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Assessment of Forever Earth Curriculum 2008-2009: Final Report

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Executive Summary

Forever Earth is a floating environmental laboratory and learning center at Lake Mead National Recreation Area that provides hands-on science experiences for students in the Clark County School District. The Forever Earth program was brought about through the efforts of numerous partners including Forever Resorts, a division of Forever Learning LLC, the National Park Service, Lake Mead National Recreation Area; Outside Las Vegas Foundation; and UNLV's Public Lands Institute. In 2005, a formal written agreement was reached between Fun Country Marine Industries and UNLV's Public Lands Institute to operate and manage the Forever Earth houseboat for the purpose of enhancing outdoor environmental education efforts in Southern Nevada. During the first year of the assessment program, knowledge, attitude, and performance assessments were developed to document the effectiveness of program events over the duration of the program. The findings from the first two years of assessment revealed that students' knowledge and attitudes increased substantially as a result of participating in the Forever Earth field trips. Results also demonstrated that teachers' perceptions of the curriculum were very favorable. In 2008-2009, the third year of assessing the program, students again completed knowledge, attitude, and performance assessment and results indicated that students' knowledge, attitudes, and skills increased substantially as a result of participating in the Forever Earth field trips. Teachers' perceptions of the Forever Earth curriculum continued to be positive.

Introduction

The Forever Earth program was brought about through the efforts of numerous partners including Forever Resorts, a division of Forever Learning, LLC: the National Park Service, Lake Mead National Recreation Area; Outside Las Vegas Foundation; and UNLV's Public Lands Institute. In 2005, a formal written agreement was reached between Fun Country Marine Industries and UNLV's Public Lands Institute to operate and manage the Forever Earth houseboat for the purpose of enhancing outdoor environmental education efforts in Southern Nevada.

A development team consisting of science educators from Clark County School District (CCSD) and informal educators from UNLV's Public Lands Institute (PLI) and Lake Mead National Recreation Area was formed to create the Forever Earth curriculum. The four member *On-Site Experience Development Team* consisted of program staff from the PLI and Lake Mead National Recreation Area. This team created the programming that was delivered aboard the Forever Earth Vessel and on land at Lake Mead National Recreation Area, and focused on creating engaging activities and ensuring that the mission and vision of the National Park Service and Lake Mead National Recreation Area was accurately presented. The *Classroom Experience Development Team* authored the pre-visit and post-visit lessons. This team, consisting of four members (two from PLI and two from CCSD), ensured that grade-appropriate science standards were met and that the Clark County educator's perspective was carefully considered.

The curriculum for each grade level was developed to complement traditional classroom studies in grades four, five, six, and seven with engaging, participatory, on-site activities and support lessons based upon a solid framework for inquiry and discovery. Students participated in activities, performed investigations, and used scientific equipment to discover the answers to key questions. Curricula for grades four, five, six, and seven were developed, field tested and delivered.

In 2006-2007, our research team became responsible for developing an assessment plan in order to document the effectiveness of the curriculum over the duration of the program. We developed assessment instruments and administered these instruments to program participants. In the second year of the assessment program (2007-2008) the assessments were modified slightly and again administered. In this report, we describe the assessment plan and provide results for 2008-2009 based on completed assessments.

Context

The significant water and other natural resources found within Lake Mead National Recreation Area provide extraordinary material for learning about science and the environment. The primary objective in developing curriculum for the Discover Mojave Forever Earth Project was to create interdisciplinary, interactive, and inquiry-based programs for students on the floating environmental education center and research laboratory. Under the direction of Daphne Sewing, Discover Mojave Forever Earth

Project Manager for PLI, the curriculum development team created a curriculum in which participants learned about the importance of the lake and public land to the desert's flora and fauna. The curriculum manual included detailed descriptions and facilitator's guides for the activities conducted; on-site activity support materials; and pre-trip and post-trip classroom activities with accompanying support materials.

Participants in Forever Earth programs explored the Lake Mead aquatic environment and its interrelationships with the surrounding area through their participation in the following four curricula:

- Grade 4: Just Passing Through! The Water Cycle!

Students learned about Lake Mead's water use cycle by following one drop of water and then diagramming this important cycle on a magnet board. Working as scientists, students determined if water is the same in all parts of the lake by comparing water samples from the middle of the lake and from Las Vegas Bay.

- Grade 5: Finicky Fish Finish…Last!

Students explored what has happened to the Colorado River and the reasons why it is so difficult for a native fish species, the razorback sucker, to thrive in this changed environment. Students collected water quality data to determine whether habitat conditions are sufficient for the survival of young razorback suckers.

- Grade 6: Alien Invaders!

Students studied Lake Mead to determine whether it is at risk for invasion by zebra mussels. Students learned about the consequences the zebra mussels could have on the lake and its living and non-living resources. In January 2007, this curriculum was revised after the discovery of quagga mussels, another invasive species.

- Grade 7: GSI: Geo Scene Investigation

Students are introduced to topographic and geologic maps and participate in an inquiry-oriented activity designed to introduce them to the geology, landforms, geologic processes, and geologic timeline of the Lake Mead National Recreation Area.

Each of these events were one time only activities, and were designed initially to last between two and a half to four hours on the boat, not including pre-trip and post-trip activities. However, it was necessary for PLI staff to develop additional on-shore activities for many of the groups participating in the Forever Earth program. For insurance purposes, only 23 students were permitted on the boat at any one time. Given that most of the classes had in excess of 23 students, most were split into two groups, with one group on the boat for two hours and the other group doing on-shore activities for two hours.

Assessment Program

As in the first two years of the assessment program, data was collected from both students and teachers. The assessments were conducted over time (i.e., pre- and post-intervention). Pre-test assessments were conducted in the classroom during the pre-trip visit. Post-test assessments were conducted onsite upon completion of the day's activities.

Student Assessment

Student assessment items were developed in alignment with the Forever Earth curriculum. Students were assessed for three areas of growth including *knowledge, attitudes,* and *skill performance* for the four curricula.

Knowledge Items

Assessments for each of the four curricula included four to five knowledge questions related to the specific activity (e.g., *Throughout time, what geologic actions or processes have been at work at Lake Mead?).* These knowledge questions consisted of constructed-response items, where students were required to generate answers in response to a prompt rather than choose from a set of alternatives. Knowledge questions were developed to assess the instructional objectives outlined in each of the curricula. For example, one of the stated knowledge objectives for Geo-Scene Investigation (Grade Seven) was "Students will identify common rocks and minerals of the Lake Mead area." The corresponding knowledge item on the pre- and post- test was *Describe some of the common rocks and minerals of the Lake Mead area*. Developing items for each knowledge objective help to ensure content-validity of the assessment (Thorndike, 2005). See Appendix A for an example of a knowledge assessment.

Based on feedback from program facilitators, minor modifications were made to two items at the fourth grade level for 2007-2008. Two of the possible answers to item 2 (*How has the water from Las Vegas wash different from water in the middle of the lake? Answer "yes" or "no" to the following questions*) were eliminated because arguments could be made for selecting either yes or no as a correct response. Item 3 was changed from selected response to an open-ended question. A minor wording change was made to item 2 (Grade 6) in 2008-2009 (i.e. *Why can quagga mussels thrive in Lake Mead?),*

Attitude Items

The attitude scales that were developed in 2006-2007 were based on existing assessments (Metzger & McEwen, 1999; Musser & Diamond, 1999; Schindler, 1999) that were designed for the purposes of assessing children's attitudes to recreational events and to the environment. We constructed similar attitude scales to measure children's attitudes towards the Forever Earth curriculum and to the environment.

An attitudes assessment was developed for each curriculum. The attitude pre-test included four items. The first two items on each attitude assessment were questions related to the specific event (e.g., *Learning about native and non-native fish in Lake Mead was very interesting to me.)* The second two items were related more generally to the Forever Earth activity (e.g., *I would like to do another Forever Earth Activity*).

At post-test, the four pre-test items were repeated and four additional questions were included for grades four, five, and six that were designed to measure more general attitudes towards the environment (e.g., *I learned important things today about the water*). The seventh grade post-test eliminated questions five and six because these two items were not strongly related to the seventh grade curriculum. See Appendix B for an example of an attitude assessment.

No modifications were made to the attitudes assessment in 2008-2009.

In 2008-2009 a repeated post test measure was conducted. Students completed identical knowledge and attitude items one to four weeks after the post tests were administered in order to measure the long-term retention of learning. Previous research suggests that most forgetting occurs within 48 hours of a learning activity (Neath & Surprenant, 2003); thus, we assume that the repeated post-test provides a useful measure of long term retention.

Skills

Because each curriculum included a hands-on activity component, such as students using a plankton net to collect plankton as part of the sixth grade curriculum, we felt that it was important to include a performance assessment component. As Stiggins (2005) notes, observing and evaluating skills as they are being performed can be a rich and useful source of information about the attainment of specific skills. Skill performance assessments, in the form of a checklist completed by the event facilitator, were designed to measure whether or not the child demonstrated a particular skill related to the curriculum objectives and the Nevada Science Content Standards. For example, one of the science standards in the sixth grade curriculum is that students know how to use appropriate technology and laboratory procedures for observing, measuring, recording, and analyzing data. The performance skill related to this objective was *Participant collects water sample and performs water quality measurements.* Event facilitators determined whether or not the participant demonstrated the skill by checking one of two columns: *demonstrates skill* or *does not demonstrate skill.* (See Appendix C for a sample performance assessment).

In the first year of the assessment program, these performance assessments were not conducted. Primarily, this was due to the time constraints faced by program facilitators as they assessed knowledge and attitudes for 1200 participants. In the second year, the performance assessments were conducted by randomly selecting two schools at each grade level, except for seventh grade because only one seventh grade classroom completed the seventh grade curriculum and measurement tools. Initially, at each grade level, students were randomly selected. However, given the ease with which trained observers and staff found they could complete the assessments, all students from the selected schools were assessed on their performance. In 2008-2009 the same sampling strategy was used with the goal of sampling at least two schools for each grade level.

Teacher Assessment

We felt that it was important to elicit teacher perceptions to provide additional information about the effectiveness of the curriculum. We reviewed existing assessments in the literature such as the Compendium Evaluation Tool (California Regional Environmental Education Community), a teacher survey developed by the Place-based Education Evaluation Collaborative, and recommendations by Environmental Education Materials: Guidelines for Excellence (North American Association for Environmental Education). Existing assessments were Likert-type instruments and consisted of items related to knowledge, pedagogy, and attitudes.

The *Guidelines for Excellence*, developed by the North American Association for Environmental Education, outlines six key characteristics of high quality environmental education materials. For the purposes of constructing a survey to measure teachers' perceptions about the curricula, we focused on the key characteristic of "Instructional Soundness." Instructional soundness includes the following components: learner-centered instruction, different ways of learning, connection to learners' everyday lives, expanded learning environment, interdisciplinary goals and objectives, appropriateness for specific learning settings, and assessment (NAAEE, p. 4). These components of instructional soundness are related to both the content of the curriculum (knowledge) and to the ways that the content is delivered (pedagogy). The Compendium Evaluation Tool (California Regional Environmental Education Community) also indicates criteria for instructional materials. Notably, both general content and pedagogy are included as criteria. The next section of the report describes the knowledge, pedagogy, and attitude items that were developed (see Appendix D for the complete pre-survey).

Knowledge Items

Knowledge items were related to the content, goals, and objectives of the curriculum. Content-specific items (e.g., "Students' understanding of environmental concepts, conditions, and issues will increase as a result of participation in this site-based activity"), as well as more general content items were included. Content-general items were related to how well the curriculum was aligned to classroom activities and school district standards (e.g., "The content of this activity is aligned to the Curriculum Essentials Framework"). Nine knowledge items (items 1, 4, 5, 9, 10, 13, 15, 18, and 21) were included in the survey.

Pedagogy Items

Environmental education, according to the North American Association for Environmental Education, is "learner-centered, providing students with opportunities to construct their own understandings through hands-on, minds-on investigations. Learners are engaged in direct experiences and are challenged to use higher-order thinking skills" (NAAEE, p. 1). Pedagogy items were designed to reflect this view of instructional soundness and to elicit teachers' views about the appropriateness of the instructional activities. Eight pedagogy items (items 6, 7, 11, 14, 19, 20, 22, and 23) asked teachers to think about how learners might respond to the activities: (e.g., "The activity will engage fifth grade learners," and "Important concepts are conveyed in several ways so that all students can understand them").

Attitude Items

In addition to assessing teachers' perceptions of the components of knowledge and pedagogy, we developed questions related to teachers' attitudes. As Thomson and Hoffman (2005) note, one of the objectives of environmental education is directly concerned with attitudes: to help social groups and individuals acquire a set of values and feelings of concern for the environment. Attitude items included attitudes about the piloted curriculum (e.g., "I would bring my fifth grade science class to the Forever Earth Floating Classroom") and personal attitudes about the environment (e.g. "I am in favor of saving wilderness areas"). Eight attitude items (items 2, 3, 8, 12, 16, 17, 24, and 25) were included in the survey.

All knowledge, pedagogy, and attitude items were constructed as Likert-type items. Additionally, two open-ended questions were included in the post survey: 1) What are the biggest challenges that you face as a teacher in providing opportunities for student learning in settings outside the classroom?, and 2) Do you think that learning in settings outside the classroom is a valuable way to enhance existing curriculum?

Individual Interviews

Individual interviews were conducted with classroom teachers in Fall 2008 and Spring 2009. These interviews were conducted by a member of the research team using a consistent interview protocol (see Appendix E).

Summary of Assessment Program

The assessment plan of the Forever Earth curriculum in 2008-2009 included four data collection components:

1. the pre- and post- test measures of students' knowledge, attitudes, and skills
2. the repeated post-test measure of students' knowledge and attitudes
3. the pre- and post- measures of teachers' perceptions of the curriculum
4. individual interviews conducted with teachers at the conclusion of the program.

Implementation

The assessments were conducted over time (i.e., pre- and post-intervention) to determine the effectiveness of the curriculum in having an impact on student knowledge and attitudes about the environment, and the performance of skills related to the curriculum content at each grade level.

In the first year of the assessment program, the curriculum was implemented on 39 separate occasions in the 2006-2007 school year, involving 1263 students from 18 schools. All participants completed the knowledge and attitude components of the assessment program. In the second year of the assessment program, the curriculum was implemented 62 times over the 2007-2008 school year, involving 1885 students from 27

different schools. Two schools at each grade level that experienced the curriculum intended for that grade level were randomly selected for assessment of knowledge, attitudes, and skills. That is, two fourth grade classrooms that signed up for the water cycle curriculum (4^{th} grade curriculum) were assessed. This selection criterion was followed for all grade levels. In the third year of the program, 125 programs were implemented that involved 2804 participants. Ninety-three of these programs involved school groups that completed the program during the school day (see Table 1), while 32 of the groups were other agencies (e.g. National Park Service, Southern Nevada Water Authority) or groups (e.g. after school programs, Boys and Girls Clubs). Thirty-one different schools participated in the program (21 elementary schools, six middle or junior high schools, three high schools, and one K-12 school) involving 2269 students. The assessment program focused on these school groups only, and used the same selection criterion as in the previous year.

For the repeated post test measure, the goal was to select two programs from each grade level. However, for fourth grade and seventh grade only one participating school agreed to the additional data collection. Three programs were assessed in Fall and three were assessed in Spring.

Teacher interviews, occurring in both Fall 2008 and Spring 2009 semesters, were facilitated by a member of the research team.

Analysis

The knowledge measure, where students responded to open-ended questions, was analyzed using content analysis (Berg, 2001), in which student responses were coded in three categories (*no knowledge*, *partial knowledge*, and *more complete knowledge*). For example, a student response of *"I don't know anything about any fish in Lake Mead"* to the item 5 on the fifth grade assessment ("What do you know about the fish in Lake Mead? ") was coded as *no knowledge* because the response contained little, or incorrect, knowledge. *Partial knowledge* occurred when a student responded with some correct information or provided a very general statement (e.g., *"I learned that there are only 300 razorback suckers in Lake Mead"*). Student responses coded as *more complete knowledge* typically included more specific information or more than one example or reason (e.g., "*I learned that razorback sucker are endangered species. A Colorado Pikeminnow can be up to 6 feet and weigh up to 100 lb. Razorback sucker eat plankton. Razorback suckers lay their eggs on the shore in puddles").*

The scoring guide that was developed in the first year of assessment was revised in Fall 2008 to account for the variety of responses that occurred in the large sample. Minor modifications were again made in Fall 2009 to include additional examples of student responses. We calculated the median rank across the three knowledge categories (*no knowledge*, *partial knowledge*, and *more complete knowledge*) for all pre- and post-assessments. A no knowledge response was assigned a 0; a partial response was assigned a 1; and a more complete response was assigned a 2. See Appendix F for a sample scoring guide.

The analysis of attitudes compared pre-test and post-test ratings by students who participated in the events. Ratings were made on a 1-5 Likert scale.

Results

Student Knowledge

Student pre, post, and repeated post-test knowledge scores are shown in Table 2. Individual scores ranged from 0 to 2 on four separate measures for a total composite score that ranged from 0 to 8. We compared pre and post tests, pre and repeated post tests, and post and repeated past tests to determine whether scores increased due to the intervention and remained high after a one to four week delay.

Statistically significant gains occurred at each grade level. Scores were treated as interval data and compared using paired samples t-tests between pre, post, and repeated post-test composite scores. These findings show that there was a significant increase in knowledge at each grade between pre and post-test. Table 2 shows that knowledge increased substantially from pre-test to post-test across the 4^{th} , 5^{th}, 6^{th}, and 7^{th} grade samples. The increase at all grades was one standard deviation unit or more, which is considered a large effect size.

The repeated post-test scores also were significantly higher than pre-test scores at all grade levels. This indicates that gains due to the Forever Earth activity were maintained over the delay period and suggests stable long-term retention. Table 2 also shows that repeated post-test scores were statistically unchanged (i.e., grades 4 and 7) or significantly higher (i.e., grades 5 and 6) at the repeated delay test. Knowledge scores may increase between ppost-test and repeated post-test due to post-activity processing and integration by students (Neath & Surprenant, 2003).

Pre, post, and repeated post-test means for each knowledge item were also calculated for every grade level (see Table 3). Statistically significant gains occurred between the pre-test item and the post-test item in all cases except for two. Item 2 at the 4^{th} grade level and item 1 at the 5^{th} grade level did not increase significantly between the pre and post-test. On both of these items, students scored relatively high on the pre-test.

Student Attitudes

Student pre- and post-test attitude scores are shown in Table 4. Scores were treated as interval data and compared using paired samples t-tests. We created three different attitude scores, including pre-test attitudes about specific content, the matching post-test attitudes (i.e., same four items completed as the pre-test), and general post-test attitudes. We refer to these as specific *pre-test, specific post-test, and general post-test attitudes* respectively. We also repeated the assessment of the specific and general

attitude questions after a one to four week delay. Each rating was made on a 5-point scale and summed to create a score that ranged from 5 to 20.

Table 4 reveals that pre-test and post-test attitudes differed significantly for the 4th, 5th, 6th, and 7th grades. Post-test attitudes were higher in every case. A comparison of specific post-test and repeated post-test attitudes revealed a significant increase at 4th grade, no change at 5th and 6th grades, and a significant decrease at 7th grade. In general, these results suggest a lasting increase in attitudes due to the intervention.

We also found no difference between the post-test and repeated post-test general attitudes at any of the grades. General attitudes were high after the intervention and remained high after the delay.

The data shown in Table 4 indicate that attitudes increased significantly from pre- to post-test and remained stable over the delay period. Overall, these findings suggest that attitudes improved significantly due to instruction.

Teacher Assessment

Assessment of Teacher Perceptions of the Curriculum

Teachers completed pre- and post- test ratings of their perceptions of the curriculum's effectiveness with respect to knowledge, attitudes, and pedagogy. These ratings were combined into overall composite scores before and after the events. Seven teachers completed ratings. The mean rating and standard deviation are shown in Table 5.

There was no significant difference for pre- versus post-test ratings on knowledge, attitudes, or pedagogy. The means for each of these scores increased at post-test approximately one-half standard deviation, but were not significant due to the low sample size. In comparison, a sample of 20 teachers would have lead to significant statistical differences due to increased power. Thus, the current results suggest a positive trend toward increased knowledge, attitudes and pedagogy.

Conclusions

The purpose of this report was to provide results from the assessment program of Discover Mojave Forever Earth in its third year of implementation. The assessment program that was implemented was designed to evaluate the effectiveness of the four separate curricula that were developed. Data were collected and analyzed from both students and teachers.

Results support several conclusions. The most important is that each of the four curricula produced substantial increases in knowledge that were maintained over the one to four week delay following the Forever Earth activity. This pattern of results clearly indicates that the activities had significant long-term instructional benefit. A second conclusion is that student attitudes improved significantly after experiencing the curriculum. A third conclusion is that teachers demonstrated very favorable attitudes about the curriculum's effectiveness. Lastly, although the scope of the program increased dramatically, a 223% gain in the number of students served, student gains continued.

Recommendations

1. Continue the assessment program for both students and teachers. Results suggest that the assessment instruments used for students was reliable and sensitive to growth over time with respect to their knowledge, skills, and attitudes. With teachers, we recommend that the pre-post assessment strategy of assessing teachers' perceptions of the curriculum be continued, especially in cases where the curriculum undergoes revisions.
2. Continue the teacher interviews as a data collection technique, but only with teachers who have not participated in prior years. Many of the teachers are bringing their classes as an annual event, and re-interviewing them has not yielded any additional, new insights.
3. Continue to focus on growth over time as indexed by gain in pre- and post- test scores by continuing to implement the delayed maintenance measure (e.g. a post- test follow up one week later).
4. Consider implementing the assessment program for other groups and agencies. These groups and agencies now account for 34% of the programs being implemented.
5. The curriculum for sixth and seventh grades appears to be under- utilized, a trend that has been consistent for the last two years. These programs represent only 13% of the total number of curricula provided in 2008-2009. It would be worthwhile to explore why this is occurring and to address the issue. For example, perhaps modifications to the curricula are needed, or additional information needs to be provided to middle school teachers.

Table 1: Curricula Implemented by School

School Name	4th Grade	5th Grade	6th Grade	7th Grade	GATE
Jeffers ES		1			
Brookman ES		1			
Hollingsworth ES					2
Bendorff ES	2	5			
Goldfarb ES	6	4			
Gene Ward ES	3				
Cumorah K-12	1	1	1	1	
Reedom ES	3	3			
Hoggard ES		4			
Guy ES	3				
Wright ES		1			2
Lunt ES	3				
Lummis ES		4			
Paradise ES		2			
Twitchell ES		4			
Kahre ES					1
King ES		5			
Rhodes ES		1			
Taylor ES		3			
Warren ES		3			
Vanderburg ES	1				
Pittman ES	1				
Bridger MS				4	
Garrett JHS				4	
Hyde Park MS			7		
Sawyer MS			1		
Greenspun JHS				1	
Haikal Islamic JHS				1	
Legacy HS				1	
Burk HS				1	
Miley Achievement Center HS				1	
TOTAL	23	42	9	14	5

Table 2: Pre, Post and Repeated Post-Test Composite Knowledge Scores by Grade Level

	Sample Size	Pre-test Mean and Standard Deviation	Post-test Mean and Standard Deviation	Repeated Post-test Mean and Standard Deviation	t value	Significance
Grade						
4th						
Pre/Post	72	2.47; 1.40	4.68; 1.49		12.48	$p < .000$
Pre/Repeated Post	21	2.23; 1.53		4.47; 1.20	5.49	$p < .000$
Post/Repeated Post	21		4.80; 1.72	4.47; 1.20	-1.07	n.s.
5th						
Pre/Post	46	1.91; .96	5.04; 1.92		10.69	$p < .000$
Pre/Repeated Post	46	1.91; .96		5.54; 1.96	12.28	$p < .000$
Post/Repeated Post	46		5.04; 1.92	5.54; 1.96	2.04	$p < .05$
6th						
Pre/Post	56	3.07; 1.54	6.44; 1.43		14.40	$p < .000$
Pre/Repeated Post	56	3.07; 1.54		8.01; 1.33	19.18	$p < .000$
Post/Repeated Post	56		6.44; 1.43	8.01; 1.33	7.03	$p < .000$
7th						
Pre/Post	54	1.64; 1.49	4.44; 2.38		13.18	$p < .000$
Pre/Repeated Post	24	1.64; 1.49		6.16; 1.46	12.08	$p < .000$
Post/Repeated Post	24		6.54; .93	6.16; 1.46	-1.24	n.s.

Note: (4 items, 0-2 rubric score, 0-8 range). n.s. denotes a test that is not statistically significant.

Table 3: Pre and Post-test Means for Knowledge Items by Grade Level

	Grade 4	Grade 5	Grade 6	Grade 7
Item				
Pre1				
Pre2				
Pre3				
Pre4				
Pre5				
Post1				
Post2				
Post3				
Post4				
Post5				
Repeated Post1				
Repeated Post2				
Repeated Post3				
Repeated Post4				
Repeated Post5				

Table 4: Pre- and Post and Repeated Post-test Composite Attitude Scores by Grade Level

	Sample Size	Pre-test Mean and Standard Deviation	Post-test Mean and Standard Deviation	Repeated Post-test Mean and Standard Deviation	t value	Significance
Grade						
4th						
Specific Pre/Post	72	15.55; 2.54	17.95; 2.76		9.47	$p < .000$
Specific Post/RP	21		17.43; 2.43	19.14; 1.14	5.38	$p < .000$
General Post/RP	21		18.47; 1.72	18.38; 1.90	.240	n.s.
5th						
Specific Pre/Post	46	15.80; 3.63	18.86; 1.73		6.60	$p < .000$
Specific Post/RP	46		18.86; 1.73	18.56; 2.15	-1.23	n.s.
General Post/RP	46		17.63; 4.20	18.59; 1.09	.95	n.s.
6th						
Specific Pre/Post	56	16.32; 2.45	17.51; 2.84		3.75	$p < .000$
Specific Post/RP	56		17.51; 2.84	17.46; 2.90	-.26	n.n
General Post/RP	56		18.55; 1.68	18.29; 1,64	-.23	n.s
7th						
Specific Pre/Post	54	14.81; 2.22	17.14; 2.46		6.61	$p < .000$
Specific Post/RP	24		16.08; 2.71	14.37; 3.00	-4.25	$p < .000$
General Post/RP	24		8.79; 1.28	8.83; 1.12	.16	n.s.

Note: n.s. denotes a test that is not statistically significant.

Table 5: Assessment of Teacher Perceptions of the Curriculum 2007-2008

	Sample Size	Pre-test Composite Mean	Post-test Composite Mean	*t* value	Significance
Knowledge	7	37.33; 4.92	39.44; 3.41	1.57	n.s.
Attitudes	7	36.42; 2.99	37.85; 2.11	1.51	n.s.
Pedagogy	7	34.85; 5.01	38.14; 2.19	1.47	n.s.

Note: n.s. denotes a test that is not statistically significant.

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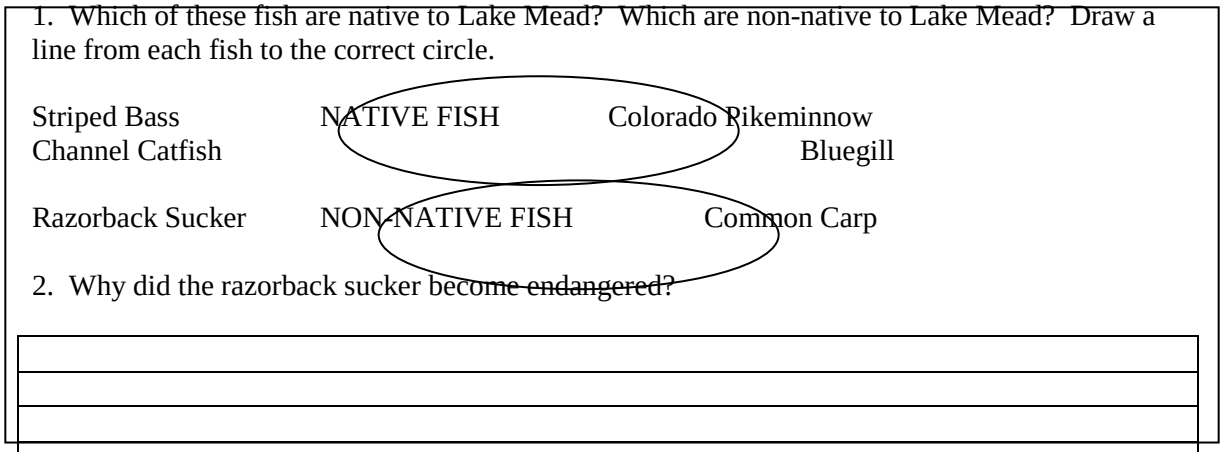
Appendix A: Forever Earth Post-Assessment: 5th Grade

1. Which of these fish are native to Lake Mead? Which are non-native to Lake Mead? Draw a line from each fish to the correct circle.



2. Why did the razorback sucker become endangered?

3. How do the striped bass and other non-native species affect the razorback sucker in Lake Mead?

4. What are the habitat needs of the razorback sucker?

5. What did you learn about the fish in Lake Mead?

Appendix B: Fourth Grade Attitude Assessment (Post)

1. I would tell my friends to do this program on the Forever Earth Floating Classroom.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

2. Learning about water at Lake Mead was very interesting to me.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

3. The Forever Earth activities were fun.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

4. I would like to do another Forever Earth program.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

5. I learned how important Lake Mead is to plants, animals, and people.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

6. I learned important things today about the water.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

7. I learned how people can use Lake Mead without hurting it.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

8. Because of what I learned today, I think it’s important to take care of Lake Mead.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

Appendix C: Performance Rubric: Forever Earth – Finicky Fish Finish Last (5th grade)

	Objective 1 Participant identifies fish using E-book of fish		**Objective 2** Participant collects water sample and measures turbidity		**Objective 3** Participant collects plankton and assists in slide making	
Participant Name	Demonstrates Skill	Does not Demonstrate Skill	Demonstrates Skill	Does not Demonstrate Skill	Demonstrates Skill	Does not Demonstrate Skill

Appendix D: Assessment of Teacher Perceptions of the Curriculum (4th Grade)

1. This site-based activity will increase my content knowledge.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

2. I would bring my fourth grade science class to the Forever Earth Floating Classroom.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

3. Students wanted to participate in this activity.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

4. The site-based activity is related to standards-based work within my fourth grade classroom.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

5. The content of the activity is aligned to the Curriculum Essentials Framework.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

6. The activity offered students opportunities to practice critical thinking processes such as problem solving, forming hypotheses, collecting and analyzing information, drawing conclusions.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

7. The site-based activity could improve my teaching in the classroom.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

8. The activity will promote respect and caring for the environment.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

9. The activity could be easily integrated into an established curriculum.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

10. The content of the activity is developmentally appropriate for fourth grade students.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

11. The needs of diverse learners are met by this activity.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

12. Participation in informal venues increases teacher knowledge.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

13. My understanding of environmental concepts, conditions and issues should increase as a result of participation in this site based activity.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

14. The activity engaged fourth grade learners.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

15. Students' understanding of environmental concepts, conditions and issues should increase as a result of participation in this site based activity.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

16. I am in favor of protecting public lands.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

17. As a teacher, I am enthusiastic about learning in settings beyond the classroom.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

18. Depth of conceptual understanding is a core element of this activity.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

19. The activity can encourage students to develop awareness and knowledge of environmental responsibility.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

20. Learning is based on students constructing knowledge to gain conceptual understanding.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

21. The content of the activity is interdisciplinary.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

22. Students are enthusiastic about learning in settings beyond the classroom.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

23. Important concepts are conveyed in several ways so that all students can understand them.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

24. If I had to choose between protecting a natural area and creating homes for humans I would choose to protect the area.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

25. I am interested in spending time working to help the environment.

Strongly agree	Agree	Not Sure	Disagree	Strongly Disagree
5	4	3	2	1

Appendix E: Interview Questions for Classroom Teachers

1. How did you find out about Forever Earth?

2. What did you like best about the Forever Earth field trip?
    a. What did the students like best?

3. Did you use any of the information from Forever Earth in your classroom instruction?
    a. Was it helpful?

4. Does the Forever Earth programming tie into the school district curriculum?

5. Do you notice a change in student attitudes towards science?

6. Have the students used any of the knowledge they gained on Forever Earth in the class?

7. Did you do the classroom preparatory activities as directed/suggested?
    a. If yes, please describe. Do you think it was helpful or beneficial for the students?
    b. If no, why not?
        1. Do you think it would have been beneficial for the students?
    c. How could the pretrip activities be improved?

8. Would you do another Forever Earth fieldtrip?

9. What was said to chaperones? (their role or directions)

10. Did you tell anyone about the Forever Earth field trip? If yes, what did you tell them?

11. Was the teacher previsit beneficial?
    a. Do you have any suggestions for improvement?

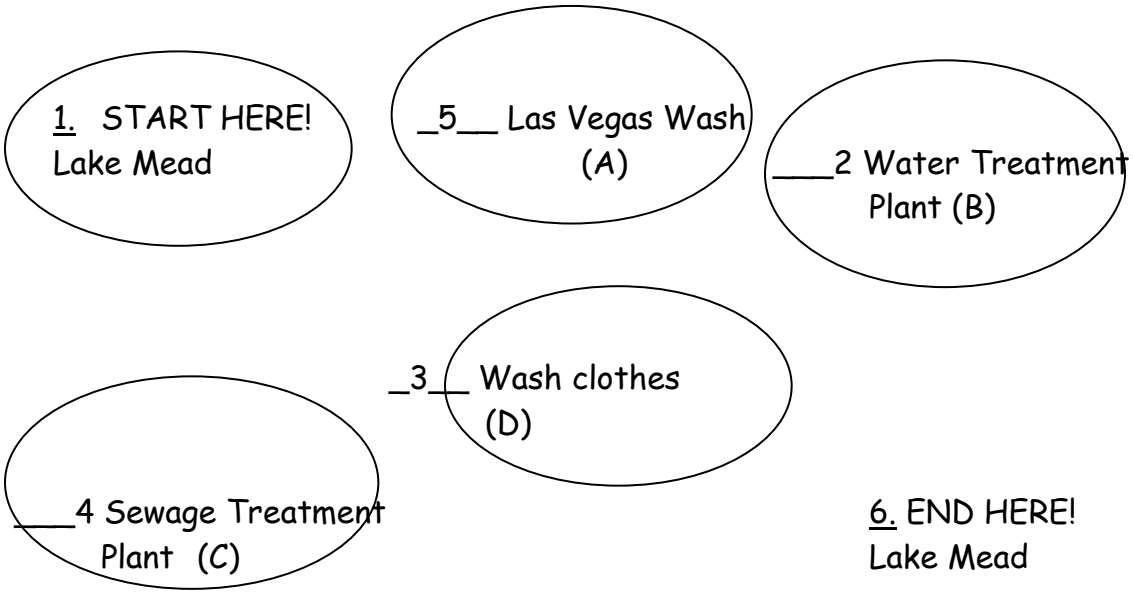
12. Was the classroom previsit beneficial?
    a. Do you have any suggestions for improvement?

13. How could the Forever Earth field trip be improved?

Appendix F: Sample Scoring Guide

Forever Earth Assessment: 4th Grade Scoring Guide

1. Describe what happens when Lake Mead's water is used by people by putting these steps in order from 1 through 6. Write the number on the line in each circle.



More complete: 2 points
- Response has 3-4 items in the correct order

Partial complete: 1 point
- Response has 1-2 items in the correct order

Less complete: 0 points
- Response has no items in the correct order

2. How is the water from Las Vegas Wash different from water already in the lake? Answer "yes" or "no" to the following questions.

_Yes____ Would one water sample be clearer than the other sample?
__No___ Would the plankton be different?

More complete: 2 points
- Response has both items answered correctly

Partial complete: 1 point
- Response has one item answered correctly

Less Complete: 0 points
- Response has neither item answered correctly

3. List some of the reasons why the water is so low in Lake Mead

More complete: 2 points

- Response has 2 correct responses and no more than 1 incorrect answer
    - People have used the water for different things
    - Evaporation
    - Drought

Partial complete: 1 point

- Response must include one correct positive item

Less complete: 0 points

- Response does not include any correct items
    - The dam has a leak
    - pollution

4. What can you do to save and protect the water in Lake Mead?

More complete: 2 points • Response includes two correct answers o Take shorter showers o Turn off the tap when brushing teeth o Don't litter o Only use what you need o Use less water o Recycle
Partial complete: 1 point • Response includes one correct answer or one less-specific answer o Don't waste water
Less complete: 0 points • No information or incorrect information provided