Expedition Earth Science: An Experiential Education Program and its Impact on Student Perceptions and Attitudes Regarding Science

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Abstract

Expedition Earth Science (EES), an experiential off-campus and primarily outdoor education program, was designed to provide authentic hands-on learning experiences for 9th grade Earth science students at the Liverpool High School Annex, located in Central New York. The program, now in its 12th year, attempts to answer two fundamental problems in science education; how do you keep high school students interested and engaged in science education throughout high school? And, how do you get students to see the relevance and real-life applications of the content that we teach? In this study, students’ perceptions and attitudes regarding science were measured utilizing a pre and post survey instrument that collected mostly quantitative but also some qualitative data related to the EES program. It was found that preliminary data (additional data to be collected throughout the 2012-2013 school year) seems to indicate that the EES program is effective in increasing students’ perceptions and attitudes regarding science education. Therefore, this research suggests that students’ views on science education can be positively impacted by experiential education programs, like EES, that provide students with novel and authentic science experiences.

Introduction

Perceptions. Attitudes. Confidence. These affective domain traits and personality characteristics are often overlooked or misunderstood in the process of teaching and learning. The cognitive domain is usually of primary concern in education. However,
research has shown that the affective domain has a great impact on cognitive processing and academic success (Blackwell, Trzesniewski, Dweck, 2007). Therefore, with regard to science education, the goal is not to simply fill students with scientific factoids devoid of context that can be regurgitated for an exam, but to convey the meaning of science within a humanistic and social framework that gives a more accurate view of the scientific process and enhances students’ scientific literacy.

The impact of perceptions and attitudes on science education was summarized by Reid (2011). Two key findings included that a successful curriculum approach to science education can result in positive gains in student buy-in and attitudes, and that student-perceived potential (perception) of a career path assists in boosting students’ perceptions and attitudes. Aschbacher, Li, and Roth (2010) also demonstrated that students’ perceptions of science influenced their desire to continue or abandon their career track concerning science. 45% of self-described science, technology, engineering, math (STEM) students in 10th grade eventually dropped their career goals in these fields and were described by the researchers as “lost potentials”. What led to these changes? The reasons were varied but generally included perceptions of STEM as too difficult, poor school science experiences, and a lack of compelling extra-curricular activities. However, students who persisted in the STEM field did so due to internal ambition, positive perceptions of school science, and enriching and interesting extra-curricular activities (Aschbacher, Li, Roth, 2010) (underlining provided for emphasis on key points related to this study).

Realizing the potential for student attrition in the STEM field, some science educators have put more effort into engaging students in the affective domain. In the geoscience field, a new paradigm for teaching seeks to integrate motivation, emotion, and outdoor education to provide an enriched educational environment (van der Hoeven Kraft, et al., 2011). In this approach the researchers combined motivation theory, theories of emotion, and the power of place (field-based experiential learning) to greater influence educational outcomes and significantly shift student attitudes. This approach makes much more sense in the STEM field where often science, and its sister disciplines, are seen as offering only cold facts, numbers, charts, and graphs. Cognitive and affective domains need to be considered when
trying to impact student learning. Also, experiential programs provide students with the opportunity to engage in meaningful, authentic, and real-life experiences that help generate a feeling of community and social connection to the discipline being studied (McConnell, van Der Hoeven Kraft, 2011).

Experiential education programs are often utilized to strengthen the affective domain of learning since these programs are seen as an appropriate venue to engage students in real-life, authentic, and meaningful tasks that elevate perceptions and attitudes in science. Pavelich and Moore (1996) discussed this concept in their study while using the Perry Model (student interviews) to acquire data regarding experiential experiences. Their data demonstrated that Colorado School of Mines students showed gains in not only content understanding but also elevated levels of appreciation for how science works and their view of science in general (from lower level Perry Model positions to higher). Studies have also shown that students engaged in transformative experiences, or experiential education activities, more likely perceive the subject matter as relevant to their lives and can see themselves as potentially pursuing a career in that field (Pugh, et al., 2009).

However, the simple act of being outdoors or offering an authentic experience does not guarantee the desired results. In developing an effective program, confounding factors should be considered in order to minimize undesired outcomes (Ewert and Sibthorp, 2009). Precursor variables such as students’ prior knowledge of the information to be learned and life experiences (Chang, Yeung, and Cheng, 2009), demographics, pre-experience emotions/perceptions, and self-selection should be considered when developing a program. Also, during-event and post-event variables should be considered in areas such as group characteristics, event specific logistics (e.g., weather), and desired outcomes (e.g., projects, reports, presentations). Confounding variables like the ones mentioned above must be identified when designing an effective experiential experience that has the greatest potential to impact students” perceptions and attitudes regarding science. In fact, a poorly designed experience has the potential to cause harm and result in the opposite desired outcome (giving a negative perception or attitude regarding science).
So, what programs or educational approaches work best at increasing students’ perceptions and attitudes regarding science? The EES program, at the Liverpool High School Annex, was designed to help connect the affective and cognitive domains in an attempt to bolster students’ desire to “do” science and appreciate science.

As described on the researcher’s website, http://www.liverpool.k12.ny.us/webpages/dcalderwood/expedition.cfm?subpage=27427, Expedition Earth Science was developed to provide students with the opportunity to explore Earth science processes by conducting the work of scientists at field locations around New York State. Students select and then participate on one or more of the seven to ten expeditions offered each year. Each expedition begins at an after school meeting about two weeks before the trip where the students form teams and receive detailed assignments describing the problems that they must solve by collecting scientific data in the field on the day of the expedition. They will also receive information about the products (reports, etc.) that they are expected to produce and how they will be graded. Expeditions typically consist of 15-24 students, 2 teachers and 3-10 parent volunteers who spend all day on a Saturday or Sunday traveling to and collecting data at a location or series of locations. An example itinerary is provided as Appendix A.

However, since its inception, there have been no formal studies to measure the program’s effectiveness in attaining its goals. Therefore, this study investigates the potential of the EES program to impact students in the affective domain. Does participation in the EES program result in an increase, decrease, or no change in student perception and attitude regarding science?

It was predicted that the program would have a positive impact on students’ science perceptions and attitudes. This was based on the program’s novel approach of inserting students into the role of scientists/engineers, a role they usually have not been exposed to. First of all, field trips and outdoor educational experiences in the school setting are limited due to budget constraints and liability issues. Secondly, even when these opportunities are provided through school, they are designed as passive experiences where the student is not
actively involved in the learning. The EES program is a student-centered approach that places the student in the role of scientist or engineer and asks them to solve authentic problems where often the teacher does not know the answer or outcome. Due to the authentic nature of the experiences, the outdoor setting, and novel approach, it was believed that the program would increase students’ perceptions of science and perhaps even inspire some students to pursue scientific and or engineering careers.

**Methods**

In order to measure the effectiveness of the EES program, this study utilized pre and post survey instruments to measure student perceptions and attitudes regarding science prior to an EES experience and following the experience. The survey tools incorporated quantitative as well as qualitative measures, however, most of the pre survey was based on quantitative questions and statements.

**Pre Survey**

The pre survey, given to 180 students in eight classes from two different teachers encompassed 26 questions and/or statements that students responded to (Attachment B). The survey is broken down into six sections, each with a different purpose.

The first section included questions about the students’ academic level in Earth science (academic or honors), if they signed up for an expedition, and an open-ended question about their feelings for why they either signed up or did not sign up. This allowed the researcher to gather information regarding students’ motivation level and commitment to the EES program. The open-ended questions also gave the students a chance to describe their feelings without the constrictive parameters of a more closed response method.

Section two was composed of three questions that attempted to gauge the students’ perception of science in their elementary years, middle school years, and what their perception of science is for their future years in high school. This section of the survey used seven descriptive terms for each age group (elementary, middle, and high school) and asked the students’ to pick the one word that best described their feeling about science at

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that age. The intent of this section of the survey was to see if there is any change in perception of science as a student progresses through their K-12 years.

The third section of the survey asked the respondents to rank order nine words that describe actions associated with teaching and learning about science (textbook, field trip, outdoors, notes, etc.). The purpose here was to gather information on how students’ perceive how science is delivered to them.

The fourth section of the survey was based on the Thurstone Method of Equal-Appearing Intervals. Thurstone scaling is a unidimensional scale that measures favorableness of a topic. First, 115 statements were created regarding favorableness of science that could be responded to by either agreeing or disagreeing with the statement. Contributors from within the Liverpool High School science department or other content teachers at the 9th grade Liverpool High School Annex building developed the 115 statements. A committee of judges was then assembled to assign a value to each statement with regard to its favorableness toward or against science. The scale ranged from one to seven with one being highly unfavorable to seven being highly favorable. This initial list of 115 statements was then downsized to 12 optimal statements (each statistically designated as a 1, 2, 3, 4, 5, 6, or 7). These 12 questions were selected based on appropriateness to the study question regarding the EES program and were at equal interval from each other mathematically (for instance...two questions were selected for being statistically valued at 1, two valued at 2, one valued at 3, one valued at 3.5, one valued at 4.5, one valued at 5, two valued at 6, and two valued at 7). Therefore, each statement has an assigned value of one to seven and when all positive responses (agrees) are calculated a measure of favorableness regarding science can be assigned.

Section 5 was based on Likert scale-type questions. Five questions were developed that measure responder confidence regarding scientific skills such as using equipment, following procedures, working with others, etc. The scaling is based on a four point system with 1 signifying “I know I can do it” to 4 meaning “I can’t do it”. The purpose of this section was to measure the students’ self-image (perception) of themselves as a scientist prior to
the EES experience. The student responses were analyzed using an online statistics program at [http://jumk.de/statistic-calculator/](http://jumk.de/statistic-calculator/). The responses were analyzed for mean, median, mode, and frequency of distribution (in terms of percent of total sampled population). The results were also analyzed utilizing the Chi-squared test and Kolmogorow-Smirnow test for normal distribution to confirm the results were not a normal distribution.

Section 6 included one open-ended question, a qualitative measure that asked the students to describe their "single best science experience and why you enjoyed it so much". The purpose of this question was to allow students to personalize their feeling about science and hopefully gather more insight into their perceptions and attitudes that otherwise may not be reflected through the more structured aspects of the survey.

*Post Survey*

The post survey was given to 27 students who participated on two EES experiences. The first expedition included a scientific cruise aboard the H.W.S Scandling, a 65-foot research vessel operated by Hobart William Smith College located in Geneva, New York. The research cruise involved collecting data on three environmental factors of Seneca Lake, one of the Finger Lakes of Central New York. Students worked in groups to analyze water quality parameters (pH, dissolved oxygen, and chloride concentration), collect and survey plankton types and numbers using a plankton net and microscope, and analyze sediment dredge samples from the bottom of the lake for sediment type and presence of invasive species of mussels (Zebra and Quagga). Data collected on the trip was then summarized by the students and sent back to the college to add to their databases. Students who attended this expedition rated it on a scale of 1 (not scientific) to 10 (very scientific) as 9.3.

The second trip occurred two days later and involved students collecting, identifying, and analyzing Devonian age fossils from a quarry near Ithaca, New York. The goal of the trip was to have students practice fossil collecting techniques using authentic equipment and then use identification guides and other resources to obtain information on the fossils biology, ecosystem, diversity, etc. This experience was then followed by a trip to the...
Museum of the Earth, operated by the Paleontological Research Institute. Here, the students had the opportunity to visit the museum’s displays on various fossils through geologic time and gain further insight into their own fossil collections. Students who attended this experience rated it as 8.8 on a scale of 1 to 10.

The post survey instrument included five sections with some of these sections identical to the pre survey. The majority of the survey was quantitative in nature except for the last question, which was designed as an open-ended response.

The first section of the survey asked respondents which of the two expeditions did they attend and were followed up with trip specific Likert scale-type questions about comfort level prior to and following the trip. The scaling was based on a 4-point system similar to the pre survey so as to have respondents commit to a position. The scaling ranged from 1 being “Very Comfortable” to 4 being “Very Uncomfortable”. The last part of this section asked respondents to rate how scientific the trip was on a scale of one to ten. The purpose of this section of the survey was to gather information on the students’ perception of the trip, which could influence their responses on later portions of the survey.

The second section of the post survey included a question identical to the second section of the pre survey. This question asked respondents to circle the one word that best fit their feeling about what science would be like in their upcoming high school career. The intent of this question was to examine if the students’ experience on EES impacted, in any way, their view of future science in high school.

Sections three and four of the post survey were similar to sections four and five of the pre survey. These sections were based on the Thurstone Method of Equal Appearing Intervals and the Likert scale-type statements that measured student confidence levels with regard to science skills. The methods of scoring student favorableness to science for the Thurstone method and Likert scale-type questions were kept constant to the pre survey.
The last section of the post-survey included an open-ended question asking students: Now that you have participated in an extended Earth science trip, how would you describe your expectations in terms of how this trip impacted you and what you attribute about science?

The prompt was designed to elicit the students' perceptions of the impact of the trip. The responses were then analyzed for themes and patterns.

Results

The results described were taken from a comprehensive analysis of the survey responses. However, the post-survey data incorporated only 27 responses since there were no other expeditions completed at the time the writing of the report. Here, we use a more descriptive approach to outline the impact the EEBS program had on students' perceptions and attitudes. The 27 students include 14 students who attended the Snow Bowl expedition, and 13 students who attended the Idaho River expedition. The students were asked to rate their LKE scale using a Likert scale. The data was analyzed using inferential statistics to determine the impact of the post-survey on the students' perceptions.

The statistics section is presented in a table that displays the means and standard deviations for the pre- and post-survey responses. An analysis of variance (ANOVA) was used to evaluate the differences between the pre- and post-survey responses. Additionally, the last section of the results displays a timeline that was used to track the post-survey experiences.

Differences between the Pre-Survey and Post-Survey

A total of 180 students participated in the pre-survey (n = 130) and 27 students (n = 27) in the post-survey. In the post-survey, the 180 pre-survey totals, representing 130 students, were used to compare the results with 27 students on the EEBS. The post-survey included 116 students, of which 78 were male, 38 were female, and 12 were other. The differences were analyzed using ANOVA to evaluate the impact on the students' perceptions.
first two trips, 19 were identified as academic and 8 were honors students (one academic student attended both expeditions). As seen in Figure 1, 69% of the students (125) confirmed they did sign up for an EES experience while 31% (55) acknowledged not signing up for an experience. A greater number of honors students (84%) decided to participate over the academic levels students (58%).

**Self-reported Reasons for Attending or Not Attending an Expedition – Pre Survey**

The 69% of students who confirmed signing up for an experience responded to question 3 on the survey – “I did sign up for an expedition because I feel...” by stating common themes related to the level of fun, interest, novelty, authenticity, or the impact the experience would have on the student’s grade. Some example responses include:

- “It will be a great experience. Many people say that you can talk about things and learn all you want, but you never really learned it until you’ve actually experienced it. Lastly, I signed up for an expedition because it’s an extra credit activity.”
- “I want to explore real science and not just study it in class. I think that the trip will help me get a better view on the topic of science as a whole.”
- “It would be very fun to go to Cornell University and learn about astronomy.”
- “The expedition that I signed up for seems interesting.”
- “Having real life experiences is more beneficial than studying a textbook.”
- “It would be a good experience to learn about something that interests me. Also, actually being able to go to a place and physically learn about it.”
- It would be a fun and new experience in a field that I don’t know much about.”
- “It will be a fun experience, and that I will be able to learn a lot through hands-on science.”
- “It will be neat to do science related things outside of class.”
- “It is a fun way to get extra lab credit.”
- “It would be interesting to see what it would be like to do a real science field trip – that we are the scientists and we got the data.”
- “I might not need the lab advantages but I think the extra credit would be beneficial.”
On the other hand, students who identified as not signing up for an experience generally did so due to schedule, did not fill out paperwork, interest level, and social issues. Some examples of these responses are provided below:

- “I don’t have enough time out of my daytime for extra curricular activities, and also because I take all honors classes with two electives.”
- “I will be playing sports all year, also, I feel like I need all of my spare time to be dedicated to school work in order to succeed and pass with honors.”
- “All of the trips that I wanted to go on I am busy or I will be out of town.”
- “I would rather stay at school with people I talk to (in order) to work in case I don’t understand.”
- “My best friends weren’t going on any of them so it wouldn’t be very fun.”
- “I want to sign up. I lost the paper.”
- “There wasn’t an expedition that completely interested me.”
- “I forgot about it in my folder and didn’t ask my parents.”
- I’m busy enough already. I don’t need to worry about going on a trip. Plus, my parents probably wouldn’t have let me.”
- “With my schedule and my parents schedule we did not have anytime for these activities.”
- “I have other things to do.”
- “The trips listed did not interest me.”
- “First I forgot and second I didn’t know which expedition my friends were going on.”

Student Perceptions of Learning Methods – Pre Survey

The third section of the pre survey that asked “So far in my school career, most of my science learning has been from...” resulted in learning methods such as labs, notes, and homework being the most highly ranked (closer to a ranking of 1). As seen in Figure 2, the lowest ranked items were real-life, outdoors, and field trips, respectively (closer to a ranking of 9).
Single-Item Survey Instrument: Pre-Survey

The pre-survey asked the students to respond to the statement: In the space of 15 sentences, describe your single most significant experience and why you remember it so strongly. As mentioned in the methods section, this statement was included in the survey to determine the frequency and the intensity to which students recalled their experiences and attitudes about science in a more open-ended manner. The responses contained predominantly statements dealing with curricular novelty, and sentiments towards science. Examples of students' responses are given below:

- "I recorded the time it took for hands-on experiments last year to complete."
- "We gathered general information about velocity by using a three-person slingshot to shoot apples at a cartoon of Homer Simpson. Did I need to say anything more?"
- "My favorite science-experience was when we dissected a cow eyeball in 8th grade. I enjoyed it because it was hands-on."
- "My favorite science-experience was a physics experiment in 7th grade. We were learning about potential and kinetic energy and I was in a group with three of my friends and we dissected something amazing...outlet as well as water tank..."
“I went to Onondaga Lake in 6th grade and took samples of the water with a science class we tested clarity and chemical acidity levels. This is the first time I went outside of school for science. We also looked at plankton under a microscope.”

“I went to a fossil dig and got to bring home anything I found. I liked it because the fossils were interesting and I got to see a mountain wall explode.”

Getting to use microscopes in middle school. I liked it because we got to see something that is rare in our personal lives.”

“My single best science experience was making gold pennies. I enjoyed it so much because I was fascinated by the process.”

“The single best experiment was when we made a necklace of our own DNA in 8th grade. It was fun because it was hands-on and interesting.”

“I enjoyed the experiment with the topographic map. I enjoyed it because I got to work with people that I didn’t know.”

I don’t remember the name of it but it was outdoors.”

Every spring my dad takes me and my brother “waterfall hunting”. We go across New York and “hunt” for waterfalls. I enjoy this because I get to spend time with my dad and I get to see different waterfalls.”

“In middle school my science class made ice cream and it was the best because it was really good.”

“The single best science experience I ever did was in 8th grade with chemicals. It was the best because my friends were there.”

“My best experiment in science was making crystal arrangements. I enjoyed this because it was YOUR creation and you are the one that designed it. It was easy to do and fun.”

“A single science experience I enjoyed was in 8th grade with Mr. Robbins. He had us go outside and search for different types of leaves or flowers. After that we came back inside and used his iPhone and out knowledge to figure out what type of leaf or flower it was. I had fun because we got to use the world around us.”

“In 8th grade our technology teacher let us build rockets using 2 liter bottles and we shot them into the sky.”
➢ "My best experience in science was when my classmates and I did a lab outside. We couldn't use our thumbs for anything, and we had to pick items up."

➢ "My best science experience was in sixth grade when we went on a field trip to Green Lakes. I enjoyed it because it was interesting and I got to learn about science outside with my friends."

Perceptions of Science K-12 – Pre and Post Survey
With regard to students’ perceptions of science throughout their school career (questions 5, 6, and 7 on the pre survey), the pre survey seems to indicate a change in attitude as students move from elementary school to middle school. As seen in Figure 3, 38% of students in elementary school identified science as fun (although 26% selected boring), and 18% selected interesting. However, by middle school, Figure 4, students generally identified science as interesting (36%), less fun (11%), and still about the same as elementary school in terms of boring (24%). A larger shift can be seen in the data for what students expect science to be like in high school. Here, as seen in Figure 5, students’ perceptions of high school science are a greater expectation of stress (30%) but a similar level of interest (34%) to what was experienced in middle school (36%). The expectations question for high school science remained on the post survey and resulted in similar percentages (Figure 6) to the pre survey, however, the stress level dropped significantly (from 30% to 12%).
Response to "Science in Elementary School was..."

Figure 6: Responses to elementary school science.

Response to "Science in Middle School was..."

Figure 7: Responses to middle school science.
Response to: "I expect Science in High School to be"
Favorableness to Science – Pre and Post Survey

The twelve Thurstone scaling questions on the pre survey resulted in a favorableness rating of 5.25 for academic level students and 5.70 for honors students. The equal-interval scale ranges from 1, being a very low favorableness score, to 7 being a very high favorableness score. The difference in score is a result of question 15 on the survey where 59% of academic students agreed that they found science difficult. However, 56% of honors students disagreed with this statement and therefore resulted in a higher favorableness score. Except for question 15 and 9, honors and academic students were in agreement with their responses to all other questions. Where honors and academic students were in agreement, the honors students agreed or disagreed, on average, 13 points higher or lower than their counterparts. For example, on question 17 (Table 1) “I am curious about the world around me.” the honors students agreed at a level of 89% were the academic students agreed at a level of 75% (a 14 point difference). Another interesting result can be seen for question 9 (Table 1) where the academic students (87%) were more in favor of “Science is most interesting when done outside” than the honors students (72%).
Table 1 - Pre Survey Thurstone Scoring Data

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Table 1 - Thurstone attitude scaling. The number at the end of each question signifies its scaled weight in terms of favorableness to science. 1 is highly unfavorable, and 7 highly favorable. Averaging the values of all agrees results in a rating for favorableness. Academic students were scaled at 5.25 and honors students at 5.70.

Following an EES experience, the students’ Thurstone scaling (Table 2) exhibited a similar end result to the pre survey data in that the aggregate score for all students, regardless of academic or honors level, was registered at 5.70 on the favorableness scale of 1 to 7.
Table 2 - Post Survey Thurstone Scoring Data

Although this is only a slightly higher result in terms of the academic level students and the same for honors level students, the agreement or disagreement level was greater for the students attending an EES experience. For example, on question 13 “Science is cool”, the pre survey response for all students was 84% in agreement (93% honors and 78% academic). However, on the post survey (Table 2) the response for this question was 100%
in agreement for both honors and academic level students. This pattern, a greater level of agreement or disagreement, held consistent for all twelve questions as seen below on Table 3:

**Table 3 – Comparison Between Thurstone Pre Survey and Post Survey Data**

<table>
<thead>
<tr>
<th>Question</th>
<th>Agree or Disagree</th>
<th>Pre Survey (%)</th>
<th>Post Survey (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Science is most interesting when done outside.</td>
<td>Agree</td>
<td>80</td>
<td>88</td>
</tr>
<tr>
<td>10. Science is boring.</td>
<td>Disagree</td>
<td>81</td>
<td>100</td>
</tr>
<tr>
<td>11. Science is my favorite subject.</td>
<td>Disagree</td>
<td>74</td>
<td>65</td>
</tr>
<tr>
<td>12. I will only use science in school.</td>
<td>Disagree</td>
<td>85</td>
<td>88</td>
</tr>
<tr>
<td>13. Science is cool.</td>
<td>Agree</td>
<td>84</td>
<td>100</td>
</tr>
<tr>
<td>14. I would prefer to take most any other subject than science.</td>
<td>Disagree</td>
<td>80</td>
<td>96</td>
</tr>
<tr>
<td>15. I find science difficult.</td>
<td>Agree</td>
<td>53</td>
<td>37</td>
</tr>
<tr>
<td>16. Science solves important problems.</td>
<td>Agree</td>
<td>89</td>
<td>100</td>
</tr>
<tr>
<td>17. I am curious about the natural world around me.</td>
<td>Agree</td>
<td>81</td>
<td>100</td>
</tr>
<tr>
<td>18. Science should not be required in school.</td>
<td>Disagree</td>
<td>89</td>
<td>96</td>
</tr>
<tr>
<td>19. Things I learn in science help me understand the world around me.</td>
<td>Agree</td>
<td>92</td>
<td>96</td>
</tr>
<tr>
<td>20. Science is more about what you know than how to do it.</td>
<td>Disagree</td>
<td>70</td>
<td>77</td>
</tr>
</tbody>
</table>

*Student Confidence Levels – Pre and Post Survey*

Questions 21 to 25 on the pre and post survey were Likert scale-type question where the responder had the choice of selecting from the following choices:
1. “I know I can do it.”
2. “I think I can do it.”
3. “I doubt I can do it.”
4. “I can't do it.”

The data reported below exhibits the total number of students who replied to the question (N value), mean, median, mode, and frequency of distribution reported as percent of population selecting choices 1 through 4. The Chi-square test and Kolmogorow-Smirnov test for normal distribution confirmed that there was a significant difference from the uniform or normal expected distribution at a level of 99% or more for each of the five questions.

Question 21 – How confident are you that you could read the procedures for an experiment and feel sure about conducting the experiment on your own?

Pre Survey

<table>
<thead>
<tr>
<th>N Value</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Choice 1 %</th>
<th>Choice 2 %</th>
<th>Choice 3 %</th>
<th>Choice 4 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>1.689</td>
<td>2</td>
<td>2</td>
<td>43</td>
<td>47</td>
<td>9</td>
<td>1</td>
</tr>
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</table>

Post Survey

<table>
<thead>
<tr>
<th>N Value</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Choice 1 %</th>
<th>Choice 2 %</th>
<th>Choice 3 %</th>
<th>Choice 4 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>1.667</td>
<td>2</td>
<td>2</td>
<td>44</td>
<td>48</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Question 22 – How confident are you that you could collect real scientific data, record the data properly, analyze the data, and then tell someone else what it means?

Pre Survey

<table>
<thead>
<tr>
<th>N Value</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Choice 1 %</th>
<th>Choice 2 %</th>
<th>Choice 3 %</th>
<th>Choice 4 %</th>
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<tr>
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<td>2</td>
<td>2</td>
<td>29</td>
<td>59</td>
<td>11</td>
<td>1</td>
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</table>
Post Survey

<table>
<thead>
<tr>
<th>N Value</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Choice 1 %</th>
<th>Choice 2 %</th>
<th>Choice 3 %</th>
<th>Choice 4 %</th>
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</thead>
<tbody>
<tr>
<td>27</td>
<td>1.556</td>
<td>1</td>
<td>1</td>
<td>52</td>
<td>41</td>
<td>7</td>
<td>0</td>
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</tbody>
</table>

Question 23 – How confident are you that you could tutor another student about collecting data?

Pre Survey

<table>
<thead>
<tr>
<th>N Value</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Choice 1 %</th>
<th>Choice 2 %</th>
<th>Choice 3 %</th>
<th>Choice 4 %</th>
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</thead>
<tbody>
<tr>
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<td>2.124</td>
<td>2</td>
<td>2</td>
<td>25</td>
<td>46</td>
<td>21</td>
<td>8</td>
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Post Survey

<table>
<thead>
<tr>
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<th>Mode</th>
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<th>Choice 2 %</th>
<th>Choice 3 %</th>
<th>Choice 4 %</th>
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<td>2</td>
<td>37</td>
<td>48</td>
<td>15</td>
<td>0</td>
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</table>

Question 24 – How confident are you that work with a group of peers – sharing responsibilities – and complete the assigned scientific task?

!Pre Survey

<table>
<thead>
<tr>
<th>N Value</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Choice 1 %</th>
<th>Choice 2 %</th>
<th>Choice 3 %</th>
<th>Choice 4 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>179</td>
<td>1.363</td>
<td>1</td>
<td>1</td>
<td>73</td>
<td>20</td>
<td>5</td>
<td>2</td>
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</tbody>
</table>

Post Survey

<table>
<thead>
<tr>
<th>N Value</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Choice 1 %</th>
<th>Choice 2 %</th>
<th>Choice 3 %</th>
<th>Choice 4 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>1.444</td>
<td>1</td>
<td>1</td>
<td>70</td>
<td>22</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

Question 25 – How confident are you that you could listen to instructions about using a piece of scientific equipment and then use the equipment as directed?

Pre Survey

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<table>
<thead>
<tr>
<th>Value</th>
<th>Mean</th>
<th>Median</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Fall 1</th>
<th>Fall 2</th>
<th>Fall 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>170</td>
<td>8.34</td>
<td>8.34</td>
<td>-</td>
<td>-</td>
<td>8.34</td>
<td>3.5</td>
<td>2.5</td>
<td>1.6</td>
</tr>
</tbody>
</table>

**Post Survey**

<table>
<thead>
<tr>
<th>Value</th>
<th>Mean</th>
<th>Median</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Fall 1</th>
<th>Fall 2</th>
<th>Fall 3</th>
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<td>21</td>
<td>12.44</td>
<td>11.6</td>
<td>-</td>
<td>-</td>
<td>12</td>
<td>3.8</td>
<td>2.5</td>
<td>1.6</td>
</tr>
</tbody>
</table>

**Comfort Level Post-Fall Survey**

The comfort level was measured on a 1 to 10 scale, with 1 being very uncomfortable and 10 being very comfortable. The survey results showed that 52% of the participants felt comfortable at the same level on the post-survey as on the pre-survey.

**Figure 1** Change in Comfort Level from Pre-Exposure to Post-Exposure

![Comfort Level Chart](image-url)

**Fear of Science Post-Survey**

The fear of science post-survey aimed to understand how the fear of science was perceived by the participants. A question in the survey asked: "Thinking about the past two weeks, how would you rate your experience?" The participants were asked to rate their experience on a scale of 1 to 10, with 1 being very comfortable and 10 being very uncomfortable. The option to select a rating below 1 was also available.

**Figure 2** Fear of Science Post-Survey Results

![Fear of Science Chart](image-url)
their EES experience in the students’ own words. Examples of these responses are listed below:

*Seneca Lake Expedition*

- “I think that it was more fun and this trip has a lot of interesting things to do. I **would rather do this because it is more hands-on.** I think science is now more fun.”
- “The expedition was a **great hands-on experience** for me. I used to **think that hands-on science was going to be hard but it was fairly easy.**”
- “This trip made me realize that science is not just about studying the world, but it’s about getting out in the world and **studying something that matters.**”
- “It was very fun. If I could – I would **do it again in a heart beat.**”
- This trip was very exciting and I learned a lot. I now see that **scientists solve problems everyday with their data.**
- “**Before** I went on this expedition, **I found science boring** and pointless. I had no interest in it. However, after the expedition, I learned that **science is helpful outside of the classroom, and it is now more interesting to me.**”

*Ithaca Fossil Expedition*

- “This trip has made me **more interested in science.** It was very interesting and very fun.”
- “I think the expedition was really fun! I really **would like to go on another trip** if possible. Also, the trip showed how **science is not just bookwork,** it can be really fun.”
- “This **trip increased my already positive view on science.** I like doing lots of science outdoors (hands-on). It helps me learn more. That’s why the fossil trip taught me a lot about science.”
- “The trip to the Ithaca Fossil Expedition was probably **the coolest field trip/expedition I’ve been on.** If science meant going out and digging up fossils every day, I wouldn’t mind it.”
“Going into the expedition I believed I was struggling with fossils a little bit. 

Coming out of the expedition I felt I learned quite a bit that I didn’t know before. 

I had a fantastic science overview and it was fun too.”

“The science expedition was interesting. It was cool to see actual evidence of fossils being in New York from years ago.”

Discussion

When discussing the results of this study, at this point in time, it is important to consider the limitations of the post survey. Since this is a study in progress, with only 27 post expedition respondents, the inferences drawn from comparing pre and post survey data will not be fully understood until the end of the 2012-2013 school year. There are still five expeditions scheduled for this school year and approximately 100 students who have committed to attending at least one trip. It should also be understood that the population fluctuates from expedition to expedition due to changing schedules of students and parents. Each EES experience has students who drop out and others who would like to join.

Although the relatively small amount of post survey data at this point limits the conclusions that can be drawn about the effectiveness of the EES program, there are some interesting results that can be highlighted looking at both the pre and post survey information. These aspects are discussed below:

1. Having 69% of the student population commit to an out of school, weekend-based, school experience is probably slightly more than expected. Although this is the first study to look so closely at the EES program and collect reliable data, it was the researcher’s opinion, based on historical observations and lab credit records that approximately 50% of the student population participated in the program. Historically, and as seen in Figure 1, a larger percentage of honors students (84%) attend EES trips than academic students (58%). This has been fairly common and worth future consideration in terms of what factors lead to such a significant discrepancy.
2. Brain-based research suggests novelty is a driving force for learning. The brain seeks out that which is new and novel. This association can be seen in the pre survey responses of students who confirmed their desire to attend an EES experience. The wording of the students identifies this connection with such phrases as “real world”, “fun”, “new”, and “outside”. These are often conditions not associated with school where most learning takes place at a desk within the four walls of a classroom. In this sense, I believe the EES program is successful at offering a venue that developing brains seek out.

3. As shown in Figures 3, 4, and 5, students' perceptions and attitudes regarding science change over time. The data seems to indicate that students move from an impression of science being fun in elementary, to interesting in middle school, to an expectation of interesting (but also stressful) in high school. It was interesting in the post survey that the anticipated stress level dropped from 30% to 12% following an EES experience (although there is no data, or analysis, to suggest this is a direct correlation to attending an EES trip).

4. A very telling result, regarding students' perceptions, can be seen in Figure 2. Here students rated real-life, outdoors, and field trip as the least most teacher utilized aspect of their science education. The EES program fills this gap for those students interested in this type of educational learning approach.

5. The Thurstone method, utilized on both the pre and post survey, brought to light several different views concerning student perceptions and attitudes. First, is was interesting to see that 74% of the pre survey students did not identify science as their favorite course but 84% acknowledged that science was “cool”. Clearly there is an “affection” for science. This association, as science is “cool” but not interested in it as an area of study or career, was also identified by Kitts (2010). Kitts identifies the paradox that while students find science interesting and feel their parents would be proud of them if they were to enter the field, students still feel that they do not want to pursue this career path. Second, an area for further study would be to determine
why 87% of academic students find science most interesting when done outside compared to only 72% for honors students. The general assumption of the researcher would be that all students would equally find science more interesting when done outside. Or, that the honors students would find more interest than academic level students. Here too is an opportunity for future research.

6. Perhaps the most telling aspect of the Thurstone method was that although the pre survey favorableness scale was 5.25 and 5.70 for academic level students and honors students, respectively, the post survey favorableness (5.70 for both groups) was significantly stronger in both statements that were agreed and disagreed upon. What this implies is that students who attended an EES experience were still just as favorable to science but at a much higher frequency (e.g. 84% agreeing on a statement for the pre survey – but 100% agreeing on the same statement on the post survey). Even with such limited post survey data, there seems to be a strong relationship between attending an EES experience and students’ positive view of science.

7. According to the limited post survey data, the EES program seems to have a positive impact on confidence levels with regard to question 22 that asked about the students’ confidence level with collecting, recording, analyzing, and reporting scientific information. The pre survey identified 29% of the respondents at the confidence level of “I know I can do it”, however; the post survey resulted in 52% of respondents selecting “I know I can do it”. Also, the median and mode for question 22 changed on the pre survey from response 2 “I think I can do it” to response 1 on the post survey “I know I can do it”. There was also a slight increase in confidence level for question 23 (tutoring another student about collecting data) from 25% “I know I can do it” to 37%. Questions 21, 24 and 25 resulted in little or no change from pre survey to post survey. This seems to signify that the EES program does have a positive impact on the students’ perception of their own confidence level related to these two questions. The full understanding of this will not be known for
certain until the end of the 2012-2013 school year once all participating students have taken the post survey.

8. The most reveling impact that EES has on students’ perceptions and attitudes can be witnessed through the post survey question of “...how would you describe your experience in terms of how this trip impacted your view or attitude about science?”. Using direct comments from students sheds light on their thinking regarding the EES program. Of the 27 students that participated on an EES experience, there were no negative comments or even neutral comments. Phrases such as “... would like to go on another trip...”, “more interested in science”, “do it again in a heart beat”, and “...trip increased my already positive view on science” really speaks to the power of the program to change perceptions and attitudes. This relationship between perceptions and attitudes and the EES program gains even more strength in terms of science education when students also rated these experiences as highly scientific (9.3 Seneca Lake and 8.8 Ithaca fossils out of 10). So, it appears the EES program does not just supply a fun event for the students to attend, but a meaningful learning experience that has the power to positively affect students’ perceptions and attitudes regarding science education.

Conclusion
At this time, with only two out of seven expeditions completed, and based on extensive pre survey data (but limited post survey data) there appears to be an increase in students’ perceptions and attitudes regarding science brought about by participation in the EES program. Additional data collected over the coming school year will better define this relationship between students’ perceptions and attitudes and the EES program.

A caveat to the above assumption is that post survey data may lean toward exhibiting increased perceptions and attitudes toward science based on the students who self-selected for these extra curricular experiences. In essence, a chicken and egg scenario. Is there a perceived increase in science perceptions and attitudes because of the EES program...or...is the program benefiting from students with an already positive view of

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science education? As stated previously, more time and data will be necessary to
distinguish the difference.

Following the 2012-2013 school year, the results of this study can be put into action to
better inform future decisions about the direction of the EES program. It is expected that
information from this study could be utilized to understand why students choose to attend
or not attend an expedition and how the program can reach out to more students.
Generally speaking, students do not self-select for the program due to prior commitments
and lack of interest. Although reaching those students who have an active schedule may be
difficult, it would be encouraging to find methods by which the program could involve
more disengaged students.

Another future action may be to develop expedition opportunities that better meet
students’ interest. For instance, this year a new expedition was developed that will include
a trip to Cornell University to assist scientists with collecting data on distant galaxies and
nebulas. In the past the EES program did not offer an astronomy expedition. However, this
new experience has shown great interest and students had to be turned away from this trip
once the maximum student limit was reached.

Yet another action may be to develop varied survey instruments that better probe our
students’ academic interests, perceptions, attitudes, and career goals so that the program
can be more aligned with these characteristics.

**Acknowledgements**
I would like to take this opportunity to thank those people who assisted me in the
completion of this project. My academic advisement students were a great asset in helping
me crunch data and giving me the peace and quite to “get the job done”. My colleagues at
the Annex were most helpful in acting as statement judges when developing the Thurstone
method statements. Their emails with statement suggestions were both time saving and
added moments of comedy. My wife and family have been extremely crucial in giving me
the space and time to put my all into the research project – you now have me back as your

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husband and dad! And, I certainly cannot forget the inspiration given to me by my fellow African travelers. Each one special in his or her own way guiding the “rookie” through this amazing process. Thanks also go to Dan and Melinda who provided an enriched learning experience that was both rigorous and relevant. Finally, to the continent of Africa – which provided an awe-inspiring landscape that filled my soul and brought so many memorable experiences.

Sources


Reid, N., 2011, Attitude Research in Science Education – Chapter 1, Attitude Research in Science Education: Classic and Contemporary Measurements, Information Age Publishing Inc. 3-44.

Appendix A

EXPEDITION
EARTH SCIENCE
LIVERPOOL HIGH SCHOOL

FALL OR SPRING EARTH SCIENCE FIELD CAMP

OVERVIEW

Camp Talooli is a children’s camp and conference center, owned and operated by the Children’s Council of Central New York, a Camp Fire Council Inc, 10 miles North of Liverpool High School. Utilizing the camp’s 170 acres of forest and private lakes, a series of authentic scientific questions will be posed to a group of 24-30 students. Covering a range of topics including ecology, cultural resources and geology, each of the questions will require students to form teams and to utilize concepts and skills that are part of the Regents Earth Science syllabus.

Students will select research topics and form teams 2 weeks prior to the field camp weekend. Through library research and team meetings each research team of 2-6 students will determine what background understandings, skills and equipment will be needed to plan and carry out experiments and data gathering during the field camp weekend.

The students will arrive at camp and receive an orientation on Friday night. With teacher and parent volunteers as supervisors, everyone will sleep in cabins at the camp Friday and Saturday night. We will have the use of the dining lodge for work/meetings of the entire group. All day Saturday will be used for data gathering and analysis. Teams will then use G3 laptop computers to create summary presentations Saturday evening and present their reports to the entire group on Sunday morning. Finally, students will be required to submit individual written reports and give a brief presentation to their classmates following the field camp weekend.

Mr. Calderwood and Mr. Peneston will organize and coordinate enough parent volunteers to provide at least one adult to support each team throughout the weekend.

SCHEDULE

Friday
Tasks to be completed

The topics, questions, experiment methods and products should reflect authentic objectives and practices used by professional scientists and land use planners. Students will select from the list of topics below and form teams.

**Team #1   Mapping the Hidden Lake Wilderness Area   3-5 students**

✔ How big, deep and unique is this lake and its ecosystem?
✔ In what ways should it be developed or preserved as a place for environmental education?
✔ Inventory the plant, fish and other animal species with special concern for rare or protected species.
✔ Create a site map including lake depth contours and surrounding terrestrial habitats.

**Team #2   Historic Cultural Resources Sampling   3-5 students**

✔ What archeological evidence can be found to describe the history of the site as a farm from the early 1800’s until the 1930”s?
✔ Collect, map and analyze the contents of the old farm dump, abandoned in the 1930’s.
✔ What do the artifacts suggest about the lives of the people who farmed here?
✔ Should areas of the camp be preserved for the their cultural resources?
✔ How might the camp utilize these resources for educational purposes?
Team #3  Prehistoric Cultural Resources Sampling  3-5 students

✓ Is there any archeological evidence that native Americans used, visited or lived at the site of the camp?
✓ Using sample test pits and screens search for identifiable prehistoric artifacts.
✓ Identify and label any artifacts.
✓ Are their areas of the camp that should be preserved or excavated to protect or develop these cultural resources?
✓ How might the camp utilize these resources for educational purposes?

Team #4  Glacial Geology of Camp Talooli  3-4 students

✓ Test the hypothesis that Lake Temalo is a glacial “kettle lake”?
✓ Sample, describe and identify the sediments beneath the lake as well as the surrounding soils.
✓ Do layers, glacial erratics and tilting occur in the sediments of the surrounding hills?

Team #5  Lake Temalo Analysis  3-5 students

✓ Inventory the fish animals and water plants found in the lake.
✓ At selected depths measure and describe the water chemistry including pH and dissolved oxygen. Also measure water temperature, clarity, etc.
✓ Is there evidence of a thermocline in the lake?
✓ Should the camp have any special concerns about the use and management of the lake for fishing, boating and swimming?

Team #6  Historic Land Use and Vegetative Mapping  4-6 students

✓ What parts of the camp contain the oldest and tallest trees? Can we measure or estimate how old and tall?
✓ What parts of the forest have regrown after having been cleared by the farmers in the last century?
✓ Is there any evidence that the Iroquois cleared parts of the property hundreds of years ago?
✓ Map the types and approximate age of the sections of the forest and field that now cover the camp.
✓ Identify and map any cultural clues such as fences and building foundations that describe historic land uses.

COST

Students will provide their own transportation, a sleeping bag and a camp use fee of $30. This fee covers the cost of 2 breakfasts, 1 lunch, and 1 dinner and provides that the camp will be reserved solely for the use of these LHS students. The camp will also provide the use of canoes, rowboats and life jackets as needed.
Appendix B

Pre-Survey

“What do you think?” Survey

This survey has questions about you and about your view of science. There are no correct or incorrect answers, only answers that are right for you. Please think carefully and be honest about your responses.

Academic Science

1. Are you enrolled in an Academic science or honors science?

2. Did you sign up for an Expedition Earth Science (EES) experience?
   - Yes. Go to question 3
   - No. Go to question 4

3. I did sign up for an expedition because I felt that

   __________________________
   __________________________
   __________________________

   OR

4. I did not sign up for an expedition because I felt that

   __________________________
   __________________________
   __________________________
For questions 5 through 7, circle the one word that best fits your feeling about the following statement.

5. Science in elementary school was...  

(ONE WORD ONLY)

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<td>Cool</td>
</tr>
<tr>
<td>Stressful</td>
<td></td>
<td></td>
</tr>
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</table>

6. Science in middle school was...

(ONE WORD ONLY)

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<th>CURIOUS</th>
</tr>
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<tbody>
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<td>Exciting</td>
<td>Cool</td>
</tr>
<tr>
<td>Stressful</td>
<td></td>
<td></td>
</tr>
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</table>

7. I expect science in high school to be...

(ONE WORD ONLY)

<table>
<thead>
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<th>CURIOUS</th>
</tr>
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<tbody>
<tr>
<td>Interesting</td>
<td>Exciting</td>
<td>Cool</td>
</tr>
<tr>
<td>Stressful</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For question 8, place the following words in order from *most* to *least* based on the following statement.

8. So far in my school career, most of my science learning has been from....

<table>
<thead>
<tr>
<th>Textbook</th>
<th>Notes</th>
<th>Labs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Trip</td>
<td>Real-life</td>
<td>Homework</td>
</tr>
<tr>
<td>Collecting Data</td>
<td>Hands on</td>
<td>Outdoors</td>
</tr>
</tbody>
</table>

1. _____________ Most
2. ______________
3. ______________
4. ______________
5. ______________
6. ______________
7. ______________
8. ______________
9. ______________ Least
For questions 9 to 20, either agree or disagree with the statement.

<table>
<thead>
<tr>
<th>Agree</th>
<th>Disagree</th>
</tr>
</thead>
</table>

9. Science is most interesting when done outside.
10. Science is boring.
11. Science is my favorite subject
12. I will only use science in school.
13. Science is cool.
14. I would prefer to take most any other subject than science.
15. I find science difficult.
17. I am curious about the natural world around me.
18. Science should not be required in school.
19. Things I learn in science help me understand the world around me.
20. Science is more about what you know than how to do it.
For questions 21 to 25, circle the number that best fits your comfort level for that topic. Use the statements below to make your decision.

1 = “I know I can do it.”  2 = “I think I can do it.”  3 = “I doubt I can do it.”  4 = “I can’t do it.”

21. How confident are you that you could read the procedures for an experiment and feel sure about conducting the experiment on your own?

1 2 3 4

22. How confident are you that you could collect real scientific data, record the data properly, analyze the data, and then tell someone else what it means?

1 2 3 4

23. How confident are you that you could tutor another student about collecting data?

1 2 3 4

24. How confident are you that you can work with a group of peers - sharing responsibilities - and complete the assigned scientific task?

1 2 3 4

25. How confident are you that you could listen to instructions about using a piece of scientific equipment and then use the equipment as directed?

1 2 3 4

26. In the space of 1 to 3 sentences, describe your single best science experience and why you enjoyed it so much.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Appendix I
Post Survey

"Expedition Earth Science Survey"

This survey has questions about you, and about your view of science following your Expedition Earth Science (EES) experience. There are no correct or incorrect answers, only answers that are right for you. Please think carefully and reflect on your EES experience. Then, respond in a thoughtful manner to the questions and statements below.

1. On which Expedition did you participate?
   - Seneca Lake Expedition → go to questions 2, 3, and 4
   - Ithaca Fossil Expedition → go to questions 4, 5, and 6

Questions 2, 3, and 4 are for the Seneca Lake Expedition.

2. Prior to the Seneca Lake Expedition, my level of comfort about the Expedition was

<table>
<thead>
<tr>
<th>Very Comfortable</th>
<th>Comfortable</th>
<th>Uncertain</th>
<th>Very Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

3. Following the Seneca Lake Expedition, my level of comfort about the Expedition was

<table>
<thead>
<tr>
<th>Very Comfortable</th>
<th>Comfortable</th>
<th>Uncertain</th>
<th>Very Uncertain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
4. On a scale of 1 to 10, rate how scientific the Seneca Lake Expedition was?

Not Scientific  →  Very Scientific
1  2  3  4  5  6  7  8  9  10

Questions 5, 6, and 7 are for the Ithaca Fossil Expedition.

5. Prior to the Ithaca Fossil Expedition, my level of comfort about the Expedition was:

Very Comfortable  →  Very Uncomfortable
1  2  3  4

6. Following the Ithaca Fossil Expedition, my level of comfort about the Expedition was:

Very Comfortable  →  Very Uncomfortable
1  2  3  4

7. On a scale of 1 to 10, rate how scientific the Fossil Expedition was?

Not Scientific  →  Very Scientific
1  2  3  4  5  6  7  8  9  10
For question 8, circle the **one** word that best fits your feeling about the following statement.

8. I expect science in high school to be...

<table>
<thead>
<tr>
<th>Fun</th>
<th>Boring</th>
<th>Curious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interesting</td>
<td>Exciting</td>
<td>Cool</td>
</tr>
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18. Science should not be required in school.

19. Things I learn in science help me understand the world around me.

20. Science is more about what you know than how to do it.
For questions 21 to 25, circle the number that best fits your comfort level for that topic. Use the statements below to make your decision.

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   1   2   3   4

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   1   2   3   4

23. How confident are you that you could tutor another student about collecting data?

   1   2   3   4

24. How confident are you that you can work with a group of peers - sharing responsibilities - and complete the assigned scientific task?

   1   2   3   4

25. How confident are you that you could listen to instructions about using a piece of scientific equipment and then use the equipment as directed?

   1   2   3   4

For questions 26, reflect on your Expedition Earth Science experience and use a few sentences to describe how you feel about the experience.

26. Now that you have participated on an Expedition Earth Science trip, how would you describe your experience in terms of how this trip impacted your view or attitude about science.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________