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Elwha Science Education Project: Formative Evaluation Report

Summer 2008 Results

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Summary of Findings

As of the 2008 summer program, evidence suggests project goals are being met:

- The Elwha Science Education Project (ESEP) is expanding to new student participants in the Olympic Peninsula area;
- High school (HS) students have a beginning understanding of the Elwha River restoration (analysis of HS journals will provide more evidence regarding student understanding);
- Middle school (MS) students are developing initial understanding of "systems" science;
- Most students plan to continue their educations beyond high school, although few are interested in career paths in the sciences;
- Students are engaged with and interested in Klallam culture;
- Students are engaged with and interested in science;
- Initial science and Klallam culture connections are developing for MS and HS student participants.

Goals and Summarized Evidence

Does the ESEP help participants link science and Klallam culture? In particular, in what ways is the ESEP linked to Klallam culture?

- Evidence suggests some cultural connections are very strong:
  - Cultural education components each day of the program
  - Elder-in-residence during HS program
  - Program structure working toward better inclusion of cultural educators during program planning and program development
  - Science educators participate in a cultural training program prior to summer program
  - HS students understand culture-science links better than MS students
- However, direct links from science to culture need improvement. If a major goal of the grant is to demonstrate how science could preserve culturally important sites, that message is not being clearly explained to students.

Does the ESEP increase the level of engagement and interest in science and Klallam culture for ESEP participants?[1]

- *Klallam culture*: The 2008 data reveal that students were interested in culture, both before and after the program. However, no statistically significant differences were found between before and after the program. Students were highly engaged during cultural experiences during **every** observed cultural experience.

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[1] High engagement is defined as 75% of students or more were engaged during observations.

- *Science*: During science education "lessons," students were highly engaged ~90% of the time. Despite the overall high engagement levels, interest in science or geosciences did not increase during the summer experience. Students were a "little" interested in science and the geosciences both before and after the summer program.

What is ESEP participants' understanding of the Elwha River restoration project (addressed in high school program)?

- Students described three areas that they understood best about the Elwha River restoration project:
  (1) the effects of the dams on salmon and their habitat;
  (2) the effects on shellfish and beach habitat;
  (3) issues of related to the fate of stored sediment after dam removal.
- Only one student discussed possible issues of flooding.

Does the ESEP impact students' interest in finishing high school and going to college (preferably in the sciences or geosciences)?

- Most students were either a little or very interested in going to a two or four year college after completing high school both before and after the summer program. Though the ESEP has no statistical impact on interest, this initial finding is promising for participants.
- Many of the student participants have particular job paths planned. The most common responses were athlete, lawyer, and veterinarian. Despite not showing interest in the environmental sciences, many students are interested in fields related to science (e.g., veterinarian, architectural engineer, massage therapist, dentist).

Other findings

- Most interviewed student participants are planning to take part in the summer 2009 program.
- The program includes some student choice, a best practice in working with "at-risk" youth (Easton, 2008; Williams, 1997).
- The most common reasons student participants cited that they were taking part in the summer program were because it was "fun" and because they wanted to "learn," primarily about history and culture. No students discussed science as the rationale for participation.
- When asked what was "interesting" about the summer 2008 cultural activities, students liked:
  (1) that they were "new,"
  (2) that they learned about making traditional Klallam objects (e.g., baskets),
  (3) that they learned about ancestors, history, and stories,
  (4) that they gained confidence.
- When asked about what was "interesting" about the summer 2008 science activities, students liked:

(1) that they were "new,"
(2) that they were hands-on,
(3) that caring for the earth is important,
(4) that they were connected to "real life."
(5) the "science camp" experience (referring to the ESEP), but "school science" is "boring."

- When asked about favorite cultural and science activities during the summer 2008 program, the most common response (for both) was that students liked *all* the activities – they had no favorite.
  - Other favorite cultural activities – learning "Native American history" and learning about ancestors, hearing stories, and having the paddling/canoe experience.
  - Other favorite science activities – learning about the macro-invertebrates in the river, river testing, and animal tracking.
- Communicative interactions during science "lessons" were very strong. For example, lessons included a high proportion of student talk, and a significant amount of it occurred between and among students. The lessons promoted a climate of respect for what others said, and student questions and comments often determined the focus and direction of classroom discourse.
- Teacher/student relationships also were very strong during science activities. For instance, active participation of students was encouraged and valued, and the teacher acted as a resource person, working to support and enhance student investigations. Evidence suggests that positive teacher/student relationships are linked to student engagement (Easton, 2008).
- Improvement is needed to clearly identify student prior knowledge to inform individual lessons and clearly identify lesson goals for students.
- Students were asked, "What does it 'look like' if someone is successful in their life?" The most typical response was setting out goals and reaching those goals. Other common responses were having a "good" job, making enough money to support one's self, having fun, and being helpful.

Summary of Recommendations

- Students have been highly engaged during both cultural and science activities. The only low engagement moments have been during outdoor science activities. In addition, most of the low engagement moments occurred during either hands-on activities or lectures. Think about how to engage students better during hands-on activities, lectures, and when outdoors.
  - One way to improve engagement during hands-on activities, lectures, and when outdoors may be to clearly discuss the goals of the summer program with student participants. More specifically, link science with Klallam culture. Centralize the message that that science has the potential to preserve culturally important sites. In addition to this "big picture" goal, discuss *why* students are doing particular science activities (i.e., lesson goals).
- Students clearly connected both with "making things" and "doing things" during both cultural and science experiences. Continue the "making" and "doing" activities, but add more "whys" (as discussed above). In other words, talk about *why* they're making and doing.
- Engagement through journaling seems effective in the HS program. Expand journaling or include another type of self-reflective practice in the MS program.
- Including an elder-in-residence is consistent with grant goals and with best practice. If possible, continue to have the elder-in-residence for summer program.
- There are some disconnects between student activities during the summer program and *real-world* science. Discuss how science activities are what "real scientists" do and *why* it's what they do.
- During interviews, some students were unclear on what geosciences are. This may have some impact on student interest in the sciences/geosciences. In addition, students said that they are interested in how science is connected to "real life." Think about how to clearly connect the science and geosciences learned to students' everyday lives.
- Students were interested in learning about science and culture that was "new." Think about how to keep the *newness* in the summer program. Program structure already reflects this through the three-year program cycle, but how can the day-to-day program likewise reflect this freshness?
- Based on student views of success, what are ways to connect science to how participants define success (e.g., setting goals and reaching those goals)?

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Vignette – A day in the Elwha Science Education Project

We are hiking, on our way to Marymere Falls. Students talk among themselves on the trail. They giggle, gossip, talk about the plants around them, and are generally excited about the walk. The science educator stops on the side of the trail and introduces the group to the vanilla leaf. He explains that the Klallam ancestors used it as an insect repellent. The "carotenoids" make it smell like vanilla and make it repellent to insects.

He clarifies, "You take a leaf, roll it up, put it in your pocket, and then, at the end of the hike, it will smell strongly of vanilla." He also explains that the white settlers used vanilla leaf to flavor cakes, but it's poisonous to our livers. Not long after, the group comes upon an enormous Douglas fir tree. The science educator asks students if they have any observations. Students note that the branches start high up and the top of the tree has disappeared. The science educator explains that it used to be the tallest Douglas fir in Washington. Many people visited, and a trail grew around the base of the tree.

The science educator asks, "Where does the tree get its nutrients?"

Students respond, "Soil."

The educator explains that the trail around the tree base caused the soil to be compressed, so the tree did not get enough water or nutrients transported from the soil. The forest service put up a fence to protect the tree's nutrient source. Then, the top of the tree fell off during a windstorm. The forest service removed the fence because the tree was no longer the largest Douglas fir in Washington.

Later, students complete a riparian transect on the creek bank on the way to Marymere Falls to understand the relationship between Barnes Creek and the surrounding forest. Students are asked to do a series of tests every meter, taking measurements from the river into the forest. The students break into groups to take the measurements. One group looks at soil moisture and temperature, another looks at sound, wind speed, and air temperature, a third group looks at soil cores (describing the feel, smell, and look of the soil), and group four looks at the forest canopy (what percent of tree cover). The science educator goes from group to group, answering questions and making comments. After the groups complete their measurements, they come together to report their findings to each other. Following a lunch break, we complete the hike to the falls.

That night, a Tribal Educator tells a story about the creation of Marymere Falls. Students are highly engaged, focusing closely on the educator's words. Eyes are either down on the floor or on the Tribal Educator. ***All*** are *present*.

Several students explained that learning about the forest and Marymere Falls was one of their favorite learning experiences of the week. One student describes, "…it inspired me to walk more in the forest and outdoors and on trails."

Project goals

This "vignette" is an example of part of a typical day during the middle school Elwha Science Education Project (ESEP) summer program on the Olympic Peninsula in western Washington State (Van Maanen, 1988, p. 1). Students learn about science and traditional Klallam culture. They spend time outdoors, walk, hear stories, and learn about the science in or near their own backyards. The ESEP is intended to help students engage with science through connecting with tribal lands. The program has a number of goals (some described in the National Science Foundation grant proposal and others that have emerged through the program itself). After the 2007 program, science and cultural educators, as well as project administrators informally "weighed in" on what they felt the major ESEP goals were. The agreed responses were as follows:

- student participants should finish high school and go to college (preferably in the sciences/geosciences);
- program should improve/increase student (and possibly community) awareness of science, specifically dam removal, which will affect daily lives;
- program should integrate/connect sites, science, stories, history, and traditions (connect science and cultural traditions/stories/history geographically, but not necessarily in other ways; science has the potential to preserve the sites/places that are so culturally important.).

Therefore, based on these and the original grant objectives (Young, 2006), the revised ESEP goals are:

- expanding to new participants;
- linking science with Klallam culture (as described above);
- increasing the level of engagement and interest in science;
- understanding engagement and interest in Klallam culture;
- helping students understand the Elwha River restoration (high school);
- helping students understand the fundamentals of field-based "systems science" (middle school);
- assisting student participants finish high school and go to college (preferably in the sciences/geosciences)

This report is organized by these objectives as well as several sub-headings. First, the program is briefly described, followed by an explanation of program participants and the expansion of the program to new participants. Then, links between science and Klallam culture within the ESEP are investigated. In addition, engagement and interest in science and Klallam culture are reviewed. The report discusses what students felt they understand "best" about the Elwha River restoration and other science learned during the ESEP summer program. Finally, I explore student views about continuing their educations beyond high school. Within this section, student views of "success" and what they would like to do when they "grow up" are described. A section on recommendations concludes this report.

Program Description

The ESEP has two strands. One strand focuses on the geosciences and environmental science; the other concentrates on traditional Klallam culture. The guiding concept is that science has the potential to protect and/or restore sites important to Klallam culture. By integrating the science into sites and stories that are culturally valued, the science becomes more relevant to tribal youth. Eventually, this connection to "home" may allow students to engage better with the science content. The impetus behind this notion stems from the lands and waters in the local Klallam community – concentrated around the Elwha River. The Elwha River is the location of the Klallam creation story (Valadez, 2008). Generations of ancestors are buried near its banks, ceremonies are based here, and personal livelihoods and food are connected to the salmon in its waters (2008).

Klallam community leaders were a major stimulus behind the Elwha Act (PL 102-495), a measure intended to restore the Elwha River ecosystem. As part of the restoration, two dams will be removed (Elwha Watershed, n.d.). The dams, constructed in 1913 and 1927, have had significant impact on fisheries, destroyed important clam beds, increased coastal erosion at the mouth of the river along tribal land, and influenced the loss of the Klallam creation site (Olympic Peninsula, 2003). The dam removal is currently scheduled to begin in 2012 and will clearly impact the Klallam community and tribal lands (Elwha Watershed, n.d.). The ESEP piggybacks on this effort.

The ESEP has several programs. The main educational event is a week-long summer science and culture "camp" for middle and high school students. During summer 2008, the middle school (MS) program was from July 13-17, and the high school (HS) program was from June 22-28. HS students fulfilling all requirements can receive science credits for their participation (see Appendix A).

During August, several participants joined a filmmaking project documenting their experiences with the Elwha Ecosystem Restoration, and some students took part in a series of school-year weekend field trips. However, the summer program reaches the greatest number of participants and is considered the flagship experience of the ESEP. The current evaluation focuses on this summer camp experience.

Evaluation Methodology

To address the above goals, students completed a pre-program survey (Appendix B) and a post-program semi-structured interview conducted up to two weeks following the close of the program (Appendix C). Parent/guardian consent and student assent as well as pre-program survey data were sought through the enrollment packet, distributed starting in May 2008 (Appendix D). Packets were collected from May through the start of each summer program. Educators were interviewed within one week after each program (Appendix E).

I made observations during the middle school program (Appendix F) using a modification of the GeoKids observation protocol (GeoKids LINKS, 2004).[2] The GeoKids observation protocol was developed through a National Science Foundation funded GK-12 program at St. Joseph's University in Philadelphia intended to link universities, public schools, and communities through the geosciences. The GeoKids protocol is adapted from the Reformed Teaching Observation Protocol (RTOP), an instrument intended to show how closely instruction is linked to national science standards for "reformed" teaching (Piburn, Sawada, Falconer, Turley, Benford, & Bloom, 2000, para. 1).

While the RTOP was developed for classroom instruction, the version used here reflects the nature of using both the outdoors and indoors as the "classroom," and the RTOP was developed for use in inquiry-based classrooms. The ESEP is likewise deeply rooted in inquiry-based learning.

The original RTOP has excellent reliability for 4 subscales (Lesson design and implementation, Procedural Pedagogic Knowledge, Communication Interactions, and Student/Teacher Relationship R^2 are .87 or higher). The 5th subscale, Propositional Content Knowledge has an R^2=.67, while lower, is still considered acceptable (Piburn, et al., 2000). Reliability and validity estimates for the observation protocol used in the current study will be included in forthcoming reports as more observation data are collected (at this time, *n* is too small for appropriate estimates). Quantitative data were analyzed using basic descriptive statistics (using SPSS and Excel software programs), and qualitative data were coded using ATLAS.ti, Version 5.2. Typical quotes were collected to exemplify recurring themes. Qualitative analyses were both *top-down* and *bottom-up* (open coding) (Miles and Huberman, 1994). Some themes were generated from the evaluation questions (top-down); others were developed from themes that emerged from the data (bottom-up or open coding).

[2] No observation data were collected during the high school program. Therefore, all observational analyses are based solely on data from the middle school program.

Participants

Table 1
Student Participant Demographics for ESEP Summer 2008

	Middle school participants (n=34)	**High school participants (n=20)**
Gender		
Male	15	12
Female	19	7
Ethnicity		
Native American or Alaskan Native	27	17
White/Caucasian	7	4
Enrolled/affiliated Klallam	24	13
2007 participant	--	11

Note. Some students considered themselves both Native American and White/Caucasian. Other students were "affiliated" with the Klallam Tribe but considered themselves only White/Caucasian. Clearly, the issue of ethnicity is not clear-cut.

In all, 54 students took part in the ESEP during summer 2008. Thirty-four were middle school students and 20 were high school students. Participating students were predominantly Klallam (n=37), either enrolled as Klallam or "affiliated" themselves as Klallam. Of the 20 high school students, 11 had taken part in the ESEP for at least one year.

Participation rationale

The most common reasons student participants cited that they were taking part in the summer program were because it was "fun" and because they wanted to "learn," primarily about history and culture. One student explained that they hoped "to learn about the past and get ready for the future" (DS27MS, pre-survey), and another described an interest "to learn about my culture and how my ancestors lived" (DS16HS, pre-survey). Other common reasons for taking part were spending time outdoors, seeking friendship, and a parent or guardian "forcing" students to participate. It is interesting to note that although HS students could receive credits for successful program completion, no students cited "school credit" as the reason for program participation. Likewise, no students discussed science as the rationale for participation.

All but two interviewed students said they would take part in the summer program again. Most who agreed to join the 2009 summer program cited how much "fun" the 2008 program was. One of the students who declined to take part explained that "it wasn't what I thought it would be" (P26MS, line 112); another was merely noncommittal. Two students who wanted to take part in the program were worried about the possible costs of getting to the Olympic Park Institute and therefore, taking part in the 2009 summer program.

Program expansion

During summer 2008, both Elwha Klallam and Jamestown S'Klallam students were recruited (only Elwha Klallam students were recruited during summer 2007). Eleven of the 2008 participants had already taken part in the ESEP. The total number of 2007 participants was 33 students. In other words, approximately 80% of the 2008 participants were new to the program. The 2007 program only included HS students and 45% of the 2008 high school students were new to the program. The data support that the program expanded from 2007 to 2008.

Instructors and chaperones

Adult program participants include cultural educators, science educators, program coordinator, program chaperones, and a tribal "elder-in-residence". The primary cultural educator for the ESEP works for the Lower Elwha Klallam Tribe and has been teaching Klallam language at a local high school for ten years. She has developed curriculum for Washington State for teaching tribal sovereignty and knows many of the student participants from school, from home, or through their families. Other cultural educators are Klallam community members sharing their particular expertise with students. Like the lead cultural educator, most of the community member participants are either related to or know the students in the program. During the HS program, a Klallam "elder-in-residence" took part in each day of the program, participating in educational activities, recreation, and meals.

The science educators are staff from the Olympic Park Institute. Science instructors are less experienced than the cultural educator in terms of formal teaching experience, but two have worked with the ESEP for one or two years. Two of the educators are new to the ESEP, but all took part in a Klallam-centered cultural training session in May 2008. The program coordinator is also a staff member at Olympic Park Institute and has been working as an environmental educator for seven years. He has been involved with the ESEP (as an educator or as coordinator) from its inception. Finally, chaperones are predominantly members of the Klallam community. Many are parents of student participants, and some are tribal employees. Often, chaperones serve as both "chaperone" and as cultural educator.

Program Structure

The program is led through the Olympic Park Institute (primarily science content and instruction) and the Lower Elwha Klallam Tribe (primarily education and river restoration departments), but is supported by the Jamestown S'Klallam Tribe and Olympic National Park. Funding is through the National Science Foundation Opportunities for Enhancing Diversity in the Geosciences Program. The program coordinator is currently an Olympic Park Institute staff member, but a new program structure is slated to start in summer 2009. The new structure will better balance the cultural and science strands of this effort by employing a cultural educator as well as a science educator for program direction (Horwood, 1995).

The summer program is theme-based on a three year cycle. The 2008 HS program theme was "Elwha Earth Sciences, Wildlife, and Fisheries" and the MS theme was "Naturally Native." Themes were developed by the program coordinator through suggestions from the cultural educator (P22, line 46).

During the program, students are picked up at home or at the Lower Elwha Klallam Tribal Center and welcomed into the program. Then, they are bussed out to the Olympic Park Institute campus. There, they take a campus tour and check into their cabins. The days at the Olympic Park Institute are long – they begin at around 7 a.m. and continue until 9:30 p.m. Students are in "trail groups" during the day. There are 8-12 students in each trail group along with a science educator, a chaperone, and (often) an additional cultural educator or tribal elder. Students are in their trail groups from after breakfast until free time in the late afternoon. Program schedules are in Appendix G.

Science-Culture Links

By linking science, technology, engineering, and mathematics (STEM) content with cultural values, students are more likely to stay in the STEM pipeline (Seymour & Hewitt, 1997). The 2008 data reveal that students were interested in their native culture, both before and after the program ($\overline{X}_{pre}$=1.65; $\overline{X}_{post}$=1.60; 0= not interested; 2= very interested). However, no statistically significant pre-post differences were found (*p*=.60).

Evidence suggests some cultural connections are very strong within the overall program structure:

- cultural education components are included each day of the program (both HS and MS);
- an elder-in-residence is included in the HS program;
- the program structure is working toward better inclusion of cultural educators during program planning and development;
- science educators participate in a cultural training program prior to summer program.

In particular, the program coordinator role will be split into two positions starting in summer 2009. In lieu of coordination and direction being solely in the science education position, program direction will be a joint responsibility of a lead cultural educator and science educator. This joint responsibility is consistent with the concept of valuing both culture and science within the ESEP.

While the evidence shows that the ESEP is positively working towards integration of science and culture, the message that science has the potential to preserve the sites/places that are so culturally important (see goals) needs work, particularly in the MS program. Based on observations and document analysis of curriculum, most links between science and culture were made indirectly or not at all. For example, a cultural educator shared a story about Marymere Falls. The program also included a riparian transect activity while on a hike to Marymere Falls. However, the group did not discuss how learning about the riparian zone on Barnes Creek near the falls could help preserve or care for the falls or the riparian zone.

Students were mixed with regard to their understanding of the links between science and culture. Some felt there were definite links between the two "halves" of the program (9 respondents). One of the high school students explained, "when you really pay attention and you… [see that] this is an anemone and this what it does, and this is what it's purpose is for the ocean, and this is what it's purpose was for our ancestors. Stuff like that. They would teach us the science part and she [the cultural educator] would be right there teaching us the cultural part" (P30 HS, line 218).

Other students (5 respondents) were unsure about the links. One MS student explained, "I guess they were connected in some ways. You would go out and go hike and learn about sciences. And then after that we would do some… Native American history" (P24 MS, line 56). Still other students felt that there were no links between science and culture during the program (4 respondents). A MS student described, "We did the canoe journey, which I could tell was for part of the tribal stuff, but like the science stuff, I couldn't really see how they connected in any way" (P25 MS, line 98). Student responses were split depending on which program they attended. Virtually all HS student respondents thought there were clear links between culture and science (8 of 9 respondents), while virtually all MS respondents thought the links were less clear (7 of 9 respondents).

Instructors likewise had mixed feelings regarding the science-culture links. One described, "[we could have been] more organized. We would have all these people come but then the times would switch all the time and stuff so I feel like we could have done better intro-ing and tying it to things as educators" (P18, line 51). When asked, "What do you think would make the traditional culture part of the program better?" another educator explained:

> I think more direct ties to the science. Just because a lot of times it felt like... like we had journal questions about it, but it was never really a direct tie. There was always things that were definitely connected together, but not ever being tied together. (P19, line 69)

Science

Science engagement

As mentioned above, all observations were during four consecutive days of the MS program. No observations were made during the HS program. During observed science education "lessons," students were highly engaged ~90% of the time (75% of students or more were engaged) (~5 hours of observations). Engagement was defined by active participation or learning. Overall, science lessons were organized by the following activities:

Table 2
Observed Science Lesson Activities during 2008 MS Program

Hands-on activity or materials	34%
Lecture with discussion	18%
Hiking	9%
Lecture or presentation	7%
Class discussion	5%
Cooperative learning	5%
Informal student presentation	5%
Administrative tasks	5%

Note. Percents are rounded.

Hands-on activities and lecture with discussion composed most of the observed science lessons. The majority of observed learning also occurred outdoors (78% of observation time), an experience that students overwhelmingly enjoyed. During post-program interviews, many students cited being outdoors or a particular outdoor activity (e.g., canoeing, camping, experiencing the woods) as their favorite part of the program. Location of instruction lead to differences in student engagement. Interestingly, all indoor activities had high engagement; all low engagement activities occurred outdoors. Observations (protocol in Appendix A) showed a strong focus on propositional (i.e., facts and concepts) knowledge ($\overline{X}$ =4.5), while focus on procedural knowledge, including self-reflection, could be improved ($\overline{X}$ =2.75 for both). A science educator's words reflect a greater need for student self-reflection:

> *Educator:* [For the journals] we really needed to edit it down more and we really needed more time - to like make those connections and talk about the journal with the kids, as opposed to rushing between different things.
> *Interviewer:* And then writing on the bus.
> *Educator:* Right, yeah, writing during the time after dinner. This is what happened during today, answer these questions about the day as opposed to here's what we just learned about, what do you guys think about it, write it down in your journal and we'll share. A lot more accountability a lot more of a direct connection.
> *Interviewer:* Right - so answering the questions that are related to a particular activity right after you did the activity.
> *Educator:* Right and then having those questions lead you to the next activity. (P19, line 72)

Please see Tables 3 and 4 for further detail on subscale information.

Table 3
Propositional Knowledge Subscale for Observation Protocol

Subscale: Propositional knowledge	**Mean (n=4)**
The lesson involved fundamental concepts of the subject.	4
The teacher had a solid grasp of the subject matter content inherent in the lesson.	5
Elements of abstraction (i.e., symbolic representations, theory building) were used when appropriate.	4.33
The teacher stressed recognition of patterns/symmetry more than traditional estimation/ intuitive measurement.	5
Connections with real world phenomena were explored.	4

Table 4
Procedural Knowledge Subscale for Observation Protocol

Subscale: Procedural knowledge	**Mean (n=4)**
Students made predictions, estimations, and/or hypotheses and devised means for testing them.	4.5
Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent phenomena.	2.75
Students were reflective about their learning.	2.75

Other instructional strengths were the subscales of communication interactions and student/teacher relationships. Both subscales had mean scores of 5 on a scale of 1 to 5, where is considered indicative of "good" reformed science teaching practice. Clearly, communication and student/teacher relationships are positive features of the ESEP. Table 5 includes individual item data from both subscales.

Table 5
Communication Interactions and Student/Teacher Relationships Subscales for Observation Protocol

Subscale: Communication interactions	**Mean (n=4)**
The teacher's questions triggered divergent modes of thinking.	4.25
There was a high proportion of student talk, and a significant amount of it occurred between and among students.	4.5
Student questions and comments often determined the focus and direction of classroom discourse.	5
There was a climate of respect for what others had to say.	5
Subscale: Student/teacher relationships	
Active participation of students was encouraged and valued.	5
Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.	5
In general, the teacher was patient with students.	5
The teacher acted as a resource person, working to support and enhance student investigations.	5
The metaphor "teacher as listener" was very characteristic of this lesson.	5

Student/science instructor relationships were exceptionally strong ($\overline{X}$ =5). For example, the statements, "Active participation of students was encouraged and valued" and "The teacher acted as a resource person, working to support and enhance student investigations" were evidenced during all science education observations. During observations, science lessons had high "communicative interactions" ($\overline{X}$ =4.7). The stronger the communication, the more likely students will engage with the material. For example, instruction included a high proportion of student talk, and a significant amount of it occurred between and among students. Science lessons also incorporated a climate of respect for what others had to say, and student questions and comments often determined the focus and direction of classroom discourse. These characteristics are linked to engagement.

Engagement is also linked to identifying student prior knowledge to inform lessons and clearly identifying lesson goals for students. During observations, these areas were shown to need some improvement ($\overline{X}_{\text{prior}}$=2.0 and $\overline{X}_{\text{goals}}$=2.5).

We also can evaluate science lessons based on Bloom's taxonomy of cognitive skills (Clark, 2007):

- Knowledge (e.g., observation and recall of information, knowledge of dates, events, places)
- Comprehension (e.g., understanding information, translate knowledge into new context)
- Application (e.g., use information, use methods, concepts, theories in new situations)
- Analysis (e.g., seeing patterns, organization of parts, identification of components)
- Synthesis (e.g., generalize from given facts, predict, draw conclusions)
- Evaluation (e.g., make choices based on reasoned argument, verify value of evidence)

Based on Bloom's taxonomy, the following was observed for science instruction (percents are rounded; some observations and activities overlapped categories):

- 48% of science instructional time on knowledge and comprehension tasks
- 38% of science instructional time on application and analysis tasks
- 18% of science instructional time on synthesis and evaluation tasks

There were also some differences in student engagement by type of instruction. To reiterate, student engagement was overwhelmingly high throughout most science instruction observations. That being said, 5 of the 9 observed "low engagement" activities occurred during Application tasks, most of which were either hands-on activities or lecture.

The concluding message about engagement during science activities is that students on the whole are **very** engaged. However, to improve engagement, instructors should think about ways to keep students engaged when working outdoors and to keep students focused when doing application tasks such as hands-on activities or during lecture. By trying to identify student prior knowledge during science lessons (although I understand how difficult this is during a 1-week summer program), clearly describing lesson goals for students, and allowing time for self-reflection during the MS program, science instructors could improve students engagement.

Science and geoscience interest

Despite the overall high engagement levels and evidence of a high percentage of time spent on application, analysis, synthesis, and evaluation tasks, interest in science or geosciences did not increase during the summer experience. The paired t-test was used to determine if student interest post-program was significantly different from pre-program interest. Students were "a little interested" in science both pre and post ($\overline{X}_{\text{pre}}$=1.32; $\overline{X}_{\text{post}}$=1.08; 0= not interested; 2= very interested). This difference **is** statistically significant ($p<.05$), so interest declined from before to after the program. Students were also "a little interested" in geosciences (sometimes called earth science) both pre and post ($\overline{X}_{\text{pre}}$=1.21; $\overline{X}_{\text{post}}$=1.32; 0= not interested; 2= very interested). Pre-post geosciences interest were not statistically significant (p=.23).

Table 6
Participant Interest in Science and the Geosciences

	Mean (pre)	**Mean (post)**
How interested are you in science?*	1.32	1.08
How interested are you in geosciences (sometimes called earth science)?	1.21	1.32

***p<.05**
Note. A score of "1" indicates "not interested and "3" indicates "very interested."

Although interest in science and geosciences did not increase from pre to post program, one interesting pre-post difference was found. While no significant difference in interest in science compared to interest in geosciences was present before the program (p=.32), a statistically significant difference between science and geosciences interest was discerned after the program ($\overline{X}_{\text{sci}}$=1.11; $\overline{X}_{\text{geosci}}$=1.32; p=.05). Despite no dramatic shift in interest in the geosciences before opposed to after the program, students did tend to differentiate "science" from "geoscience" more after the program.

"Favorite" science activities

Students taking part in the summer 2008 program most typically stated that they didn't have a "favorite" science activity. Instead, they "liked them all." For example, one student described, "I kind of liked them all; they were all a lot of fun. I got to learn stuff each time" (P32 HS, line 144). The other common responses to, "what was your favorite science activity during the summer program?" were the river analysis and animal tracking projects. During the river analysis project (from the MS program), students searched for macro-invertebrates in a nearby creek. By learning which macro-invertebrates can be found in "healthy" rivers vs. "not-so-healthy" rivers, students gauged the overall health of the creek. One student described,

> *Student:* I liked doing the stream thing, we caught the insects… the little bugs you caught in the water – you can tell if the stream is healthy or not.
> *Interviewer:* And what did you like about that?
> *Student:* I liked catching little bugs. And then you gotta put them back and not kill them which is nice. (P26 MS, line 148)

Another favorite activity was related to animal tracking (completed during the high school program). A wildlife biologist from the Point No Point Treaty Council led students through a typical process for bear tracking. Using a radio telemeter, and a tracking collar, students took turns being the "bear" and the "tracker." Trackers used the radio telemeter to track the student "bears." A student explained, "Probably my favorite was the bear tracking thing… I got to be the bear. I ran a mile up to that other lodge place and… I thought they were going to look for me, but they were just tracking me and I was supposed to stay where I was and only go ten feet" (P34 HS, line 131). The combination of "doing" science while having fun is evident in students' favorite science activities.

When asked what they found interesting about science, students liked science activities that were "new" and "hands-on," that caring for the earth is important, and students prefer when activities are connected to "real life." A middle school participant explains, "The interesting part is learning new stuff I think. If you learn anything new I think that's pretty much interesting. Cause you learn something new every day and that just helps you in life; the more you learn the more it's easier for later" (P24 MS, line 102). Another student clarifies:

> *Student:* There's a lot I didn't know about - birds and animals. And I really didn't care until I actually found out what it does to them.
> *Interviewer:* What do you mean by 'what it does to them?'
> *Student:* Like if you trash the environment what it will do, and if you feed it food, it will get addicted. (P34 HS, line 119)

Program structure reflects student attraction to "new" learning. The ESEP curriculum is on a three-year cycle, where there are new concepts, sites, experiences included in each of the years within that cycle.

Another common response to "favorite" science activity was that students liked "science camp" (the ESEP summer program) but that "school science" is "boring." One HS student expands on this theme by saying,

> *Student:* I'm not really interested in it at school, but once you go out there and do like a bunch of experiments and investigations, it's pretty cool."

> *Interviewer:* So the science that you did this past week [during the ESEP summer program] – would you consider that the same or different from what you do at school?
> *Student:* Very different because you actually get to go out there and investigate. (P34HS, line 21)

Culture

Cultural interest and engagement

Students thought cultural activities were interesting when they were "new," when they learned about making traditional Klallam objects (e.g., baskets, paddles), when they learned about ancestors and history, when they learned stories, and when it helped them gain confidence. One student describes that "The native culture that I learned was just really interesting, because some of the stuff that I was taught, I never knew that my ancestors did or used. That was really cool on that" (P29 HS, line 29). Another student tells about her interest in learning about ancestors, "I'm very interested because there are a lot of things that not a lot of people know about the cultures. If they don't know a lot about it, they don't know if they like it or not. But I learned about the canoes and what they did to live" (P27 MS, line 27). By learning about their culture, students gained confidence in themselves: "[It] just makes me feel more confident about what I know about my culture and about myself" (P35 HS, line 35).

Students were interested in their "traditional culture" both before and after the program, and there were no statistically significant differences ($\overline{X}_{pre}$=1.65; $\overline{X}_{post}$=1.60; p=.60). Students were highly engaged (75% or more engaged) during *all* observed cultural activities.

"Favorite" cultural activities

Like the favorite science activity, many students described that they liked **all** the cultural activities - they had no favorite. When asked, "Do you have a favorite?" one student explained, "Not really, cause the camp made it all fun" (P34 HS, line 102). Others talked about learning Native American history, learning about ancestors, and hearing stories. A HS student told about hearing stories from a tribal elder. He says, "He [told] how each part of the land was made and I thought that was kind of cool. Or like how this part of the land was treated in the beginning and all the rivers were set and stuff like that. I thought that was pretty cool" (P32 HS, line 103). Another HS student talked about a cultural educator telling stories at Freshwater Bay. She said,

> I like the stories that she told because everything that they were teaching us, she always had a story to tell. Like about fishing… this man would go out every day and he would go halibut fishing and he would be the first one out and the last one in. He would never have anything so all the families would give him a little bit of what they had. The little boy could never figure out why his dad was so unlucky and never caught any halibut so he snuck away in a blanket and went in his canoe to where his father went, and he caught a

> halibut. He went off… did a fire, cooked it up, and ate the whole thing himself… It's a gluttony story… It was just like this lesson… how not to do this stuff. (P30 HS, line 222)

Still other students remarked on their paddling/canoe experience. A student told that this was his first canoe journey. He says, "That was pretty cool. I've never been out on a canoe before" (P35 MS, line 79).

Science Understanding

The Elwha River restoration was a major focus on the HS student program. After talking with MS science teachers, and from personal experience with MS students, the ESEP coordinator determined that MS students do not have the appropriate background knowledge to understand the Elwha River restoration (Education Group, 2008). Therefore, the middle school program focused more on "systems" science. Once the MS students have stronger background knowledge, the program will focus more on the Elwha River restoration for their HS program. The program coordinator explains:

> Basic systems thinking ('What is this connected to?', 'How does changing the fish population change the bear population?', 'How does the dam change the nearshore?') is essential to understanding ecosystems, which is essential to understanding ecological restoration, which is essential to understanding the Elwha Ecosystem Restoration Project." (Personal communication, May 27, 2009)

The following will discuss HS student understanding of the Elwha River restoration project. Then, MS student understanding of science learned during the summer program will be presented. The data on science understanding are sparse but will be investigated more thoroughly through analysis of HS student journals.

High school student understanding of the Elwha River restoration project

Based on semi-structured interview data, high school students described three areas that they felt they understood best about the Elwha River restoration project. Students discussed the effects of the dams on salmon and their habitat, the effects on shellfish and beach habitat, and issues of sediment. One student described, "…it will bring a whole bunch of our salmon back" (P31 HS, line 192)." Another student said that "… now if you were to go and try to gather stuff, like if there was a tribe living on the beach you would pretty much starve to death because there is barely anything on there. If you ate mussels for the rest of your life then you would live. But that's pretty much all there is" (P30 HS, line 114). Another explained, "It helped me because if I wouldn't have gone to this I would have never known that there was a football field of sediment behind the dams" (P29 HS, line 130).

Only one student discussed flooding as a possible ramification of dam removal. Given that many students live on Lower Elwha Klallam tribal lands, the possibility of flooding due to dam removal could be an area students might like to learn more about. She describes,

> I'm just really nervous in case it floods and whatnot, but at least they're thinking ahead and they made levees out toward the dike and stuff so if it does flood we'll have time to get out and stuff. And they made another exit for us to get out cause down here it's going to flood first if it does flood because the river is already on the other side of that bank over there." (P34 HS, line 158)

An analysis of student journals tracking concepts learned is forthcoming.

Middle school student understanding of "systems" science

The program coordinator defines "systems" science through the Washington State K-12 Science Standards (2008):

> **Systems** thinking makes it possible to analyze and understand complex phenomena. Systems concepts begin with the idea of the part-to-whole relationship in the earliest grades, adding the ideas of systems analysis in middle school, and emergent properties, unanticipated consequences, and feedback loops in high school. (p. 2)

MS students felt most confident that they learned about plants and river health/macro-invertebrates "best." One student explained that "I understand that… near the water, because it gets really cold… there's… not many plants… the plants are… I think four meters back from the water" (P24 MS, line 120). Students also felt confident that they learned about river health during their program:

> *Student:* I think that was pretty fun. I mean trying to find little insects isn't exactly easy, but it's fun I guess. I takes work. You have to look around through rocks and stuff and try to figure out which ones are good. They are saying that even if the insect is in bad water [that] doesn't mean that the water is bad. It just means that it can get used to the clean water. And we found mostly clean insects…
> *Interviewer:* So what did that tell you about the river?
> *Student:* The river was clean. It was saying that stuff can adapt to other things. Things adapt. (P24 MS, line 120)

The "systems" thinking about adaptation and the connection between the macro-invertebrates and the river is evident in this student's description of the activity. This description is reflective of common student responses to this interview question.

Student Interest in Post-High School Education

Interest in the sciences/geosciences is related to eventual career choices in the sciences. However, before students can reach that goal, they must first graduate high school and attend a two or four year college.

Student grades are reported as follows.

Table 7
Self-Reported Grades for Participating MS and HS Students

	Mostly A	**About half A & half B**	**Mostly B**	**About half B & half C**	**Mostly C**	**About half C & half D**	**Mostly D**	**Mostly below D**
All (n=23)	22%	22%	4%	35%	9%	9%	0%	0%
Middle school (n=14)	29%	29%	0%	36%	7%	0%	0%	0%
High school (n=9)	11%	11%	11%	33%	11%	22%	0%	0%

The median grade for MS participants is getting "about half A & half B," while the median grade for HS participants is "about half B & half C." However, there is no statistically significant difference between middle and high school students' self-reported grades (X^2=6.3, p=.28).

Most students were very interested in going to a two or four year college after completing high school both before ($\overline{X}$ =1.91) and after the summer program ($\overline{X}$ =1.87). When analyzed by grade, there was also no statistically significant difference between middle ($\overline{X}$ =1.86) and high school ($\overline{X}$ =1.91) students' interest in going to college.

When asked why they wanted to go to college, most students explained that a degree is needed to get a good job or they already have a particular degree in mind based on the job they eventually want. One MS student explains that, "I want to be a vet, so I want to go through all the years of college that I can" (P26 MS, line 26).

Many of the student participants have particular job paths planned. The most common responses were athlete, lawyer, and veterinarian. However, many students are interested in fields related to science (e.g., veterinarian, architectural engineer, massage therapist, dentist).

Based on these typical student objectives, we wondered if these fields were related to students' views of success. When asked, "What does it 'look like' if someone is successful in their life?," responses were not necessarily related to job type. The most typical response was setting out goals and reaching those goals. In other words, someone is successful if "[you] complete… what you want to do in life" (P29, line 29). Another student described that success is "being able to accomplish a goal that you made for yourself" (P24, line 53).

Beyond goal-reaching, students viewed success as having a "good" job. A MS student describes, "I just want to get a good job where I can make money and make a family where I could like feed them and stuff. Where I can give good food and not have to be out of their lives and to where I only come home at nights and then leave really early" (P23 MS, line 55). Other themes included making "enough" money, having fun, and being helpful.

Wrapping Up

The NSF grant goals are being met, as of the 2008 summer program. Evidence suggests the following:

- The Elwha Science Education Project (ESEP) is expanding to new student participants in the Olympic Peninsula area;
- High school (HS) students have a beginning understanding of the Elwha River restoration (analysis of HS journals will provide more evidence regarding student understanding);
- Middle school (MS) students are developing initial understanding of "systems" science;
- Most students plan to continue their educations beyond high school, although few are interested in career paths in the sciences;
- Students are engaged with and interested in Klallam culture;
- Students are engaged with and interested in science;
- Initial science and Klallam culture connections are developing for MS and HS student participants.

Recommendations

- Students have been highly engaged during both cultural and science activities. The only low engagement moments have been during outdoor science activities. In addition, most of the low engagement moments occurred during either hands-on activities or lectures. Think about how to engage students better during hands-on activities, lectures, and when outdoors.
    - One way to improve engagement during hands-on activities, lectures, and when outdoors may be to clearly discuss the goals of the summer program with student participants. More specifically, link science with Klallam culture. Centralize the message that that science has the potential to preserve culturally important sites. In addition to this "big picture" goal, discuss *why* students are doing particular science activities (i.e., lesson goals).
- Students clearly connected both with "making things" and "doing things" during both cultural and science experiences. Continue the "making" and

"doing" activities, but add more "whys" (as discussed above). In other words, talk about *why* they're making and doing.

- Engagement through journaling seems effective in the HS program. Expand journaling or include another type of self-reflective practice in the MS program.
- Including an elder-in-residence is consistent with grant goals and with best practice. If possible, continue to have the elder-in-residence for summer program.
- There are some disconnects between student activities during the summer program and *real-world* science. Discuss how science activities are what "real scientists" do and *why* it is what they do.
- During interviews, some students were unclear on what geosciences are. This may have some impact on student interest in the sciences/geosciences. In addition, students said that they are interested in how science is connected to "real life." Think about how to clearly connect the science and geosciences learned to students' everyday lives.
- Students were interested in learning about science and culture that was "new." Think about how to keep the *newness* in the summer program. Program structure already reflects this through the three-year program cycle, but how can the day-to-day program likewise reflect this freshness?
- Based on student views of success, what are ways to connect science to how participants define success (e.g., setting goals and reaching those goals)?

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Appendix A: Science Credit Documentation

How to earn science credit for your participation in the high school summer program:

1. **Participation:** To earn credit, you must be actively engaged in our studies and activities – all 7 days from June 22 to 28, 2008. If you are asked to leave the program due to disruptive behavior, you will not be eligible to receive credit. If you unexpectedly need to leave the program due to illness, injury or unanticipated family obligations, you may be given the option to submit an additional paper (one paper per missed day) at the discretion of the credit committee.

2. **Journal (evidence of learning):** To earn credit, you must complete daily journal entries. We will provide you with a journal designed to assist you in this process. You must complete the journal with quality work, and submit it to the credit committee by the end of the program. Your educator will give you feedback on the quality of your journal throughout the week.

3. **Sharing a product of your learning with the community:**

   This can be done in two ways, so think through how you would like to share your experiences and knowledge gained.

   A. **Group Presentation:** Select one or two group members to present with on Saturday. All three of you will actively present your work for 10 minutes (plus a question and answer period). You will need to use visuals (poster or slides/power point).

   B. **Individual Science Paper:** This product will be a 3 page 1.5-spaced essay. The paper must be completed by the end of the program and submitted to the credit committee.

   You can choose one of two options for your presentation or paper:

   1. **Scientific Investigation** – a scientific investigation of your choosing. You will present your observations, prediction, procedure, data, analysis, and conclusions.

   2. **Scientific Problem Solving** - a scientific design process of your choosing. You will choose a current issue, present data and information critical to understanding the issue, present a problem contained in the issue and ideas

related to solving the problem, design a solution plan and criteria for evaluating the solution, present anticipated results of the plan, and evaluate the results against anticipated results from other potential solutions.

Who will grade you and confirm the science credit? [redacted], principal for [redacted] High School in [redacted] School District will award credit to students who complete the requirements with satisfactory work. The credit committee will submit your work to [redacted]. If you are enrolled in school outside of the Port Angeles School District, you will need to transfer the credit to your school.

Appendix B: Pre-Program Survey

We are interested in learning how your participation in the Elwha Science Education Project influences you. To help us do this, please answer the following:

date of birth: _________________ age: ______ □ girl or □ boy

current grade: □ 6th □ 7th □ 8th □ 9th □ 10th □ 11th □ 12th

school: □ Stevens Middle School □ Crescent School □ Lincoln High School
□ Port Angeles High School □ home school □ other: _____________________

your name according to the school:
____

What ethnicity do you consider yourself?
____

What is your tribal enrollment?
____

What is your tribal affiliation?
____

What connections do you feel to your traditional culture?

How many times per week do you use traditional knowledge? _____ times

How many times per week do you use your native language? _____ times

How interested are you in your traditional culture?
___ not interested ___a little interested ___very interested

Why?

How interested are you in science?
___ not interested ___a little interested ___very interested

Why?

How interested are you in earth sciences (sometimes called the geosciences)?
___ not interested ___a little interested ___very interested

Why?

How interested are you in going to school (like college or a trade school) when you finish high school?
___ not interested ___a little interested ___very interested

What kind of school are you interested in?

If you don't want to go to school, what would you like to do when you finish high school?

Why?

What are your grades in school?
___ mostly A ___ mostly C
___ about half A & half B ___ about half C & half D
___ mostly B ___ mostly D
___ about half B & half C ___ mostly below D

How interested are you in the outdoors?
___ not interested ___a little interested ___very interested

Why?

How much time per week are you outdoors? ______ minutes / hours / days (circle one)

The Elwha Science Education Project includes a summer program. Why do you want to go to the summer program?

Appendix C: Post-Program Semi-Structured Interview Protocol

Hi. Do you remember me from hanging around all week, taking notes? My name's [redacted], and I'm from Western Carolina University in North Carolina. I'm trying to understand what's working well and not working well about the Elwha Science Education Project summer program that you took part in this week. I have some questions about your interests in science and the Elwha River, your traditional culture, school, and the outdoors. I also have questions about your opinions about this program. It will take about an hour to talk about these things. Do you have any questions before we start? Would it be ok if I recorded this? You can ask me to turn the recorder off at any time.

0) First, I'd like to ask you a housekeeping kind of question. When were you born? _________

0) What grade are you in?

Thanks. Now, I'm going to ask you some questions about your interests.

0) How interested are you in your traditional culture?
___ Not interested ___A little interested ___Very interested
) Why?

0) How interested are you in the outdoors?
___ Not interested ___A little interested ___Very interested
) Why?

0) How interested are you in science?
___ Not interested ___A little interested ___Very interested
) Why?

0) How interested are you in earth sciences (Sometimes it's called the geosciences)?
___ Not interested ___A little interested ___Very interested
) Why?

0) How interested are you in going to school (like college or a trade school) when you finish high school?
___ Not interested ___A little interested ___Very interested
) [*If "not interested"*] What are you interested in doing after you finish high school (prompts: work, military)?
) [*If "a little" or "very interested"*] What kind of school are you interested in?
) Why?

0) What do you want to do when you grow up?

0) Do you have a favorite subject at school? What is it? Why?

0) What are your favorite things to do outside of school? Why?

Now, I'm going to ask you some questions about the summer program. Are you ready? Do you have any questions for me before we get started?

0) How did you feel about the traditional cultural activities during the summer program?
) [Prompts: Too easy, too hard, just right? Why?]
) [Prompts: Interesting or not interesting? Why?]
) What was your favorite traditional cultural activity? Why?
) What was your least favorite traditional cultural activity? Why?
) How were the activities connected to you, your family, or your community?
) What would make the traditional culture part of the program better for you?

0) How did you feel about the science you learned during the summer program?
) Too easy, too hard, just right? Why?
) Interesting or not interesting? Why?
) How were the activities connected to you, your family, or your community?
) What was your favorite science activity during the program? Why?
) What was your least favorite science activity during the program? Why?
) What would make the science part of the program better for you?

0) How were the cultural parts of the program connected to the science parts of the program?
) Did that work well for you? Why or why not?

Now I'd like to ask you a few questions about the Elwha River restoration project…
0) What do you feel you understand best about the restoration? What helped you understand this?
) Is there anything you'd like to understand better?
) Do you feel like the Elwha River restoration will affect you or your community? How?

0) Was the program like you expected? Why or why not?
) What did you like best? Why?
) What did you like the least? Why?

0) Is there anything we haven't talked about that you would change about the program? Why? What would make this better?

0) Is there anything else you'd like to add?

Thanks so much for helping with this. I really appreciate it.

Appendix D: Parent/Guardian Consent and Student Assent Forms

ELWHA SCIENCE EDUCATION PROJECT

____
student name

yəhúmict či ʔaʔ tə ščtəŋ́xʷən

PARENT CONSENT FORM
Researchers at Western Carolina University will be evaluating the effectiveness of the Elwha Science Education Project (ESEP). Your child's responses will be used to help improve the ESEP for your child and for future participants. In addition, the information we collect about the ESEP will help give evidence for future program funding. Your child's participation is voluntary, and they may withdraw at any time or choose not to answer any of the questions. You or your child can also ask questions about this study at any time. We ask permission to collect the following:

- ***Photographs and video*** for use in program presentations and for teaching future educators about this program;
- ***Your child's coursework, grades, attendance record, and WASL information*** from the Port Angeles School District or Crescent School District to understand if the ESEP is helping your child at school;
- ***Program observations and application survey*** information. Observations and questions in the application survey are related to your child's participation in the Elwha Science Education Project. The questions are about their interests in the outdoors, science, and school. Your child's responses and observations will be used for program feedback and research purposes. The application survey will take about 15 minutes to complete.
- ***Interviews*** for program feedback and research purposes. Interviews will be conducted after the summer program and last approximately 1 hour. Questions are about your child's interest in science and school, about your child's interest in and understanding of the Elwha River, and about what "worked" and didn't "work" about the program.

Your child's responses will be held strictly confidential. That means that individual records of this study will be kept private, and results will only be shared in aggregate or unidentified forms. No real names will be used when data are shared with others for research or educational purposes. Only researchers from Western Carolina University will have access to study data. We will take the following steps to keep information about your child confidential, and to protect it from unauthorized disclosure, tampering, or damage: data files will be kept in a locked cabinet, computer files will be password protected, and your child's name will be kept separate from data related to him or her.

If your child and you agree for him/her to take part in **all parts** of this study and your child **does** take part in **all parts** of the study, he/she will be eligible for a raffle drawing for a **free iPod shuffle**.

If you have any questions, you can contact me, [redacted]. You can also contact [redacted] or e-mail at [redacted]. If you have any concerns about your child's treatment in this study, you can reach Dr. [redacted] from the Western Carolina University Institutional Review Board at [redacted].

Please initial the following to give your parental consent for participation in this research.
___ I grant permission to collect photographs and video.
___ I grant permission to collect information about my child's attendance records, grades, and coursework information.
___ I grant permission to collect application survey and observation data.

___ I grant permission to interview my child:

□ with audiotaping. □ without audiotaping.

Parent/Guardian Name: ____

Parent/Guardian Signature: ____________________________Date: ____________________

ELWHA SCIENCE EDUCATION PROJECT

____
student name

yəhúmict či ʔaʔ tə ščtəŋ́xʷən

We are doing a research study about the Elwha Science Education Project. Your participation and answers to questions will be used to help improve the Elwha Science Education Project for next year and the years after that. Your opinions will be important for helping make this program better for you and other students who take part in it and to help keep the Elwha Science Education Project funded. However, if you do not want to be in this research study, you can still take part in the Elwha Science Education Project. If you decide that you want to be part of this study, you will be asked to do a survey before the summer program, an interview after the summer program, and to allow me to make observations during the summer program. The survey will take about 15 minutes and the interview will take about 1 hour. Questions will be about your interests, the Elwha River, the outdoors, science, school, your traditional culture, and what you think worked and didn't work well during the Elwha Science Education Project.

When we are finished with this study we will write about what was learned. This report will not include your name or that you were in the study.

You do not have to be in this study if you do not want to be. If you decide to stop after we begin, that's okay too. Your parents, teachers, friends, and Klallam and Olympic Park Institute educators will not know how you answer any questions we ask.

If you and your parent or guardian agree for you to take part in **all parts** of this study and you **do** take part in **all parts** of the study (application survey, observations, and interview), you will be eligible for a raffle drawing for a **free iPod shuffle**.

If you decide you want to be in this study, please sign your name.

I, ________________________________, want to be in this research study. I was born on ________________, 19__.

___________________________________ ______
(Sign your name here) (Date)

Appendix E: Educator interview and consent documents

My name's [redacted], and I'm from Western Carolina University in North Carolina. I'm trying to understand what's working well and not working well about the Elwha Science Education Project summer program that you took part in this week. I have some questions about your opinions about the science and culture parts of this program. It will take about an hour to talk about these things. Do you have any questions before we start? Would it be ok if I recorded this? You can ask me to turn the recorder off at any time.

Ok, first I'd like to ask you some questions about yourself.

0) What was your role for this summer program?

0) What is your experience working with kids?

0) Why did you take part in the Elwha Science Education Project summer program?

Thank you. Now, I have some questions about your experience with this summer's program.

0) Can you tell me a little about the lesson I observed? It was the one about _________.
) You said your goals for this lesson were ___________. Did you feel like you met those goals? Why or why not?
) Why did you choose those goals included in that lesson?
) What went well for that lesson? Why?
) What would you do differently next time? Why?

0) How do you feel about the traditional cultural activities during the summer program?
) Too easy, too hard, just right for students? Why?
) Interesting or not interesting? Why?
) What was *your* favorite traditional cultural activity? Why?
) What was the kids' favorite cultural activity? Why?
) What was *your* least favorite traditional cultural activity? Why?
) What was the kids' least favorite cultural activity? Why?
) What would make the traditional culture part of the program better?

0) How do you feel about the science students learned during the summer program?
) Too easy, too hard, just right for students? Why?
) Interesting or not interesting? Why?
) What was *your* favorite science activity during the program? Why?
) What was the kids' favorite science activity? Why?
) What was *your* least favorite science activity during the program? Why?
) What was the kids' least favorite science activity? Why?
) What would make the science part of the program better?

0) How were the cultural parts of the program connected to the science parts of the program?
) Did that work well? Why or why not?

0) In general, were there any other particular activities or experiences that you thought “worked” particularly well? Why?

0) In general, were there any other particular activities or experiences that you thought need “work”? Why?

For HS program:

0) What did kids best connect with regarding the river restoration? Why?

0) What did kids struggle to connect with regarding the restoration? Why?

0) Can you tell me about your support for this program? In other words, how well were you supported to prepare for this program [Prompts: by OPI; by the tribe?]?
) What was most helpful for preparing for the program? Why?
) What would you like more help with? Why?

0) Is there anything we haven’t talked about that you would change about the program? Why? What would make this better?

0) Is there anything else you’d like to add?

Thank you.

ELWHA SCIENCE EDUCATION PROJECT SCIENCE EDUCATOR CONSENT FORM

What is the purpose of this research?
Researchers at Western Carolina University will be evaluating the educational effectiveness of the Elwha Science Education Project (ESEP). We are hoping to better understand how the ESEP is working, including the effectiveness of the ESEP summer program. Your responses will be used to help improve the Elwha Science Education Project for future participants. Also, your responses will be used to provide evidence for continued funding for the ESEP through the National Science Foundation.

We ask permission to collect the following:
- ***Photographs and video*** for use in program presentations and for teaching future educators about this program;
- ***Program observations***. Observations will be made of one "lesson" during the summer program. Issues addressed will be: lesson goals, content, implementation, cognitive activity, student engagement, and overall lesson quality. Observations will last as long as the lesson experience;
- ***Interviews*** for program feedback and research purposes. Interviews will be conducted after the summer program and last approximately 1 hour. Questions will be about your opinions regarding the science and culture parts of this program as well as what you thought "worked" and didn't "work" for this program.

Will my answers be confidential?
Yes. Your name will not be used at all in this research – only a pseudonym will be used, and identifying characteristics will not be included. Only researchers from Western Carolina University will have access to study data. We will take the following steps to keep information about you confidential, and to protect it from unauthorized disclosure, tampering, or damage: data files will be kept in a locked cabinet, computer files will be password protected, and your name will be kept separate from data related to you.

Can I withdraw from the study if I decide to?
Absolutely. You can withdraw from the research at any time, without penalty, and ask that your answers not be used.

Is there any harm that I might experience from taking part in the study?
No. There is no foreseeable harm to participants by taking part in the research.

How will I benefit from taking part in the research?
You will obtain the satisfaction of knowing that you participated in a study that will help improve the Elwha Science Education Program summer experience. Your observations and interviews will also be used to give evidence for continued ESEP funding. In addition, if you are interested, we will send you a copy of the results.

Who should I contact if I have questions or concerns about the research?
If you have any questions, you can contact me, [redacted] or at [redacted]. You can also contact [redacted]2 or e-mail at [redacted]. If you have any concerns about your treatment in this study, you can reach Dr. [redacted] from the Western Carolina University Institutional Review Board at [redacted].

Please initial the following to give your parental consent for participation in this research.
___ I grant permission to collect photographs and video.
___ I grant permission to collect observation data.
___ I grant permission to interview me:
□ with audiotaping. □ without audiotaping.

Participant Name________________________________ Date______________

Participant Signature______________________________

Researcher Signature _____________________________

ELWHA SCIENCE EDUCATION PROJECT CULTURAL EDUCATOR CONSENT FORM

What is the purpose of this research?
Researchers at Western Carolina University will be evaluating the educational effectiveness of the Elwha Science Education Project (ESEP). We are hoping to better understand how the ESEP is working, including the effectiveness of the ESEP summer program. Your responses will be used to help improve the Elwha Science Education Project for future participants. Also, your responses will be used to provide evidence for continued funding for the ESEP through the National Science Foundation. Please note: no precise data regarding stories or traditions will be collected. Each place/site connected to the Elwha River restoration is also connected to a story, tradition, and/or local history. Evaluation data will only address this issue.

We ask permission to collect the following:

- ***Photographs and video*** for use in program presentations and for teaching future educators about this program;
- ***Program observations***. Observations will be made of one "lesson" during the summer program. Observations will address the following issues:
  - Was this a story, tradition, or description of local history?
  - What place/site is this story, tradition, or description of local history connected to?
  - Who shared this story, tradition, or description of local history?
  - Is there a science concept also connected to this place? How?
  - Are students engaged with this experience? How?;
- ***Interviews*** for program feedback and research purposes. Interviews will be conducted after the summer program and last approximately 1 hour. Questions will be about your opinions regarding the science and culture parts of this program as well as what you thought "worked" and didn't "work" for this program.

Will my answers be confidential?
Yes. Your name will not be used at all in this research – only a pseudonym will be used, and identifying characteristics will not be included. Only researchers from Western Carolina University will have access to study data. We will take the following steps to keep information about you confidential, and to protect it from unauthorized disclosure, tampering, or damage: data files will be kept in a locked cabinet, computer files will be password protected, and your name will be kept separate from data related to you.

Can I withdraw from the study if I decide to?
Absolutely. You can withdraw from the research at any time, without penalty, and ask that your answers not be used.

Is there any harm that I might experience from taking part in the study?
No. There is no foreseeable harm to participants by taking part in the research.

How will I benefit from taking part in the research?
You will obtain the satisfaction of knowing that you participated in a study that will help improve the Elwha Science Education Program summer experience. Your observations and interviews will also be used to give evidence for continued ESEP funding. In addition, if you are interested, we will send you a copy of the results.

Who should I contact if I have questions or concerns about the research?
If you have any questions, you can contact me, [redacted] or at [redacted]. You can also contact [redacted] or e-mail at lschromen[redacted]. If you have any concerns about your treatment in this study, you can reach Dr. [redacted] from the Western Carolina University Institutional Review Board at [redacted].

Please initial the following to give your consent for participation in this research.
___ I grant permission to collect photographs and video.

___ I grant permission to collect observation data.
___ I grant permission to interview me:
□ with audiotaping. □ without audiotaping.

Participant Name_________________________________ Date______________
Participant Signature_______________________________

Researcher Signature ______________________________

Appendix F: Observation Protocols

ESEP summer program cultural experience

For cultural experiences, it isn't my place to "evaluate" the experience, nor to describe the experience in any detail for the purposes of "research." It is more appropriate to think about the experience in a more holistic way. The idea is that each important place/site is connected to a story, tradition, and/or local history. However, it is **not** appropriate for me to share the details of stories, traditions, and histories. Science informs management practices/behaviors that preserve (or don't preserve) the places that are so culturally and historically important. Therefore, each science lesson should be connected to a traditional story, tradition, place, and/or local history. For the purposes of overall program evaluation, I will describe only this.

Educator(s):
Description of students in class:
    Number:
    Age(s):
Chaperone(s):
Other observers or participants:
Research observer:
Date:
Start time:
End time:

The questions I ask are:
Was this a story, tradition, or description of local history?

What place/site is this story, tradition, or description of local history connected to?

Who shared this story, tradition, or description of local history?

Is there a science concept also connected to this place? How?

Are students engaged with this experience? How?
    [LE low engagement, 25% or more of the students off-task
    HE Mixed or high engagement, 76% or more of the students engaged]

ESEP summer program science observation protocol

Educator(s):
Description of students in class:
Number:
Age(s):
Chaperone(s):
Description of other observers or participants:
Research observer:
Date:
Start time:
End time:

Basic description of the lesson:
Where was it?

What was it about?

What was the goal(s) of the lesson?

What is a basic description of "what happened" (lesson activities)?

Cultural connections: Science informs management practices/behaviors that preserve (or don't preserve) the places. Each science lesson should be connected to a traditional story, tradition, place, and/or local history. Describe how this lesson was connected to one (or more) of these concepts.

Lesson implementation	Never occurred				Very descriptive
1. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein.	1	2	3	4	5
2. The lesson engaged students as members of a learning community.	1	2	3	4	5
3. The teacher preceded this lesson with a description of lesson goals.	1	2	3	4	5
4. In this lesson, student exploration preceded formal presentation.	1	2	3	4	5
5. This lesson encouraged students to seek and value alternative modes of investigation or of problem solving.	1	2	3	4	5

6. The focus and direction of the lesson was often determined by ideas originating with students.	1	2	3	4	5

Lesson Content	Never occurred			Very descriptive	
Propositional knowledge					
6. The lesson involved fundamental concepts of the subject.	1	2	3	4	5
7. The lesson promoted strongly coherent conceptual understanding.	1	2	3	4	5
8. The teacher had a solid grasp of the subject matter content inherent in the lesson.	1	2	3	4	5
9. Elements of abstraction (i.e., symbolic representations, theory building) were used when appropriate.	1	2	3	4	5
10. Connections with real world phenomena were explored.	1	2	3	4	5
Procedural knowledge	Never occurred			Very descriptive	
11. Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent phenomena.	1	2	3	4	5
12. Students made predictions, estimations, and/or hypotheses and devised means for testing them.	1	2	3	4	5
13. Students were actively engaged in thought-provoking activity that often involved the critical assessment of procedures.	1	2	3	4	5
14. Students were reflective about their learning.	1	2	3	4	5
15. Intellectual rigor, constructive criticism, and the challenging of ideas were valued.	1	2	3	4	5

Program culture	Never occurred			Very descriptive	
Communicative interactions					
16. Students were involved in the communication of their ideas to others using a variety of means.	1	2	3	4	5
17. The teacher's questions triggered divergent modes of thinking.	1	2	3	4	5
18. There was a high proportion of student talk, and a significant amount of it occurred between and among students.	1	2	3	4	5
19. Student questions and comments often determined the focus and direction of classroom discourse.	1	2	3	4	5
20. There was a climate of respect for what others had to say.	1	2	3	4	5
Student/teacher relationship	Never occurred			Very descriptive	
21. Active participation of students was encouraged and valued.	1	2	3	4	5
22. Students were encouraged to generate conjectures, alternative solution strategies, and ways	1	2	3	4	5

of interpreting evidence.					
23. In general, the teacher was patient with students.	1	2	3	4	5
24. The teacher acted as a resource person, working to support and enhance student investigations.	1	2	3	4	5
25. The metaphor “teacher as listener” was very characteristic of this lesson.	1	2	3	4	5

Holistic description of lesson quality:
Description:

Ineffective instruction (1- passive learning/activity for activity’s sake) to exemplary instruction (5- purposeful instruction with students highly engaged in meaningful work)

Type of Instruction (I)

L lecture/presentation
T Transition time
SP student presentation (formal)
LWD lecture with discussion
D Demonstration
CD class discussion
WW writing work (if in groups, add SGD)
RSW reading work (if in groups, add SGD)
HOA hands-on activity/materials
SGD small group discussion (pairs count)
CL cooperative learning (roles)
LC learning center/station
TIS teacher/faculty member interacting w/ student
UT utilizing digital educational media and/or technology
AD administrative tasks
I Interruption
OTH other: Please describe.

Student Engagement (S)

LE low engagement, 25% or more of the students off-task
HE Mixed or high engagement,76% or more of the students engaged

Cognitive Activity (Bloom’s Taxonomy) (C)

K Knowledge (e.g., observation and recall of information, knowledge of dates, events, places)
C Comprehension (e.g., understanding information, translate knowledge into new context)
AP Application (e.g., use information, use methods, concepts, theories in new situations)
AN Analysis (e.g., seeing patterns, organization of parts, identification of components)
S Synthesis (e.g., generalize from given facts, predict, draw conclusions)
E Evaluation (e.g., make choices based on reasoned argument, verify value of evidence)

Time in minutes

	5-10	**10-15**	**15-20**	**20-25**	**25-30**	**30-35**	**35-40**	**40-45**	**45-50**	**50-55**	**55-60**	**60-65**
Instruction (I)												
Student (S)												
Cognitive (C)												

Appendix G: 2008 Program Schedules

High School Summer Program: June 22-28, 2008

Sunday 6/22	Mon 6/23	Tue 6/24	Wed 6/25	Thursday 6/26	Friday 6/27	Saturday 6/28
Elwha Earth Sciences, Wildlife, and Fisheries	7:15 Wake Up, shower	7:15 Wake Up, shower	7:15 Wake Up, shower	7:15 Wake Up, shower	7:15 Wake Up, showers	7:15 Wake Up, shower
	Breakfast Helpers 7:50	Breakfast Helpers 7:50	Breakfast Helpers 7:50	Breakfast Helpers 7:50	Breakfast Helpers 7:50	Breakfast Helpers 7:50
Student home pick-ups as needed	**8:00 Breakfast** Clean up crew	**8:00 Breakfast** Clean up crew	**8:00 Breakfast** Clean up crew	**8:00 Breakfast** Clean up crew	**8:00 Breakfast** Clean up crew	**8:00 Breakfast** **Move out of cabins**
10:00 Meet at Elwha	9:00 Morning Meeting	9:00 Morning Meeting	9:00 Morning Meeting	9:00 Morning Meeting	9:00 Morning Meeting	9:00 Morning Meeting
	Wildlife Habitats on **Barnes Point**	Know Your Fishing Rights	Modern Fishing Issues	Turning Knowledge into Action	Pulling it all together	10:00 depart for closing field site with Elder at Elwha Entrance Station
Group Lunch to Go	**Group Lunch**	**Group Lunch**	**Group Lunch**	**Group Lunch**	**Group Lunch**	**Snacks**
Freshwater Bay (PA Low -1.2 at 12:06) Intertidal habitats and organism gathering **Arrive campus** Cabins, campus tour Elders Circle *Science Credit reqs* expectations ½ hr journal writing 4:00 Free Time Chaperones supervise	Guest biologists for bird and wildlife habitat methods ½ hr journal writing 4:00 Free Time Chaperones supervise	Elwha River Management Town Meeting UAA, Treaty Rights ½ hr journal writing 4:00 Free Time Chaperones supervise	Fish seining at Marine Life Center in Port Angeles ½ hr journal writing 4:00 Free Time Chaperones supervise	Create presentation posters or write research papers ½ hr journal writing 4:00 Free Time Chaperones supervise	Canoe journey protocol Canoe safety lunch Ring Ceremony Canoe exploration of Lake Crescent / finish presentations or papers Cooking fish on sticks at amphitheatre ½ hr journal writing	11:30 arrive Peninsula College Longhouse Noon Student Presentations **1:00 Dinner with Families at Longhouse** Student home drop-off as needed (~ 2:30 to 3:30)
Helpers w/ dinner 5:50	Helpers w/ dinner 5:50	Helpers w/ dinner 5:50	Helpers w/ dinner 5:50	Helpers w/ dinner 5:50	Helpers w/ dinner 5:50	
Dinner at 6:00 pm Journaling time	**Dinner at 6:00 pm** Journaling time	**Dinner at 6:00 pm** Journaling time	**Dinner at 6:00 pm** Journaling time	**Dinner at 6:00 pm** Journaling time	**Dinner at 6:00 pm, eat out with salmon** Journaling time	
7:30 Making fishing gear, evening circle	7:30 wildlife biology, evening circle	7:30, tribal governance {tentative}, evening circle	7:30 Treaty Play, evening circle	7:30 Red Eagle Soaring, Snoqualmie youth theatre, evening circle	7:30, TBD, evening circle	
9:30 Goodnight	9:30 Goodnight	9:30 Goodnight	9:30 Goodnight	9:30 Goodnight	9:30 Goodnight	

Middle school summer program: July 13 - 17, 2008

Sunday 7/13	Mon 7/14	Tue 7/15	Wed 7/16	Thursday 7/17
Naturally Native				
	Breakfast Helpers 7:05	Breakfast Helpers 7:05	Breakfast Helpers 7:05	Breakfast Helpers 7:05
Student home pick-ups as needed	**7:15 Breakfast** Clean up crew	**7:15 Breakfast** Clean up crew	**7:15 Breakfast** **Clean out of cabins**	**7:15 Camping Breakfast at Fairholm** Clean up crew
10:00 Meet at Elwha Ctr	9:00 Morning Meeting	9:00 Morning Meeting	9:00 Morning Meeting	9:00 Morning Meeting
	Plant Habitats on ***Barnes Point***	*Ecosystems of* ***Lake Crescent***	***Canoe to Fairholm***	***Coming home with what you know***
Group Lunch	**Group Lunch**	**Group Lunch**	**Group Lunch**	
Welcome, expectations, and group dynamics Cedar Bark Harvesting **Arrive campus** Cabins, campus tour Elders Circle [tentative] 4:00 Free Time Chaperones supervise	Gathering plants/respect for plants Traditional food plants Intro river/soil and riparian transect ½ hr history books 4:00 Free Time Chaperones supervise	Maps River system processes and geomorphology Soil and riparia inquiry ½ hr history books 4:00 Free Time Chaperones supervise	Camping prep Canoe to Fairholm ½ hr history books Set up campground 4:00 Free Time Chaperones supervise	Pack up camp Canoe back to campus **Noon** Canoe Landing at Olympic Park Institute Cooking salmon **12:30 dinner with families**
Helpers w/ dinner 4:50	Helpers w/ dinner 4:50	Helpers w/ dinner 4:50	Helpers w/ dinner 4:50	
Dinner at 5:00 pm	**Dinner at 5:00 pm**	**Dinner at 5:00 pm**	**Dinner Delivered at 5:00 pm at Fairholm**	Transport students home as needed
7:30 Elders stories and history	7:30 gift making [tentative]	7:30 Elwha Dance Group	7:30 Campfire and traditional ghost stories	
9:30 Goodnight	9:30 Goodnight	9:30 Goodnight	9:30 Goodnight	