruz (nationally focused) were revised slightly, and they shifted in focus from preparation for field tests to supporting program leaders in implementing BEETLES practices and materials.

There was a shift in the end-goal of the Institutes from field tests in CLI1 and NLI1 to implementation in CLI2 and NLI2. For example, during the CLI 1 and NLI 1 institutes, participants were expected to field test the BEETLES materials, so there was explicit attention and encouragement to having participants teach sessions as they were written

[4] Snow, J. & Romero, V. (December 2012). BEETLES Project Evaluation Annual Report: Year 1 Pilot Phase; Snow, J. & Romero, V. (September 2013) BEETLES Project Evaluation Annual Report: Year 2; Chi, B., Romero, V. & Chung, J. (October 2014). BEETLES Project Evaluation Annual Report: Year 3.

for the purposes of piloting the materials and providing feedback for improvement. On the other hand, during implementation-focused Institutes (CLI2 and NLI2), there was more of an emphasis on helping programs determine how they might adapt and modify BEETLES to best reach their programs and how to support their program staff.

Across the four institutes, the BEETLES team presented a total of 11 professional learning modules they had developed:

1. Making Observations
2. Teaching and Learning
3. Explanations and Evidence
4. Nature and Practices of Science
5. Matter and Energy in Ecosystems
6. Constructing Understanding
7. Questioning Strategies
8. Promoting Discussion
9. Assessing for Learning
10. Field Journaling With Students
11. Adaptations and Evolution

In addition, the BEETLES team developed a variety of resources and materials that help leaders facilitate reflection on practice through ongoing follow-up with staff and the incorporation of teaching observations as part of instructional improvement at their sites, including 27 student activities; 16 "how-to" videos; and two instructional observation protocols.

Based on pre-Institute and post-Institute surveys, Institute participants shared that the Institutes were highly valuable experiences, leaving with tools and materials they would pilot test and/or implement at their respective sites, the impact of which are described in more detail below.

They reported high levels of satisfaction for the PL sessions that were offered to them during the Institute, as well as for the various topics presented on science teaching and learning. For example, at the end of the first California Leadership Institute, nearly all participants found these sessions "useful" or "very useful." In particular, 95% of respondents felt *Questioning Strategies* was "very useful," and 92% felt *Making Observations* was "very useful." Three other sessions were also considered very useful: *Teaching and Learning* (80% of respondents), *Promoting Understanding* (81% of respondents), and Constructing Understanding (85% of respondents). Participants' comments on the feedback survey further illustrated this:

I found most of the sessions and activities to be enormously innovative. . . .

***

The activities and sessions were not only new, but they were also high level and rigorous in a way that most outdoor science activities are not. They also took concepts and ideas that are historically glossed over or taught directly, and put the onus on the learner to go more deeply with the idea on their own. For example, Build Do Waste was a wonderful and creative way for students to think about how matter and energy are used in an organism, while still using the out-of-doors and observation and evidence to support their concept invention. Simple, yet innovative and effective. Wow!

Participants also indicated feeling closely aligned with the BEETLES approach to teaching. For example, on the post-survey, participants were asked to indicate on scale of 1-10 how aligned they felt with the BEETLES project, with 1 being "not aligned" to 10 being "very aligned." Participant responses (n=26) ranged from 7-10, with 42% of respondents indicating a "10." Many participants further shared that they felt their programs shared similar philosophies and approaches to teaching and learning, and that BEETLES provided them with materials that would help support their respective programs. These findings were similar to those across the remaining three Institutes provided by the BEETLES team.

Summary of Field Test Experience and Feedback

Following the first California and National Institutes (i.e., CLI1 and NLI1), program leaders participated in a field test of the BEETLES professional learning modules and students activities. As part of the field test, program leaders selected six of the BEETLES professional learning modules that they then presented to their staff over the duration of the year. Program leaders and program staff then provided feedback to the BEETLES team about various aspects using the materials, such as time it took to prepare and present the sessions, ways in which programs modified the sessions, and the receptiveness and engagement of staff. Programs were also invited to share suggestions for improving the modules and materials. Over the four years of the BEETLES project a total of 30 programs (i.e. 12 programs in California and 18 throughout the United States) participated in the field test.

Following the Institutes, participants generally felt optimistic and were eager to field-test BEETLES at their respective programs. On the Post-Institute survey, while most programs anticipate some level of challenge, primarily related to time constraints and potential staff resistance, program leaders were generally optimistic and eager to field test BEETLES at their respective program sites. One program leader commented:

There will be challenges, and it will take time to implement. I don't feel that it is insurmountable. It will take time. Having this vision for what teaching should look like helps. I feel good with the enthusiasm and tools to carry this out. Having another person on site who is enthusiastic will be extremely valuable.

Over the duration of the project, almost all programs successfully field-tested the BEETLES professional learning modules and student activities. It is important to note that programs ranged in the types of programming they offered, and therefore, the way in which they field tested the modules often reflected that variation. For example, in larger programs that had multiple sites, such as NatureBridge and Nature's Classroom, professional learning modules may had been presented to multiple staffs at one time; to leadership or executive staff; or in some cases to other organizations that the program was interested in partnering with:

> *We are one sanctuary out of about 50 in the state... and we do trainings for all the educators across the state. So, that was another one we did earlier this year in the winter--we did teaching and learning and evolution and adaptations [for the 50 sanctuaries].*
>
> *****
>
> *[We] took the opportunity to invite another residential environmental learning center staff to join us in those trainings and they did, and so it was an opportunity for us to collaborate with another center.*

In addition, there were several programs that participated in the National Leadership Institute that had graduate programs in addition to residential programs. In these instances, programs also delivered modules as part of the curriculum for graduate students.

Overall, program leaders reported that BEETLES was well received by their staff as part of the field test process, though some challenges were shared. For example, across programs there seemed to be a consistent challenge related to the format of the PL modules, particularly that the modules were presented using PowerPoint presentation, which required participants to be indoors. Programs shared that their staff often wanted more opportunities to be outdoors and often commented on spending the majority of the PL sessions indoors. Some programs, however, took it upon themselves to address this concern by printing the slides and taking the modules outdoors; other program sites recognized that not all professional learning opportunities can happen outdoors, and that the student activities were great for balancing out the need to take the learning outdoors. Another challenge reported by programs was the amount of time it took to prepare and present sessions often took longer than anticipated. Program leaders acknowledged though that this could be due to a lack of familiarity with the content of the modules and that over time as programs became more familiar with the content they would be able to modify the modules into a more realistic time frame.

For example, the principal at San Joaquin Outdoor Science School, shared in a follow-up interview that during the year following the field test, he incorporated sessions into the staff orientations and in-service days throughout the year, and in subsequent years had plans to review the modules in more depth to split them up in smaller sessions that would be more digestible for staff and provide ongoing opportunities to continue developing field instructors' knowledge and skills:

As far as the PL sessions go, one thing that we had great success with was this spring, we had a kind of large (staff) turnover as well, and so we took Making Observations and Questioning Strategies and smooshed them together into one session, one three-hour session, since we had already presented and given feedback on those. And that went very well. So, I think maybe looking at taking those bits and pieces from various sessions and doing an overall BEETLES session…will be something that we'll continue doing in the future.

Summary of National Residential Outdoor Science Program Needs Assessment

During the pilot year of BEETLES, the evaluation team conducted interviews with the four program leaders (a) to learn about each program site, including the organizational structures and staff hiring and training processes; and (b) to provide an opportunity for program leaders to share in-depth feedback about the BEETLES workshops. During these interviews, the evaluation team learned that while these program were all located in a similar region (i.e., the Bay Area) they had distinct characteristics and features that shaped their overall practices and needs. This was further reinforced during end of field test interviews with program leaders of the 12 programs that participated in the first California Leadership Institute (i.e., CLI1). Given that the BEETLES project was working towards working with a national audience, it was deemed important for the BEETLES project to understand the features and landscape of ROS programs nationally and assess their professional learning needs. These preliminary impressions were the impetus for conducting a needs assessment survey to systematically examine trends with similarities and differences across ROS programs in the United States.

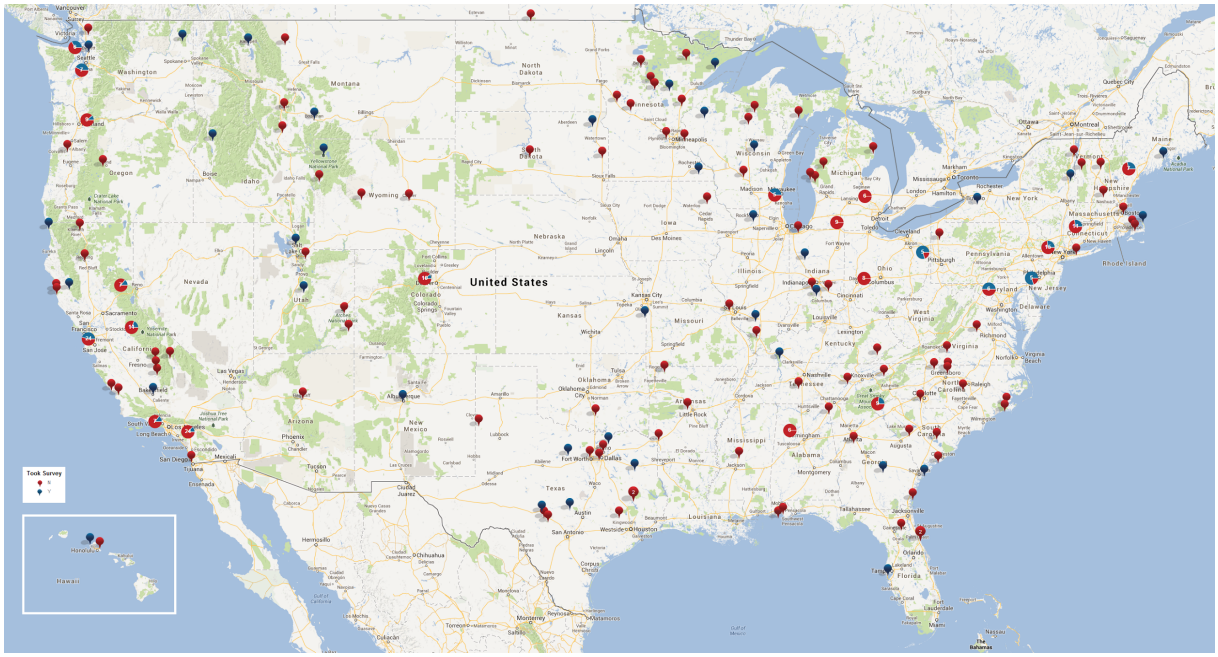
The evaluation team worked closely with the project team to develop an instrument that to examine key characteristics of ROS programs throughout the United States including programs' awareness and interest in BEETLES; professional learning practices; leader (e.g. qualifications, role); programming (e.g., content, format; instructional practices); organizational and physical characteristics; target population; and staff characteristics (demographics, qualification, staffing positions). See Table 4 for a description of the constructs in the assessment instrument.

Table 4. Final Survey Constructs and Item Descriptions with Value to BEETLES		
Construct/ Sub-Construct		Description of Items and Value to BEETLES
BEETLES Interests	Awareness	Program leaders' current level of awareness of the BEETLES project to gain insight to what extent program leaders had heard of BEETLES.
	Interest	Program leaders' interest in participating in the BEETLES project to identify any potential programs for outreach and recruitment.
Professional Leaning	Budget	Programs' level of financial support and to what extent programs allocate funds for PD opportunities for staff (instructional and/or leadership).
	Leader PD	Professional development program leaders typically participate in, including Frequency and types of professional development.
	Staff PD	The ways in which the program supports and provides professional development for ROS staff, including frequency and topics covered.
Program Leader Information	Professional Qualifications	Program leaders' educational pathways and professional experiences to gain insight into the hiring practices of leadership staff.
	Demographics	Demographic information (i.e., race, ethnicity, sex, age) about program leaders to gain insight into the diversity of ROS programs.
	Role	Program leaders' primary role and responsibilities, including in program and curricular planning.
Programming	Content	Content of programming, including topics, activities, and academic standards to determine to what extent, if any, science is incorporated.
	Format	Format of programming, including types of activities and lessons, role of classroom teachers, number of students, and schedule of programming (e.g., day, evening).
	Preparation & Follow-Up	How staff prepares for and follows up with schools to examine how ROS may connect programming with school-based curriculum.
	Instructional Practices	Program's approach to differentiating instruction to support diverse learners.
ROS	Natural Characteristics	The natural characteristics and features of the program's physical site to provide contextual understanding of the programming offered.
	Organizational Structure	The key characteristics of the program's organizational structure (e.g. leadership) to gain insight into.
Audience	Population	Demographic information of students and schools served .

ROS Staff Characteristics	Program Goals	The program's established goals, including mission and priorities.
	Demographics	Demographic information about program staff (e.g., race/ethnicity, sex) to gain insight into the diversity of staff.
	Hiring: Qualifications	The minimum professional and education experience and training when hiring staff.
	Staffing	Number of staff members and periods of employment.

The evaluation team identified multiple existing databases of residential outdoor programs in consultation with the BEETLES project team and other field experts. Given the BEETLES project team's focus on residential outdoor science programs that provided science learning experiences, the evaluation team conducted an extensive search to identify programs that fit the following criteria: residential programs (i.e. offering overnight school program experiences); significant focus on science in their programming or program description statement (e.g., field investigations, focus on ecology or science content and or processes); and programming offered during the academic school year. . The final database included 340 programs that were initially invited via email to participate in the National Needs Assessment survey. Following the initial outreach, 33 of the email addresses bounced back. Efforts were made to identify a secondary contact, and invitations were re-sent. By survey close, respondents (n=92) represented programs across 31 states, as illustrated in Figure 2, yielding a response rate of 32%.

Figure 2. Distribution of Programs who Completed National Needs Assessment



Key: Red = No; Blue = Yes

Findings from the needs assessment were then used to inform the team in strategy and decision-making. For example, the national needs assessment suggested that California programs offered more professional learning opportunities and emphasized science more than programs outside of California. This finding affirmed the project teams' understanding that professional learning opportunities, particularly those that focus on science, are limited among ROS programs. In addition, the project team had made an assumption that many programs lead daylong hikes based on their experience with California ROS programs. However the needs assessment data revealed that most programs (> 80%) typically lead hikes that are between one and three hours in length, with California programs being twice as likely to cite hikes as "Very Important" and tending to lead longer hikes than non-California programs. This information helped the project team reconsider how staff resources were allocated towards developing longer model hikes for programs, given that they may not be utilized as much as they had originally thought[5].

In addition, an indirect outcome of the needs assessment was an updated database of existing ROS programs throughout the United States that consists of nearly 300 programs that offer science-based, residential experiences for students. The project team used this database in their outreach and recruitment efforts, and has been shared with the environmental education field.

SECTION 2: INFLUENCE OF BEETLES ON RESIDENTIAL OUTDOOR SCIENCE PROGRAMS

There were at least five areas in which BEETLES' influence was examined:

- Program leader attitudes
- Program philosophy and design
- Curriculum design/Field instructor practices
- Staff training/professional learning opportunities
- Youth/student outcomes

Program Leader Attitudes

BEETLES Institutes were effective in changing program leaders' attitudes. Pre/Post surveys indicate a shift from an instructor-centered approach to one that is student-centered.

Pre-Post-Institute surveys included items asking program leaders to indicate their level of agreement to various statements regarding their attitudes towards teaching and learning science. A paired-samples Wilcoxon Signed Ranks test of significance was conducted to detect changes in participant attitudinal items from pre-Institute to post-Institute. Attitudes regarding *Instructor-Centered Pedagogy* (Factor 1) decreased significantly

[5] More details about the needs assessment were included in Snow, J. & Romero, V. (September 2013) BEETLES Project Evaluation Annual Report: Year 2; Chi, B., Romero, V. & Chung, J. (October 2014). BEETLES Project Evaluation Annual Report: Year 3.

(p<.05) by the end of the Institute. In contrast, attitudes regarding *Student-Centered Pedagogy* (Factor 2) increased significantly (p<.05) by the end of the Institute, suggesting that participants shifted their attitudes about teaching and learning from one that is grounded in direct-instruction that is more typical of current instructional practices in residential outdoor science schools, to one that emphasizes practices that are discussion-based, learner-centered and science-focused. For example, respondents reported an increase on items such as "Learners need time to discuss concepts" or "Learners should be asked questions about their ideas." Further, the group effect suggests that the NLI group generally started and ended with higher scores than the CLI group (though the rate of change was approximately the same between groups.

Table 5. Items for Factor Analysis

Item	Text
Factor 1: Instructor-Centered Pedagogy	
D01	If people are presented with a clear, coherent explanation of a concept, they will learn the concept.
D02	When designing an educational activity, one should assume that most of the learners have little useful knowledge of the topics to be covered.
D04	When learners ask questions, they should be given the answers.
D07	Listening to presentations is a good way for people to learn the concepts.
Factor 2: Student-Centered Pedagogy	
D05	Learners need time to discuss concepts.
D09	Learners should be asked questions about their ideas.
D11	In order to teach well, it is important to consider what students already know about a subject.
Note: All items had the following response options: 1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Somewhat Agree, 5=Agree, 6=Strongly Agree ("Not Sure" was considered an omission)	

In addition, a second set of analyses examined the effect of time across three administrations for Factors 1 and 2 (i.e., Factor 3 was only administered during PRE and POST). The repeated-measures ANOVAs revealed a significant effect of time in the upward direction for Factor 2 ($F(2,30)=7.38$, $p<.01$). Within-subjects repeated contrasts revealed a significant difference between PRE and POST administrations ($F(1,15)=14.12$, $p<.01$), but not between POST and EFT. The time effect for Factor 1 was not found to be statistically significant. Put another way, the effect of the Institute did not appear to change (lessen or

increase) over the course of the program year regarding program leaders' attitudes toward student-centered pedagogy.

Finally, program leaders reported that the relevance to programs of all of the following science-focused concepts also increased significantly ($p<.01$) by the end of the Institute: student-centered instruction, inquiry-based instruction, Learning Cycle instructional method, discussion-based instruction, questioning strategies, scientific habits of mind, nature of science and practices of science. (Note: This was true for the NLI 2 but need to double check for others.)

These findings suggest that the Institutes were effective in shifting program leaders' attitudes towards instruction, and that the effects were sustained over the course of the program year as they faced implementation challenges and successes.

BEETLES Institutes were effective in increasing program leaders' comfort and preparedness to teach field instructors about scientific processes.

The analysis for Factor 3 showed a significant main effect of time ($F(1,85)=24.33$, $p<.01$). In addition, the direction of the time effect suggests an increase in scores between PRE and POST administrations. Similar to Factor 2, the effect of the Institute did not appear to change (lessen or increase) over the course of the program year regarding program leaders' attitudes toward student-centered pedagogy.

Table 6 Items for Factor Analysis

Item	Text
Factor 3: Preparedness in Teaching Field Instructors	
C03	I feel very comfortable leading a discussion with field instructors.
C05	I feel well prepared to teach field instructors about how to make observations about the natural world.
C06	I feel well prepared to teach field instructors about asking questions about the natural world.
Note: All items had the following response options: 1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Somewhat Agree, 5=Agree, 6=Strongly Agree ("Not Sure" was considered an omission)	

These findings suggest that the Institutes were effective in increasing program leaders' preparedness towards training field instructors, and that the effects were sustained over the course of the program year as they faced implementation challenges and successes.

Program Philosophy and Design

Program leaders' participation in the BEETLES Institutes influenced ROS programs in diverse and sustainable ways. For example, program leaders reported how their sites revised their organizational mission, goals, curriculum, and staff professional learning opportunities practices to support deeper engagement with learner-centered practices in science.

For many programs, participating in BEETLES provided the opportunity for programs to reflect on their overarching objectives and goals for participants, to rethink their curriculum, and to think about overarching teaching practices and how to support students, as exemplified by the program leader quote below. Nine CLI 1 sites and 6 NLI sites specifically shared that participating in BEETLES facilitated reflection about their program's objectives and goals and how the programming is supporting those objectives/goals. Several program leaders called it "BEETLE-fying" their lessons and programs.

> *I also feel like it's definitely pushed our program so that it's more student-centered and less content-centered. More of the learning comes from the students, and the students are articulating it, and students creating their own conceptual understanding as opposed to us, "okay, did you learn these three facts by the end of the class?" I think it's pushed our program more in that realm of student-centered. I think is more effective learning, but also provided the tools and kind of resources to make that transition easier.*

Organizational Mission

Participating in BEETLES encouraged program leaders to rethink ways in which programs are serving students…

> *...for the last few years we've become an adventure-based education program [where] classroom teachers were utilizing our program more for [challenge courses and team building activities]... And I think this year we've actually taught more and done more science education than we have in many, many, many years…[the] professional learning sessions have really given our staff the background and confidence to do [science] [and know] that science doesn't have to be something canned or set up. It's right there in front of us all the time.*
>
> ***
>
> *To learn requires the correct tools… (it) shifted how we think about how we are giving kids those tools. I think that is something we always cared about as a program, but didn't have specific language to frame what we wanted…. So would just go back to games. In our training, (we) didn't always have research to back it up.*

…Encouraged programs to reconsider its program mission…

> *...We came up with five educational principals and again this tied in really well with the work we were doing with BEETLES...We designed our learning experiences from the learning cycle. Then, we decided since we were focusing on student achievement through outdoor science education, we proposed a mission adjustment so we actually changed our mission statement and went through the board and we just became much more focused on building student achievement through the lenses of outdoor science and through things like critical thinking skill and problem solving and really figuring out how to build those into our programs.*

…And reframed the way in which programs foster science learning.

> *...for a number of years we've felt that to advance what we do from a science education standpoint we really needed a framework [and] BEETLES has really provided a lot of that framework for us... our staff feel empowered to do science in a way that I'm not sure they ever did before…*
>
> ***
>
> *I think it definitely influenced how we are approaching what our objectives and lesson structure should look like… much more focused on explorations, observations, drawing conclusions*

Professional Learning, Training and Support for Field Instructors

Participating in BEETLES helped program leaders reflect on how to support field instructors through observations, ongoing feedback and continued in-services, and has influenced the ways in which both CLI and NLI sites provide and structure professional learning opportunities.

Many programs shared that each year staff trainings often included an orientation at the beginning of the program year followed by in-service days covering a range of topics that are often determined by staff interests. While most programs noted that they valued professional learning prior to participating in BEETLES, some program leaders shared that the process of presenting the professional learning modules and following up with staff reinforced the need for ongoing professional learning opportunities. One NLI site shared:

The fact that I've been doing BEETLES, I think, has re-shifted a lot of our staff (members') perspectives that when we have this down time, this is a great time to spend it doing professional development. It doesn't have to be BEETLES, but just thinking critically about how we're doing our job and how we can do it better. So, I think that that's one advantage that it's had for the organization as a whole.

Further, BEETLES provided a framework for programs to provide more structured professional learning opportunities and a foundation for how staff may facilitate learning experiences on trail with students. For example, four NLI programs shared that participating in BEETLES encouraged them to re-write some of their training materials, particularly for new staff and/or interns, to include an emphasis on the learning cycle. One program shared:

I'm creating all the new curriculum that the interns will be trained in. All of that is being put through the learning cycle filter and all those as activities as much as possible incorporate the BEETLES activities that are in the student handbook.

One CLI program leader further explained that his site now emphasized the importance of facilitating reflection on practice for field instructors, establishing goals at the beginning of each week and then revisiting their goals and discussing what went well and could be improved.

In addition, while many programs did not explicitly plan on presenting 11 professional learning modules in their entirety, both CLI and NLI program leaders shared that they had plans to or already were incorporating some level of BEETLES (e.g., components of modules, learning cycle, student activities) into ongoing professional learning and trainings. One program leader shared:

[BEETLES has influenced] our staff training, -- it's not just our educators, but we train also kind of the adult and family educators, the college educators, and so they're receiving this training to put into the other programs. And then summer camps is a really big place we kind of see more BEETLES [to] get a little more educational training for them...

The influence on trainings and professional learning does not seem to be exclusive to residential programs and/or field instructors. A number of program leaders also shared that participating in BEETLES has influence the way in which they are training leadership staff, interns, cabin leaders, summer staff. One CLI site specifically noted that their evening program director saw an opportunity to incorporate BEETLES into their cabin leader training with high school students:

[the evening director] just really looked at [what we were doing] … [and] BEETLES'ed the cabin leader training. So, now when we get the cabin leaders right off the bus, we're doing walk and talks on down in small groups.

Three NLI sites further shared that they have led BEETLES trainings for staff at their other sites and/or programs nearby. For example:

We have received requests from the Director of Education for all of Mass Audubon has asked us to do more BEETLES trainings, both for the statewide camp trainings and for the statewide educator trainings next year for the year-round educator.

In addition, two NLI sites affiliated with graduate programs for field instructors shared that they incorporated BEETLES into their curriculum. For example, at the North Cascades Institute (NCI), graduate students enroll in a local university and work at NCI as field instructors while also taking courses such as non-profit leadership, curriculum design and local natural history as well as a teaching practicum that are taught by NCI leaders. Participation in the BEETLES project has provided inspiration and concrete tools and information to rethink their existing curriculum:

My goal was (for) these graduate students to develop themselves as reflective practitioners, that they really have very applicable tools to be able to do that with. And I think that's the relevancy of some of the BEETLES sessions. Some of the practicum aspects for the graduate students – I mean, they're staff and they're also student – those trainings also back up what they learn in their practicum courses and in some cases those sessions were in their practicum courses. So I think BEETLES gets some of the core methods that we want them to have.

This graduate program director reported wanting to review BEETLES materials to revise the syllabi for the graduate courses for the next program year.

Program Curriculum

At least eleven sites (four CLI and seven NLI) shared examples of how participation in BEETLES facilitated rethinking their curriculum including the lesson format and attention to the Next Generation Science Standards. Several sites referred to this revision process as "BEETLE-fying" lessons and activities (i.e. relating these lessons and activities to the learning cycle).

CLI and NLI program leaders shared in their interviews that participation in BEETLES encouraged them and their staff to re-examine their program curriculum, lessons and activities. This resulted in many programs incorporating BEETLES into their curriculum through a range of strategies-- from encouraging field instructors to try BEETLES student activities to completely overhauling the program's curriculum.

For example, at least two program leaders shared that field instructors saw the BEETLES student activities as a "toolkit" and made the binder of student activities available to staff to try out. A number of programs reported that their field instructors were more extensively incorporating the BEETLES student activities into their lessons, relying heavily on routines such as *Walk and Talk* or *I notice I wonder, It reminds me of*. Other activities that program leaders observed field instructors using more often included *Nature Scene Investigator (NSI)*; *Decomposition Mission*; *Card Hike*; *Mind Pie*; *What Scientists Do*; and *Food Web*.

Some programs shared that through the professional learning modules, field instructors were encouraged to go deeper into their lessons, as opposed to trying to cover as much as possible, as explained by a CLI field instructor:

> *…as a naturalist, the approach to designing a lesson [before BEETLES] was more like a checklist. In BEETLES [we] talked about going a mile deep vs. a mile wide—before we were a mile wide. This year's focus is more going a mile deep with one objective, maybe two objectives in a couple of lessons…*

In addition, at least two program leaders shared that they had revised their student journals and/or added a class that focused on journaling as a result of BEETLES, as described by the following NLI participant:

> *[Schools will] sometimes [come] for one program at a time, and ... since going through the nature journaling BEETLES session, [we started] a nature journaling class. So we'll have schools that will come with that focus. Some of them are schools that the art teacher is along. So, that can be a little bit more complicated, but others are schools that are just interested in more in the science, and they want to do that through the journaling.*

At least 11 program leaders (four CLI and seven NLI) shared that they or their staff rewrote their curriculum in a variety of ways using the BEETLES approach, as illustrated by the following quotes:

> *Everything that I did this year that was different was (to) make sure that the staff wrote up all of their lessons in the learning cycle format. Before, I'd let them use any format that they were comfortable with, but having them actually sit down and work with the learning cycle and how are they presenting certain things, I think that was a real key in getting them to make sure that they weren't lecturing the students, that every single lesson had the strongest component of exploration in it…*

***

...we did three [PL modules] in the fall, and then we started talking to the staff about the need to redesign the classes that we offer... So, they would sit down, a couple of them, and they would go through the curriculum that we already have and using their new knowledge, they would rewrite it BEETLES-style. That's been an ongoing process throughout almost a year.

Three leaders (one CLI and two NLI) reported the desire and work to "completely overhaul" their program curriculum. For example, one NLI site shared that by the end of the field test they had revised nine of their 19 classes, with plans to revise all of the program's classes.

Nine program leaders (5 CLI and 4 NLI) also volunteered in their end-of-year interviews that the BEETLES Institutes enabled them to present and begin incorporating the Next Generation Science Standards into their curriculum, as described by a CLI program leader:

In general, the BEETLES curriculum has pushed us more into Common Core and Next Generation Science Standards…it has given us the tools, the resources, and … the impetus to move our program in that direction. I think if we had been trying to move in that direction on our own, I think our progress and our reflection towards NGSS and Common Core would have been much slower. I think that's huge in terms of preparing our interns into going on in the field in education, wherever they may end up, as well for our program in making that transition.

Field Instructor Practices

In addition to changes in curriculum, CLI and NLI program leaders shared that in the short amount of time they have field tested BEETLES, they have noticed a change in the ways field instructors are facilitating learning experiences for students, specifically on trail. At a minimum, the majority of programs noted that field instructors have been open to using the BEETLES student activities on trail, fostering inquiry-based experiences for students. Focus group interviews with field instructors at four CLI sites and two NLI sites confirmed the value of the student activities as a resource for leading these types of experiences on trail with students:

The three activities that I see most often are the "I notice, I wonder" just in anything, mind pies have been adapted all sorts of different classes and helping folks assess their learning and what's going to happen in their class, and the decomposition mission is the other one that I see folks doing all the time and really getting into from the art side or from the science side.

Program leaders and field instructors agree that not only are these activities a useful resource for trail-based activities, but they also have inspired some programs in designing

student activities using the BEETLES approach, as already described above. For example, in a follow-up visit to a CLI program, one field instructor shared:

> *A lot of the activities that we come up with are just very much using the eye of science. One thing I would like to point out is our training outline for lesson planning ….very much follows the [learning] cycle. I think that's something definitely we've been inspired to be focusing on how we give each other feedback based on the learning cycle. That's just like, all over the map, there been ways that BEETLES has inspired us.*

However, observations of field instructors at CLI1 and NLI1 sites participating in the field test process revealed, perhaps unsurprisingly, that the implementation of the BEETLES approach among field instructors varied. For example, some instructors reported embracing the BEETLES approach and heavily utilized BEETLES strategies, such as walk and talk, while other instructors seemed to use minimal BEETLES strategies and continued to be instructor-driven. This is not surprising, as instructors likely have a variety of reasons and experiences for teaching the way that they do including past experience, philosophy of teaching, practical time constraints, and others. It is important to note, that these observations were a one-time snapshot of a small percentage of field instructors during a time when the program leaders were focused on field testing and not in implementation. Variation in adoption of practices was to be expected and following up with the same sites with a few years of implementation would likely provide a more robust picture of field instructor demonstrating BEETLES practices.

Nonetheless, program leaders, generally seem to agree that when field instructors are using BEETLES (e.g. approach, student activities) that they have noticed a difference in the extent to which students are engaged on trail:

> *In most cases, [I have] found that kids are much more engaged, that they are not kind of staring at us ... as they are getting content dumped on them…[they are] using their brains and thinking and being able to discuss, and yeah. ...in the past, it was definitely a verbal vomit and the very narrow questions that there was an expected answer from the students and potentially, depending on the age group, might be a little heart-broken if they don't get the right answer. [Using BEETLES] is opening up our students a lot more and definitely engaging them a lot more… and I feel like there are students are taking away a lot more than they did before…*

While this evaluation study did not extensively focus on the impact of BEETLES on student engagement or learning experiences on trail, feedback from field instructors indicates evidence for BEETLES having a positive influence on students' learning experiences at ROS programs.

Program Outreach with Teachers and Schools

Classroom teachers who attend the ROS programs with their students have noticed and appreciated the change in instruction as a result of BEETLES. At least six of the programs reported in their interviews that K-12 teachers who attended the ROS with their students noticed the differences introduced by the BEETLES strategies and materials, as explained by a NLI program leader:

> *Our school teachers that are here with their kids and many of our returning teachers who have been coming from 10 years, 20 years, 5 years have said, "Oh, you're doing this whole new set of activities that I've never seen -- I've seen it differently in my students...Your staff -- they got to our kids in a way that I haven't seen from your guys before. They ask these questions in a different way. Our kids were crawling on the ground. You guys got kids that I never would've thought would ever do that." I think for us, that's proven to be the biggest support and confidence, like this was a good move that we're making and these are good things to implement.*

As this leader suggested, this type of feedback from teachers confirmed the value of incorporating BEETLES instructional strategies and materials in the ROS program, even to the point that teachers were asking the ROS program for information about BEETLES:

> *We had a teacher two weeks ago from -- coming (from) a very strong science school and saying, "Oh, I saw this technique and I want to steal this back to the classroom. How do I get these things from you guys that you are doing?" I think when they're seeing that, that's the best praise for how great some of the activities are and the changes it's made in our staff.*

Youth Outcomes

Youth attending residential ROS at participating BEETLES sites demonstrated statistically significant gains on surveys measuring their fascination with science, competency beliefs in science, and their environmental literacy.

To assess the influence of ROS experiences on youth science learning activation and environmental literacy, survey data were collected in spring of 2014 from four ROS sites using BEETLES materials that operated three to five day residential programs. As defined by The Science Learning Activation Lab at UC Berkeley and University of Pittsburgh, science learning activation is a composition of dispositions, practices, and knowledge that enables success in proximal science learning experiences. More specifically, the activated science learner is fascinated by natural and physical phenomenon, values science, has high competency beliefs, a robust and positive innovation stance, and engages in scientific sensemaking (Dorph, Cannady, Schunn, Crowley & Shields, in submission; Dorph, Schunn, Crowley & Shields, 2013). Science learning activation combines insights from science education and cognitive psychology on what supports learning, with insights from

educational psychology and social psychology about motivational and self-regulation constructs that support engagement and learning behaviors. Higher levels of activation are thought to 1) enable choices towards science learning opportunities; 2) produce positive cognitive, behavioral, and affective engagement during science learning opportunities; and 3) collectively produce greater learning from these science learning opportunities, engagement effects, and having critical sense-making skills. Environmental literacy was defined as sense of place, connectedness to nature, and environmental stewardship in caring for and protecting the environment.

Each site collected survey data before and after the residential programs from a minimum of 50 youth per site. Results are summarized in the table below, suggesting that the instruments are sensitive enough to detect the measured outcomes; the outcomes measured by the instruments are appropriate to examine in the proposed study for youth engaged in ROS; and that ROS have an impact on youth science learning outcomes.

Table 6. Student Learning Activation and Environmental Literacy Results

Scale	N	Mean Difference	t-value	Sig. (2-tailed)
Fascination	278	-.04831	-2.971	.003*
Values Science	271	-.02408	-1.086	.278
Competency Beliefs	251	-.07957	-4.339	.000*
Sensemaking	199	.03304	1.192	.235
Environmental Literacy	198	-.07196	-4.027	.000*

For example, the findings suggest that youth significantly increased in their fascination with the natural and physical world, sense of scientific competency, and environmental literacy as a result of their three to five day experiences in residential outdoor science programs. These findings indicate the positive influence of BEETLES practices and materials in ROS programs, and of ROS programs in general. Given the limited evidence of the influence of residential outdoor programs on students' science learning, these findings deserve further study.

SECTION 3: INFLUENCE ON LARGER ENVIRONMENTAL EDUCATION FIELD

BEETLES provided an opportunity for residential outdoor science program to connect, share, and in some cases collaborate with each other to improve the experiences they provide for students.

The leadership institutes provided an opportunity for residential outdoor science programs to come together to not only learn about the BEETLES professional learning modules and materials, but also to learn from other programs about the ways in which they are serving students through residential outdoor experiences. Following each Institute, program leaders consistently shared the value of connecting with other programs-- noting that they were able to share expertise about content, practices, activities-- ultimately contributing to a community of sharing and learning. Recognizing the value and expertise

that programs leaders bring to the Institutes, BEETLES provided structured time during the institutes for "Open space mini conferences" during which program leaders facilitated discussions about various topics of interest, as illustrated by the following feedback:

> *Choosing such varied programs and recognizing our common goals/and our unique differences was fantastic. Lots of time for collaboration and discussion (you did not let us stay with our partners) FANTASTIC!*
>
> *****
>
> *We need support. Most of us are isolated outdoor ed/EE organizations that may or may not have a large staff of coworkers with whom we can share ideas. We need people to bounce ideas off of and to hear new perspectives. Whoever we talked with at this institute seemed genuinely interested in what everyone else was doing and how we could support one other, even if our organizations were completely different from one another.*

In addition, programs that participated in CLI2, NLI1 and NLI2 had an ongoing opportunity to share resources, experiences, and best practices with each other through an online platform while implementing BEETLES at their program sites. In addition, one unanticipated yet positive outcome seemed to be that BEETLES provided an opportunity for programs to collaborate with other organizations through professional learning opportunities. Three NLI programs specifically noted that they started, or had plans, to collaborate with other programs in the area to incorporate BEETLES in professional learning opportunities. One program leader shared:

> *So, I would say there's a big example that we haven't talked about yet that I think is a spot that in Minnesota BEETLES is really going to have an opportunity to shine is that ...there are six residential environmental education centers in Minnesota that are part of our collaborative... [Two of the programs] have been working together to take this information and share it with the collaborative so that we can continue to use to move the field in Minnesota forward... we have plans after all of this is done to look at potential grants to help the six centers work together to approach the Environmental Department of Education -- using language that's familiar with them because based on all this theory and we have -- we can say we have this quality of education across the board because we're all using techniques that are similar.*

According to program leaders of nationally respected residential outdoor science schools and environmental education programs, BEETLES Institutes and materials are innovations that need to be shared broadly to deepen science teaching and learning in these settings:

> *Thank you so much for doing this. EE has been undervalued for years…I'm overwhelmed when I think of all the students that you impacted this week. We*

know what we each do in our small programs is important... but what you guys have done here can actually change the world.

***

What BEETLES is doing is exactly what education (not just environmental education) needs…The (BEETLES) framework will help improve instruction at our facility and all across the country.

***

The BEETLES team and curriculum are amazing. This experience may be the one I look back on as the turning point of my career that led me to be the best educator I can be – truly making a difference in young lives and turning them on to learning that lasts a lifetime. Thank you for this opportunity, for work and love of what you do and sharing it all with us. This was the best conference I've ever been to and I've been to many.

IMPLICATIONS AND RECOMMENDATIONS

The findings in this report suggest several important areas for further work and study. Given that ROS programs have typically struggled to convince district administrators, teachers, and parents of the value of sending classes of students to a residential program for three to five days (Ernst, 2012; Gruenwald & Manteaw, 2007), these findings may help to advance the quality of ROS programs learning experiences; the quality of professional learning opportunities available to ROS professionals; and increased youth and school participation in ROSs as described in more detail below.

1) Continuing a visible presence for BEETLES to serve more ROS

As suggested by a participating national ROS program leader, in order to provide a lasting impact on the environmental education field, it is important to continue and sustain BEETLES professional learning opportunities and disseminate curriculum materials that are demonstrably meeting important needs in the larger environmental education field:

> *[I think] that long-term if the [Lawrence Hall of Science] wasn't able to have some sort of a presence with [BEETLES] that that probably becomes problematic... In the short-term I think not so much because there's enough content and enough stuff to work with that there's lots to do. I guess the reason that I even bring that up is that my fear would be that like a lot of things in education, not that I think this is necessarily a fad, but that people could perceive it as something that, "Oh, yeah. That (BEE came and went. That was cute while it lasted." That sort of thing, so I would hope I guess that you guys out there could maintain some presence and be able to support it sort of as the central organization.*

Based on the national needs assessment, there were over 290 ROS programs identified. 69 programs (approximately 25%) were served by the BEETLES team over the last four years, leaving over 200 programs that could benefit from BEETLES professional learning opportunities and materials. Many more program leaders, field instructors and students could be served.

2) Examining longer term implementation and outcomes

The study findings suggest a notable change in program leaders' attitudes as well as evidence of diverse influences on program curriculum, staff development, instructional practice and activities. This type of organizational change is not typical, particularly within a single year of implementation. Though research on informal educators is more limited, educational research suggests that it typically takes formal educators two to three years to alter their classroom instruction. Given the demonstrated interest by program leaders and documented impact of the BEETLES project on program leaders, field instructors and students through this study, the BEETLES project should be further supported and examined as an important contributor to strengthening the larger environmental education field and better aligning it with current science instructional practices and the Next

Generation Science Standards. The evaluation team recommends following up with program leaders and field instructors who participated in BEETLES to examine how a program's structure, professional learning opportunities and field instructor-led activities were influenced and sustained in the longer term. Also, given the student outcomes documented through this study, the evaluation recommends utilizing the *Science Learning Activation* and *Environmental Literacy* instrumentation in more sites to further examine the influence of ROS programs on youth, and to better understand why such changes may occur for whom and under what conditions.

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