EVALUATING THE IMPACT OF AN INFORMAL ELEMENTARY SCHOOL FIELD SCIENCE EDUCATION PROGRAM

by

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In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under rules of the program.

Ann Elizabeth Leach

July 2012

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ABSTRACT

Outdoor environmental education programs are gaining popularity as a powerful complement to classroom science curricula. This study sought to develop an evaluation protocol to meet the needs of both a non-profit environmental education program and its elementary school partner teachers, and to evaluate the program's effect on third grade students' knowledge of and attitudes towards science. The data showed that students' knowledge of science topics (especially geology, ornithology, and invertebrate biology) increased after completion of the program. Students' attitudes towards science were more positive post-program, especially students' perception of the difficulty of science.

INTRODUCTION AND BACKGROUND

Project Background

Teaching Environment

The Wenatchee River Institute at Barn Beach Reserve is a non-profit organization in Leavenworth, Washington that seeks to integrate the environment, arts, and cultural heritage of the upper Wenatchee River Valley through events and education. Barn Beach Reserve is a nine-acre property, which combined with an adjacent city park creates a protected greenbelt of more than fifty acres of diverse habitats, ranging from upland ponderosa pine forest to mature riparian forest. I began my work as the Education Specialist in April 2010 and will transition into the position of Education Coordinator in July 2012. Our primary program is the Environmental Science Field Day Education Program for third, fourth, and fifth grade students at Osborn Elementary School in Leavenworth, Washington, and third and fourth grade students at Vale Elementary School in Cashmere, Washington.

School Demographics

In May 2011, Osborn Elementary School had an enrollment of 274 students in 3rd, 4th, and 5th grade. Vale Elementary School has an enrollment of 554 students in kindergarten through 4th grade. More than half of the student population at each school receives free or reduced lunch. Sixty-five percent of students at Osborn are Caucasian and 31% are Hispanic (students of all other ethnicities make up less than 5% of the total student population). At Vale, 55% of students are Caucasian and 42% of students are Hispanic, with students of all other ethnicities making up less than 3% of the total student

population. Our fruit-growing valley benefits from a substantial population of migrant workers, and 0.4% of Osborn students and 11% of Vale students are from migrant families. In addition, 19% of Osborn students and 27% of Vale students are described as "transitional bilingual" (State of Washington Office of Superintendent of Public Instruction, 2012).

Environmental Science Field Day Education Program

The Field Day Program, which just finished its fifth year, was developed by Wenatchee River Institute staff with the help and guidance of teachers and administrators at Osborn Elementary School to align with their classroom science curriculum and Washington's science standards. In several visits to Barn Beach Reserve, students participate in field and lab activities related to their classroom studies of animals, plants, water, geology, the seasons, ecosystems, climatology, and geography. Students are exposed to technology and equipment unavailable in their school classroom, such as binoculars, microscopes and stereoscopes, digital cameras, kick nets, and snowshoes. An individual student visits Barn Beach Reserve 6 to 15 times in elementary school, depending on the school and individual attendance.

Third grade students from Osborn and Vale participate in the Field Day Program in the spring, before and after the Leavenworth Spring Bird Fest in May. They study birds, arthropod biology, plants, geology, composting with redworms, cells, and microorganisms.

Fourth grade students from Osborn and Vale participate in the Field Day Program in the fall following class trips to the Wenatchee River Salmon Festival at the

Leavenworth Fish Hatchery in September. Students study riparian plants, aquatic macroinvertebrates, water quality, mapping, fish and stream biology, and classification.

Fifth grade students from Osborn participate in the Field Day Program in the winter and spring. In four visits to Barn Beach Reserve in the winter, students learned to snowshoe and study winter ecology, characteristics of snow, evergreen trees, lichen, navigation, weather and climate, the seasons, and energy and matter, through labs that correlate with their science and geography lessons at school. Finally, they study flowering shrubs and wildflowers in a fifth spring trip.

Teachers, students, parents, and school administration have expressed their support of the program through positive feedback and small monetary donations, but as of now there has been no formal evaluation of the program's effectiveness. This study was implemented to attain data regarding the Field Day Program's impact on students and teachers, and to establish a protocol for ongoing evaluation of our programs.

Focus Question

The primary focus question addressed in this study was: *How does the Wenatchee River Institute Field Day Program affect student learning and attitudes towards science?* In addition, I was interested in finding out how individual activities were received by both students and teachers and exploring how certain qualities of the activities (e.g. location, topic, or group size) affected student learning and attitudes. The findings of this study will be used not only to investigate the effectiveness of the Field Day Program, but also to improve the Field Day Program and inform the development of future programs, activities, and materials.

CONCEPTUAL FRAMEWORK

Many teachers use educational field trips as a way to enrich the formal classroom experience and supplement school science curricula. Studies from around the world over the past forty years have highlighted ways in which field trips to museums, zoos, science centers, and other informal learning institutions positively affect student learning and engagement (Bamberger & Tal, 2008; Davidson, Passmore, & Anderson, 2010; Luehmann, 2009). Participation in field trips has been demonstrated to improve learning and recall (Stavrova & Urhahne, 2010), increase student interest in science (Jarvis & Pell, 2005; Zoldosova & Prokop, 2006), foster positive attitudes towards science and learning (Jarvis & Pell; Stavrova & Urhahne), and, in the case of environmental educational field trips, promote pro-environmental feelings (Farmer, Knapp, & Benton, 2007). Students often recall field trip experiences and the educational content learned long after the field trip occurred (Pace & Tesi, 2004). This can be attributed to the social nature of field trips, as well as the novel, authentic, and often autonomous activities that informal learning institutions offer students.

Out-of-school field trips are exciting to students for the simple reason that they represent a break in routine. There exists some concern over the negative *novelty effect* that field trips can have on learning (Anderson & Lucas, 1997). However, several researchers have shown that the novelty of field trips can actually positively affect learning (Anderson & Lucas, 1997; Hurd, 1997; Sturm & Bogner, 2010), especially in cases where teachers orient students ahead of time to the physical features and content they will encounter on the field trip (Anderson & Lucas, 1997). DeWitt and Hohenstein

(2010) demonstrated that teacher-student talk was more balanced on field trips than in classrooms, allowing students the opportunity to control the direction of their learning.

Teacher preparation and strategies for field trips, such as pre-visit orientation, active involvement during the field trip, and implementation of post-visit activities, can powerfully affect student attitudes and learning (Davidson et al., 2010; Jarvis & Pell, 2005). In one study, researchers discovered a distinct relationship between a teacher's agenda for a zoo field trip on the students' attitudes and subsequent learning (Davidson et al., 2010). The teacher's attitude towards the field trip, either as a learning experience or a fun diversion, was directly reflected in the students' perceptions of the experience.

Post-visit activities that tie the field trip to classroom studies also increase learning. Anderson, Lucas, Ginns, and Dierking (2000) determined that post-visit classroom activities reinforce learning and correct misconceptions. Other research has shown that *isolated* field trips may be fun and enriching activities, but rarely support student learning (Cox-Petersen, Marsh, Kisiel, & Melber, 2003). This is in keeping with the human constructivist theory of learning that describes the construction of knowledge as dynamic in nature, and emphasizes the role of follow-up experiences in the classroom in reinforcing and restructuring knowledge acquired during the field trip experience (Anderson, Lucas, & Ginns, 2003).

Unfortunately, research suggests that many teachers do not have defined strategies for connecting field trips to their classrooms (Kisiel, 2006). Often teachers view field trips as enrichment opportunities, not as an integral part of their curriculum (Tal, Bamberger, & Morag, 2005). However, teachers are increasingly constrained by time, money, transportation issues, content standards, and organizational logistics.

The idea of collaborations between schools and informal learning institutions to create integrated learning opportunities has been much discussed in recent years (DeWitt & Osborne, 2007; Kisiel, 2010; Luehmann, 2009; Stocklmayer, Rennie, & Gilbert, 2010). Researchers have sought to establish a theoretical framework based on the human constructivist theory for such relationships (Anderson et al., 2003), and define ways in which collaboration can be mutually beneficial (Kisiel, 2010). Research suggests that collaborations with informal science institutions can have a positive influence on teachers by increasing the time they devote to teaching science and boosting their confidence towards the subject (Kisiel, 2010). The development of informal programs that integrate formal national and state science standards is one recommendation that is gaining popularity (Cox-Petersen et al., 2003).

METHODOLOGY

This study sought to determine how Field Day Program activities affected student learning and attitudes. Special consideration was taken in developing an evaluation protocol that did not demand much extra time and effort on the part of the partner teachers and could be realistically implemented on a seasonal basis by Wenatchee River Institute staff. The conclusions drawn from this study, in addition to the research that inspired it, will inform further exploration into the various effects of the Field Day Program on student learning and attitudes.

Due to logistics related to the MSSE capstone schedule, as well as the re-development of the fifth grade and third grade programs during the 2011-2012 school year, data were collected only for the Osborn third grade program. All of the programs

will be evaluated in a similar manner in the 2012-2013 school year. Data collection methods are described below and are organized using a triangulation matrix (Table 1). The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

Table 1
Triangulation Matrix and Timeline of Methods

	Pre-Field Day Program	Field Day Program	Post-Field Day Program
Q1: How does the Field Day Program affect student learning and attitudes towards science?	Pre-Field Day Student Questionnaire (Appendix A)	Volunteer Reflection (Appendix B) Field Day Observations	Post-Field Day Student Questionnaire (Appendix A)
Q2: What qualities describe a successful and/or enjoyable activity?	Pre-Field Day Student Questionnaire (Appendix A) Matrix of Qualities of Field Day Activities (Appendix D)	Volunteer Reflection (Appendix B) Field Day Observations	Post-Field Day Student Questionnaire (Appendix A) Post-Field Day Teacher Survey (Appendix C)

Treatment

In the spring of 2012, third grade students from Osborn Elementary School participated in the Field Day Program between April 25th and May 24th. In five visits to Barn Beach Reserve, they studied and identified birds using binoculars and field guides, collected and observed arthropods, planted seeds and flowers and identified spring-flowering trees and shrubs, learned about local geology and created a rock collection,

composted with redworms, and examined and sketched cells and microorganisms with microscopes and stereoscopes (Table 2).

Table 2
Field Day Activities

	Activity	Topic
Field Day 1	Intro to field marks and field guides, beaks and feet	Birds
	Bird skins worksheet	Birds
	Planting seeds and flowers	Plants
	Redworms lab	Redworms
Field Day 2	Citizen Science Birding - Celebrate Urban Birds	Birds
	Intro to binoculars	Birds
	Microscope lab	Cells, Microorganisms, Arthropods
Field Day 3	Analog birds - back-to-back drawing	Birds
	Arthropod hunt	Arthropods
	Arthropod presentation (Dr. Mark Oswood)	Arthropods
Field Day 4	Live birds of prey (Sarvey Wildlife Center)	Birds
	Bird songs and calls	Birds
	Dancing with Birds (migration)	Birds
Field Day 5	Rocks and minerals (BLM's Brent Cunderla)	Geology
	Bird walk with binoculars	Birds
	Flowering shrub scavenger hunt with digital cameras	Plants
	Migration data of the Swainson's Thrush	Birds

Data Collection Strategies

Student learning and attitudes were measured using Student Questionnaires, Volunteer Reflections, and Researcher Field Notes. Paper copies of the Pre-Field Day Student Questionnaire (or “pre-test”) were distributed to each participating classroom one week before the first Field Day (Appendix A). Teachers were asked to return the pre-tests on their first visit. The Post-Field Day Student Questionnaire (or “post-test”), identical to the Pre-Field Day Student Questionnaire, was distributed to each teacher on the final

Field Day. Teachers were asked to implement the post-test no more than two weeks after the final Field Day.

Data used for determining the qualities that made individual Field Day activities more successful or popular than others were collected primarily through the online Post-Field Day Teacher Survey (Appendix C). A link to the online survey was distributed to all teachers by email a week after the last Field Day. They were asked to complete it within three weeks of the final Field Day.

Volunteer Reflections were conducted during and immediately following each Field Day. While a formal data sheet was initially supplied (Appendix B), the volunteer reflections evolved into informal interviews that provided valuable feedback about perceived student learning and attitudes during Field Day activities, and qualities of successful activities. While not technically a volunteer, the Education Coordinator (my supervisor) also contributed observations.

I analyzed each of the third grade Field Day activities for seven parameters: location, duration, format, equipment and materials used by students, props used by leaders, physical activity, and take-home materials generated. These qualities are described in the Matrix of Qualities of Field Day Activities (Appendix D).

I also recorded personal Field Day Observations following each Field Day. Points of focus were observed student attitudes and behavior, “A-HA” moments and topics that were confusing to students, and the flow and logistics of the Field Days (e.g. group size, adult-to-student ratio, and weather conditions).

DATA AND ANALYSIS

Student Learning

Seventy-eight 3rd grade students completed the Pre-Field Day Student Questionnaire, while 73 students completed the Post-Field Day Student Questionnaire. Pre-test comprehension scores were analyzed to determine baseline knowledge and misconceptions, and attitude data were analyzed to determine baseline attitudes towards science. Post-test comprehension and attitude data were analyzed and compared to baseline data. Scores were tallied and converted to percentages for comparison. Thirty-four volunteers (and the Education Coordinator) participated in the 5 weeks of the Field Day Program; 21 of these volunteers shared their reflections.

The comparison of post-test scores to pre-test scores revealed that students gained knowledge of science topics addressed during the Field Days. Overall, students' comprehension scores improved after completing the Field Day Program. Out of 23 possible points, the median score on the pre-test was 12; on the post-test it was 18. Only one student answered all 23 questions correctly on the pre-test (N=78), while six students scored 23 on the post-test (N=73). More strikingly, only two students (3%) scored 20 or more points on the pre-test, compared to 23 students (33%) on the post-test (Figure 1).

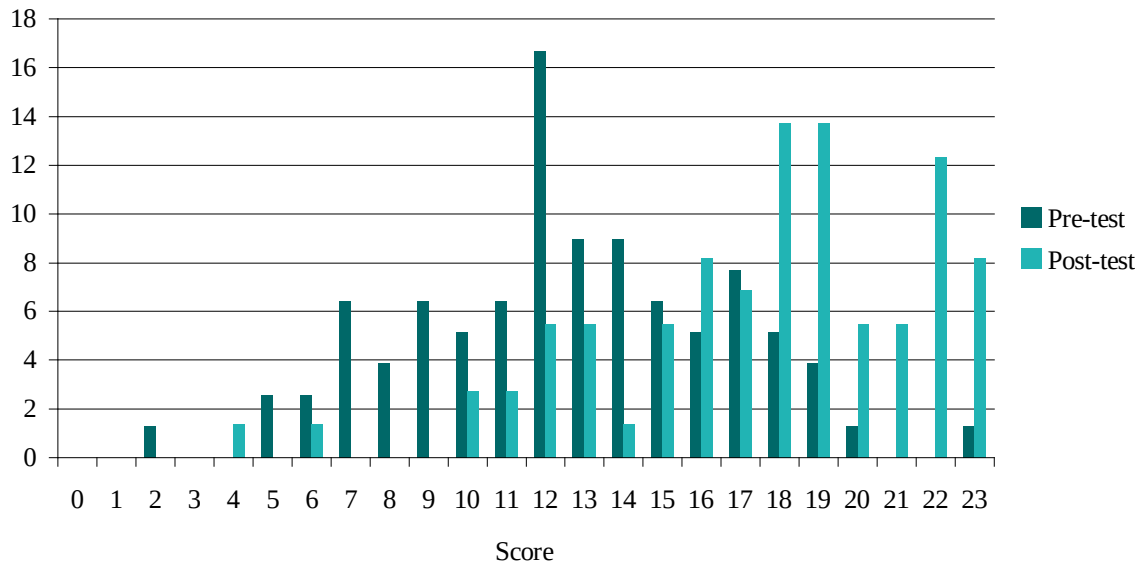

Figure 1. Histogram of the distribution of scores on the pre-test (*N*=78) and post-test (*N*=73).

Pre-Field Day Program Knowledge

Students came to the first Field Day with knowledge of the some of the topics addressed during the program (Figure 2). Analysis of the pre-tests revealed that the topic students were most familiar with before the Field Day program was plants; 82% of students (*n*=64) could list the three basic needs of plants. Additionally, 78% of students (*n*=61) understood that bird beaks are adapted to the food they eat. Students were less knowledgeable about migration, bird feet, using an index, bird vocalizations, field marks, and vermicomposting. The data demonstrated that students knew the least about geology and arthropods; five percent of students (*n*=4) circled all three types of rocks, and 7% of students (*n*=6) could name the five classes of arthropods before their Field Day visits.

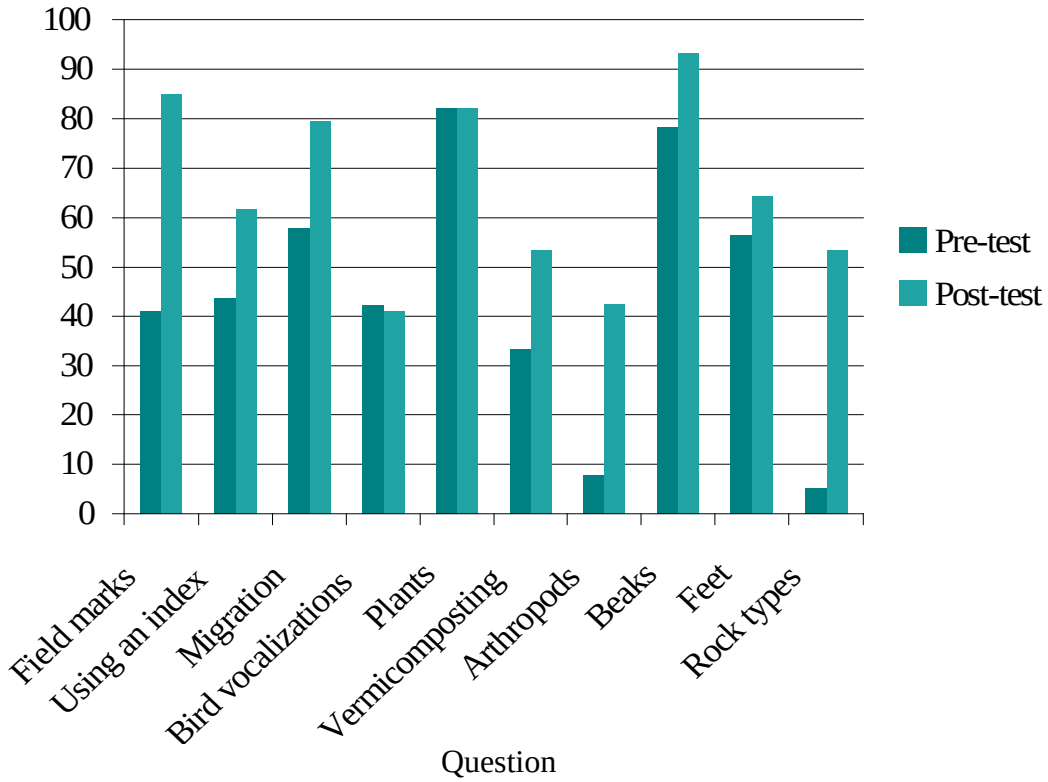

Figure 2. Comparison of correct answers to questions on the pre-test (*N*=78) and post-test (*N*=73).

Post-Field Day Program Knowledge

Students came away from the Field Day Program with improved knowledge on most topics (Figure 2). When the 10 questions were ranked by the percentage of students that answered them correctly before and after the Field Days, the order stayed roughly the same (Table 3). However, the topic of field marks rose from seventh place before the Field Days to second place after. On the final Field Day, volunteers leading the bird walk noted that students were very skilled at describing field marks on the birds they observed. Noticeably, the topic of bird vocalizations fell from 6th to 10th place.

Table 3
Ranking of Questions by Percentage of Students Who Answered Correctly on the Pre-Test (N=78) and Post-Test (N=73)

	Pre-test (percentage of students who answered correctly)	Post-test (percentage of students who answered correctly
High	5. Plants (82%)	8. Beaks (93%)
	8. Beaks (78%)	1. Field marks (85%)
	3. Migration (58%)	5. Plants (82%)
	9. Feet (56%)	3. Migration (79%)
	2. Using an index (44%)	9. Feet (66%)
	4. Bird vocalizations (42%)	2. Using an index (62%)
	1. Field marks (41%)	6. Vermicomposting (53%) 10. Rock types (53%)
	6. Vermicomposting (33%)	
	7. Arthropods (8%)	7. Arthropods (42%)
Low	10. Rock types (5%)	4. Bird vocalizations (41%)

Comparing data from the post-tests to the baseline data revealed that, on most topics, student comprehension improved after the Field Day Program, on average by 21 percentage points (Figure 3). The most noticeable improvements were answers to the questions about rock types (an increase of 48 percentage points), field marks (an increase of 44 percentage points), and arthropods (an increase of 35 percentage points).

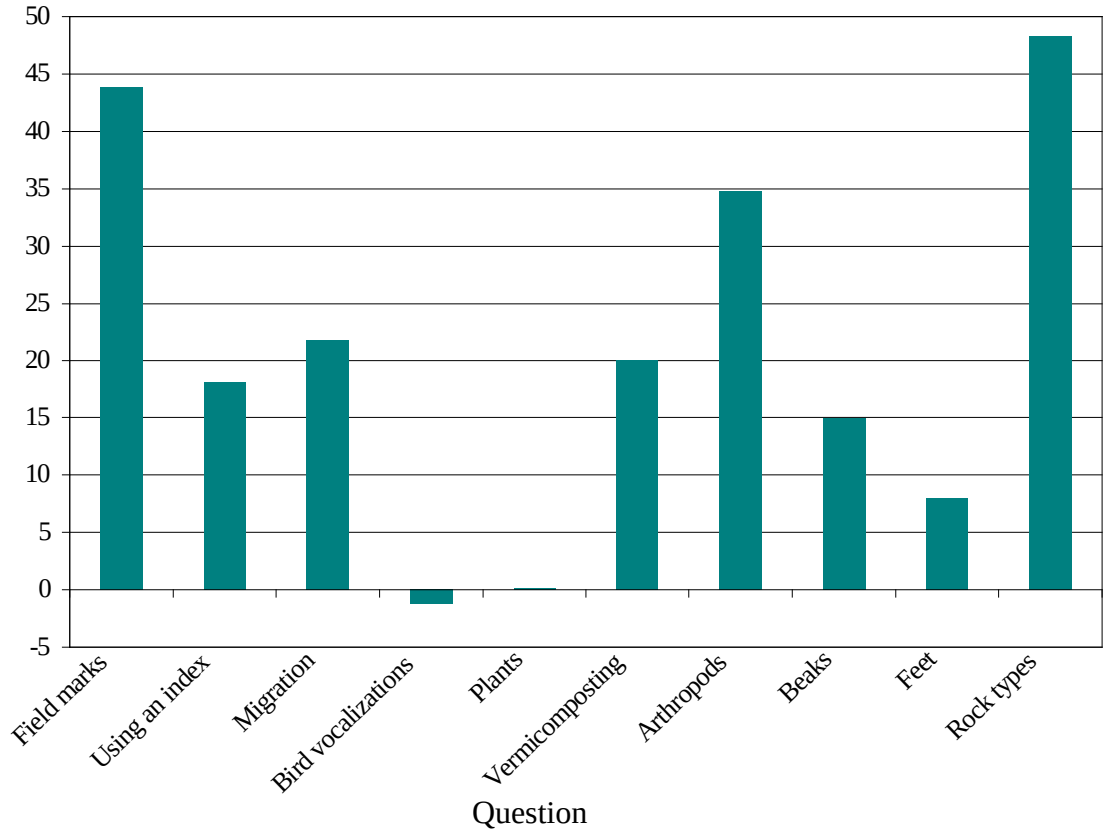

Figure 3. Change in the percentage of correct answers between the pre-test (*N*=78) and post-test (*N*=73).

The data also showed a lack of learning of some topics (Figure 3). Forty-one percent of students (*n*=30) answered the question about bird vocalizations correctly after completing the Field Day Program, compared to 42% of students (*n*=33) before the program began. Additionally, there was no improvement on the question about plant survival needs, which was answered correctly by 82% of students on both the pre-test (*n*=64) and post-test (*n*=60). On the question about adaptations of bird feet, slightly more students scored all three points on the post-test than on the pre-test. However, approximately one third of students only matched one foot to its correct function on both tests, and all of these students confused the perching and the climbing foot.

Misconceptions

Analysis of the pre-test data revealed misconceptions about some of the topics addressed by Field Day activities. On the question about migration, 27% percent of students who completed the pre-test (*n*=21) answered incorrectly that birds fly north for the winter, compared to only 11% on the post-test (*n*=8), although this was still the most common incorrect answer on the post-test (Figure 4).

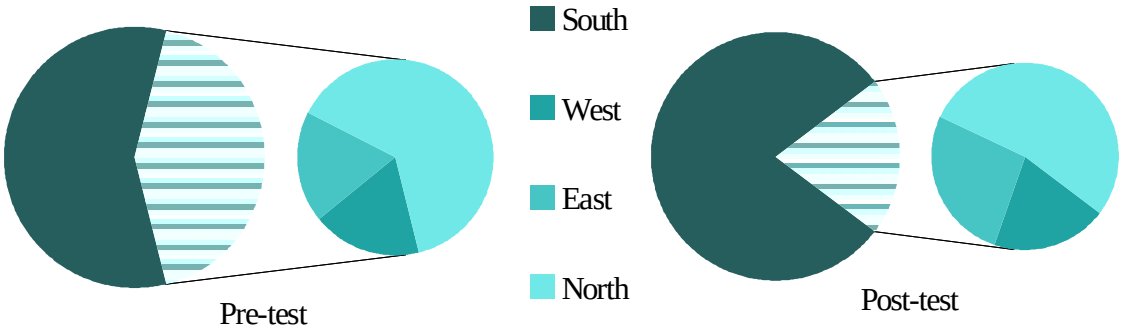

Figure 4. Pre-test (*N*=78) and post-test (*N*=73) answers to the question, "*What direction do our local birds migrate in the winter?"*

Some misconceptions did not seem to be corrected after students participated in the Field Day Program. Before the Field Day Program, only 44% of students (*n*=34) knew to look under the letter H in the index to find the page number for the Great Blue Heron; 36% of students (*n*=28) looked under the letter G. After the Field Day Program, 62% of students (*n*=45) knew to look under H, but more than half of the remaining students (*n*=17) still said G (Figure 5). Volunteer and researcher observations also indicated that students' comprehension of how to use an index improved for some, but not all, students during the course of the Field Day Program, and many students confused the index with the table of contents.

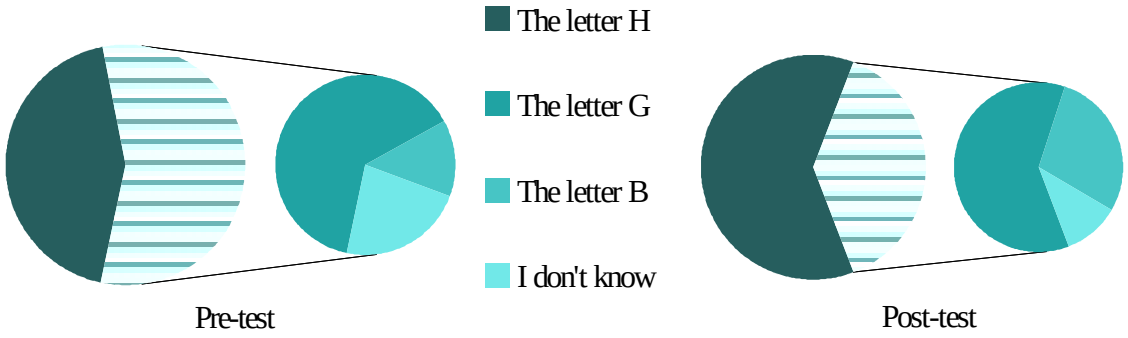

Figure 5. Pre-test (*N*=78) and post-test (*N*=73) answers to the question, "*If you were looking up a Great Blue Heron using a field guide, what letter would you look under in the index?*"

The post-test data also revealed some new misconceptions. Of the 46 students (59%) who incorrectly answered the question about field marks on the pre-test, more than half chose "the bird has a black cap on its head." On the post-test, only 15% of students (n=11) answered this question incorrectly, but "the bird has webbed feet" was the most common incorrect answer (Figure 6).

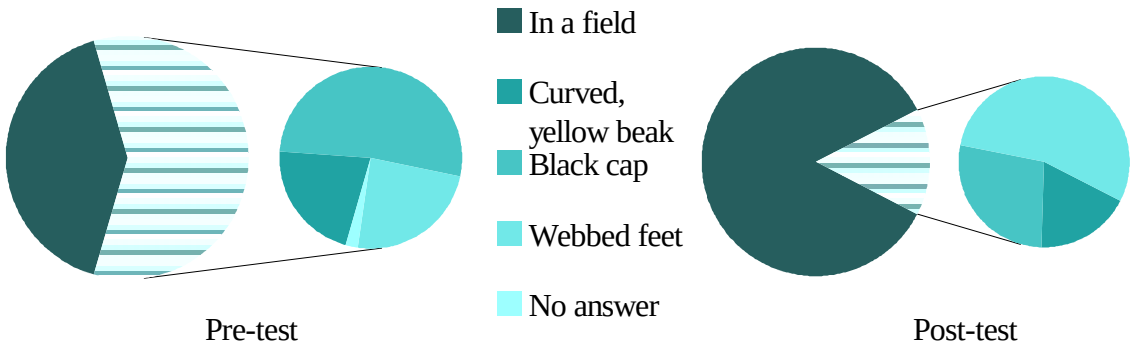

Figure 6. Pre-test (*N*=78) and post-test (*N*=73) answers to the question, "*Which of these is NOT a field mark?*"

Analysis of answers to the question about bird vocalizations demonstrated not only a lack of learning, but also that incorrect answers were more evenly distributed on

the pre-test than on the post-test, suggesting that a misconception developed during the five weeks that students attended the Field Day Program. It appears that instead of learning that birds sing and call for a variety of reasons, many students learned that birds vocalize to find a mate (Figure 7). Following this field day, the leader of this activity shared with me that she omitted the introduction, which specifically dealt with the many reasons that birds vocalize, because she felt pressed for time.

Figure 7. Pre-test (*N*=78) and post-test (*N*=73) answers to the question, "*Why do birds sing or call?"*

Misconceptions were also discovered through analysis of responses to the question that asked students to circle the five classes of arthropods among a group of nine possibilities. Incorrect answers on the pre-test were fairly evenly distributed between mammals, reptiles, birds and amphibians. However, on the post-test, 49% of students (*n*=27) incorrectly circled "amphibians," more than any other incorrect answer (Figure 8).

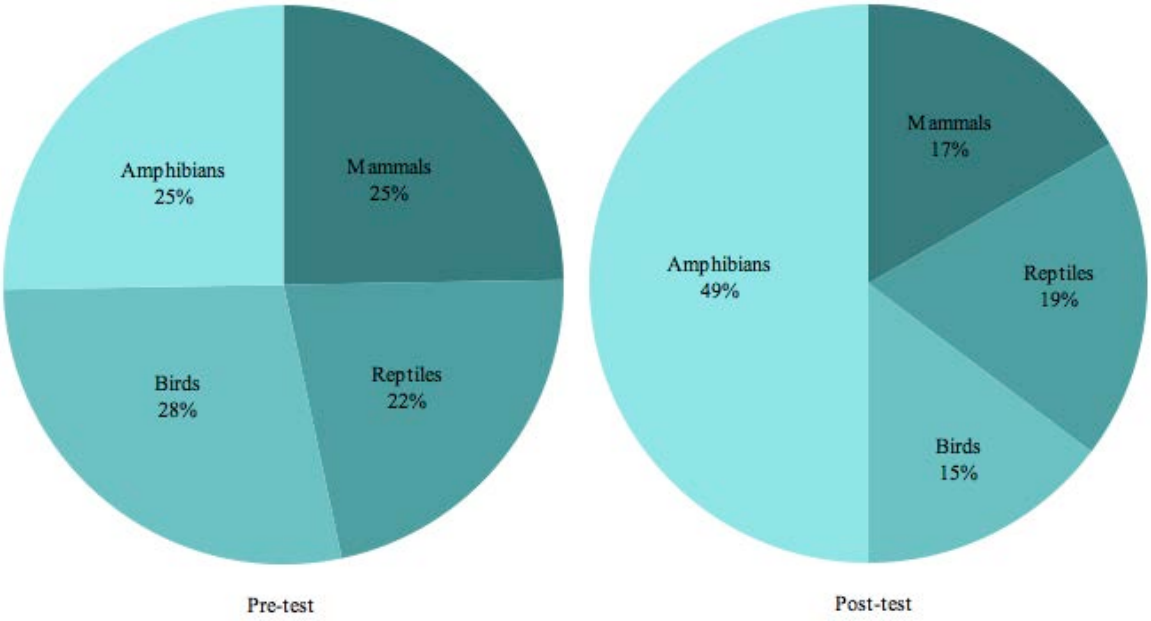

Figure 8. Incorrect pre-test (*N*=122) and post-test (*N*=54) responses to the question, *"Circle the five types of arthropods."*

Student Attitudes Towards Science

Pre-Field Day Program Attitudes

Students came to the first Field Day with mixed but generally positive attitudes towards science and the outdoors (Figure 9). Eighty-five percent of students (*n*=66) indicated that they really like to go outside, and 74% of students (*n*=58) said that science is fun (*N=78)*. Fifty-four percent of students (*n*=42) thought that science is kind of hard, but 56% of students (*n*=41) also indicated that they believe they are kind of good at science. However, only five percent of students (*n*=4) circled "I want to be a scientist" on the pre-test.

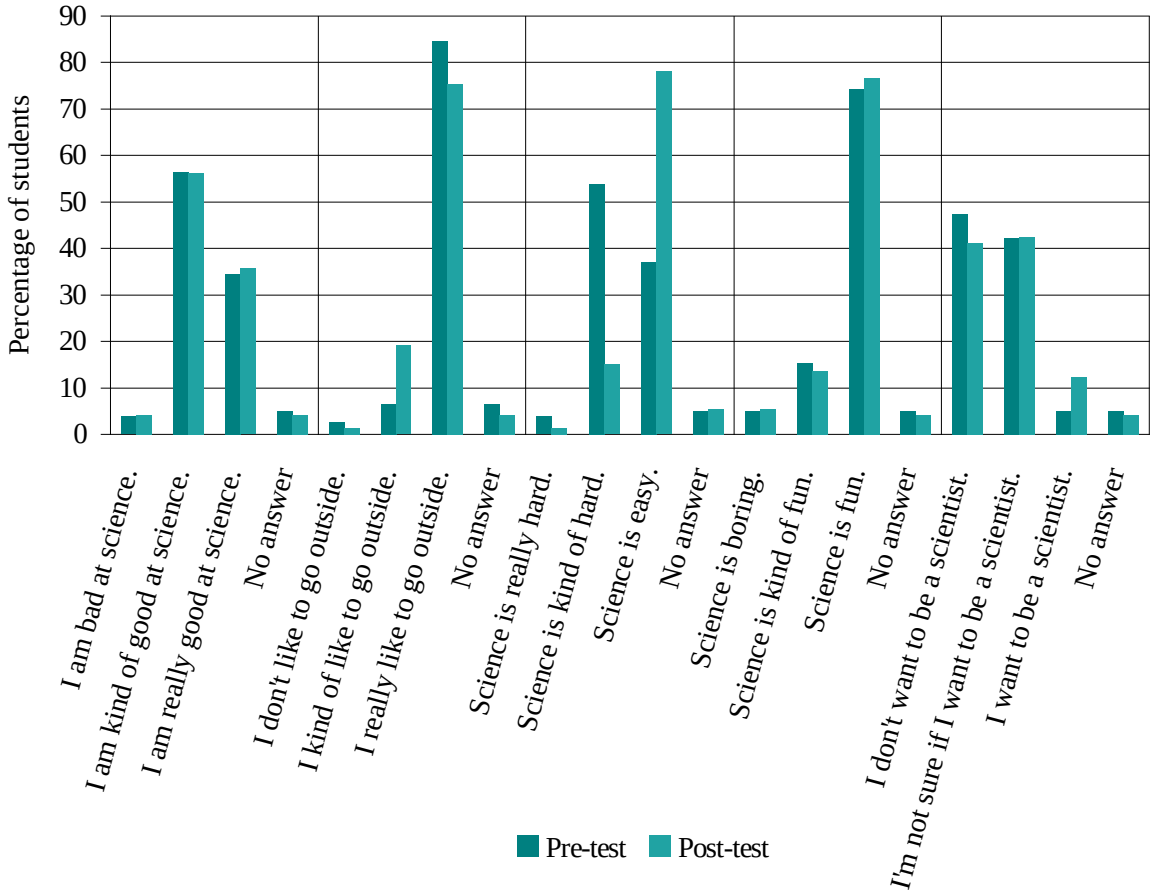

Figure 9. Pre-test (*N*=78) and post-test (*N*=73) responses to attitude questions.

Post-Field Day Program Attitudes

Overall, students responded more positively to the attitude survey after the Field Day Program (Figure 10). Fifty-six percent of answers circled on the post-test were the most positive choice, compared to 47% positive answers on the pre-test. Results to individual questions were mixed. Students appeared to have a slightly more negative attitude towards going outside after the program, as positive answers dropped by almost 10 percentage points, and neutral answers rose by 13 percentage points (Figure 9). However, one teacher mentioned something she overheard during the bug hunt: “Best comment of the day - ‘This is better than TV!’"

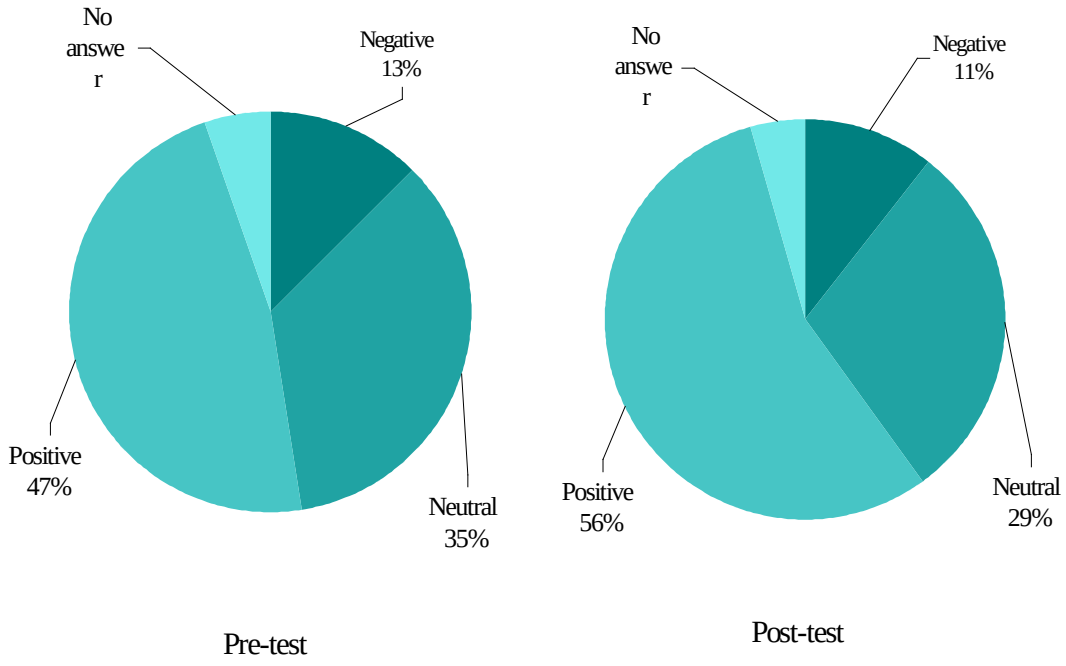

Figure 10. Students' attitudes towards science as indicated by their responses to the five attitude questions on the pre-test (*N*=78) and post-test (*N*=73).

The data indicated very little change in students' perception of their science abilities or the enjoyableness of science. More students answered that science is easy after the last Field Day – 78% on the post-test (*n*=57) compared to 37% on the pre-test (*n*=29) - and only one student felt that science is really hard (*N*=73). More students indicated that they wanted to be scientists; however, only 12% circled this choice, while the remaining responses were distributed evenly between the neutral and negative answers (Figure 9).

Qualities of Successful Activities

All of the third grade teachers at Osborn Elementary School completed the Post-Field Day Teacher Survey, although not every teacher answered every question (*N*=4).

Teacher survey responses were compared to the analysis of the qualities of Field Day activities to determine any trends.

Volunteer reflections also contributed data to the analysis of successful activities. In my observations I recorded data specific to individual field days (qualities that were unknown until the field day had occurred, i.e. group size, adult/student ratio, and weather); these are summarized in Appendix E.

Overall, Field Day activities were well-received by all teachers; when asked to rate individual Field Day activities on a scale of 0 (poor) to 5 (great), no teacher gave any activity a score of less than 4 (Figure 11). One teacher said: “Each is diverse and a wonderful opportunity for students to be introduced to new concepts/experiences and also deepen their understanding of concepts already taught.” Twelve out of the 17 activities were given a rating of 5 from all teachers. Four activities (planting, introduction to binoculars, migration data, and the flowering plant scavenger hunt) received an average score of 4.75. The redworms lab was given the lowest average rating of 4.5.

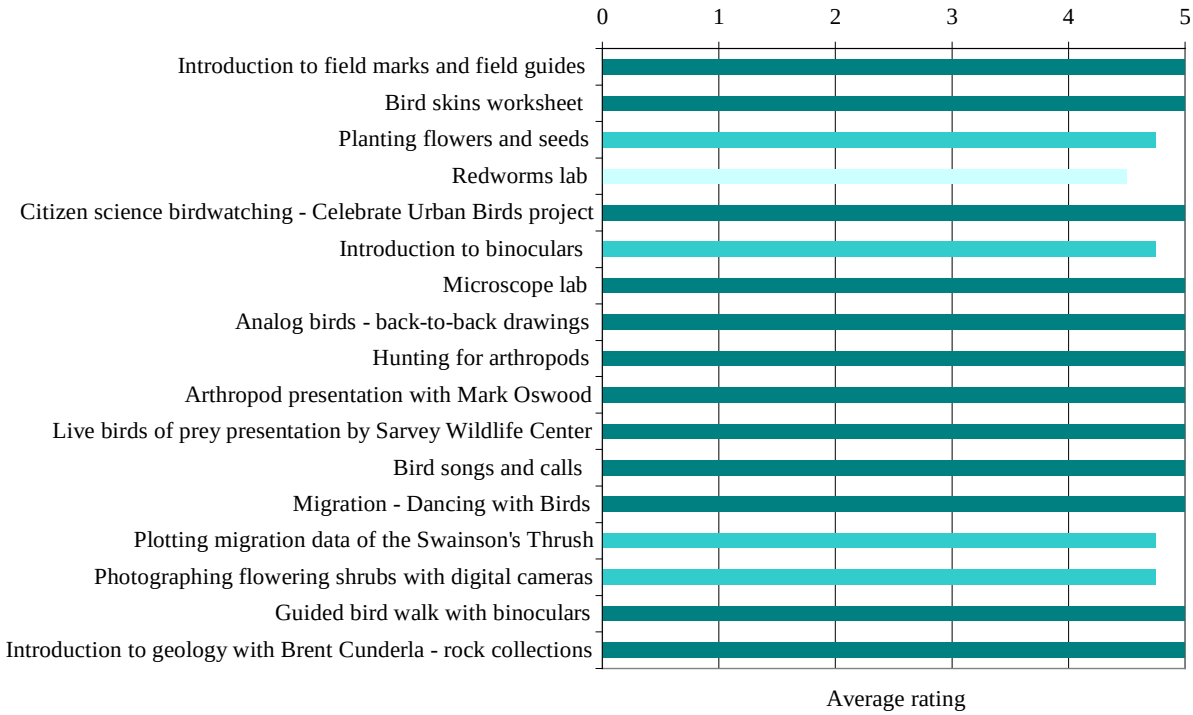

Figure 11. Teachers' average ratings of field day activities, (*N*=4).

Authentic Science Activities

Teacher responses, volunteer reflections, personal observations, and the Matrix of Qualities of Field Day Activities revealed trends in the characteristics that described a valuable or enjoyable activity. When asked which activities were most valuable, three out of the four teachers indicated that all of the activities were valuable. One teacher added, "All the activities are organized and taught in such a way that all students can be successful. The small group work is outstanding." Only one teacher listed specific activities that were valuable and gave reasons for her choices: the microscope lab ("it provides an opportunity that I can't"), and the introduction to geology and the arthropods hunt and presentation because both were led by "engaging" professional scientists.

Three out of the four teachers reflected upon which activities their students enjoyed most; two of these teachers said their students enjoyed all the activities. One

teacher listed four activities – the live birds presentation, bug hunt, arthropod presentation, and microscope lab – all of which involved real animals (captive birds of prey, local arthropods, nematodes in pond water, and preserved insect specimens). However, activities involving looking for wild birds were not indicated as being enjoyable to students. One teacher listed the guided bird walk as one of her students' least favorite activities, and another teacher commented, "afternoons are hard to find birds - not much we can do about that."

Duration of Activities

Based on the responses of the one teacher that listed specific activities, students appeared to enjoy activities longer than 30 minutes. The activities described as "most enjoyable" - the microscope lab, bug hunt, arthropod presentation, and live bird presentation - ranged from 40 to 60 minutes long. Additionally, the activities teachers rated most valuable were also longer than 30 minutes. In contrast, all of the activities that teachers rated less than 5 were 15 or 30 minutes in duration.

The least enjoyable activities for students, according to the one teacher that listed any, were migration data, flowering shrub scavenger hunt, and the bird walk. Analysis of the least enjoyable activities supported the idea that shorter activities were less enjoyable, revealing that each activity named was 30 minutes. All three activities were also part of the last Field Day. Volunteers indicated that they too wanted more time on that day, and worried that students were put off by being rushed through the activities.

The least enjoyable activities had something else in common. All of these activities generated a product – a worksheet, map, photos, or list – but students did not take the product back to the classroom with them. One teacher listed the flowering plant

activity as not enjoyable because “the kids don’t see the results of their efforts and they really want to get their hands on the equipment.” Teachers did receive a CD of the photos taken during the flowering plant scavenger hunt; however, this was after they had taken the survey and two weeks after the students took the pictures.

Alignment with Classroom Curriculum

Teacher survey responses revealed that the majority of third day Field Day activities are not actually aligned with the current classroom science curriculum set out by the school district. Three teachers noted that the introduction to geology is the only activity that directly fits with classroom curriculum. One teacher noted, “If I look at our ‘science curriculum’ as the kits the [Educational Service District] provides, the majority of the activities don’t fit – our science kits that we receive from the ESD are Earth Materials, Physics of Sound, and Human Body.” However, she added a different perspective: “If I look at our ‘science curriculum” to also include the ‘Birds’ unit provided by the Wenatchee River Institute, then the planting, flowering shrub scavenger hunt, redworms, arthropods, and microscope activities seem to not fit directly with any of them.”

Teachers shared that they connected the Field Days to the classroom by pre-teaching activities in the days before their Field Day visits. Responses showed that all four teachers used the kits, books, and photos we provided them to pre-teach or follow up some of the Field Day activities – especially activities related to birds. One teacher said that she felt the least connection in the classroom to the planting, flowering shrubs, and redworm activities because she doesn’t do anything to pre-teach them. These were also the activities that she indicated were least valuable to her teaching, based on their lack of

connection to the “bird theme” and disconnect from the classroom curriculum, but she noted that she did like the redworm activity “because of the activity sheet the kids fill out while they are observing the red-worms.” However, the leader of the redworm activity expressed frustration that the students did not follow the procedure on the worksheet, and did not seem to comprehend what she believes were simple directions and ideas. We also had difficulty keeping the redworms alive and active.

Teachers indicated that materials generated during the Field Day (data sheets, worksheets, drawings) were sent home with students after the field day, implying that they are not used in any follow-up activities in the classroom. At the time the teachers received the survey, we had not yet distributed the photos taken during the flowering shrub scavenger hunt, so it is unclear if and how the teachers use those in the classroom.

Teachers requested more help developing resources to pre-teach arthropods, microscopes, and binoculars. One teacher indicated that good resources make her “feel prepared and empowered and knowledgeable.” Another teacher was okay with the resources provided, noting, “I feel like we strive to make it all work with what we have.”

Influence of Weather

Teachers gave a rating of 5 to all of the activities that took place under sunny skies, and all five of the activities that were given less than perfect ratings happened on cloudy or rainy days. In addition, the two outdoor activities listed as students’ favorites (by their teachers) took place on sunny days, and the two outdoor activities that students’ enjoyed the least happened on a cloudy day.

Other activity characteristics described by the Matrix of Qualities of Field Day Activities (Appendix D) and the Post-Field Day description of specific Field Day

qualities (Appendix E), such as group size, adult-to-student ratio, format, topic, location, physical activity, and learning style, did not reveal trends that correlated with the value or enjoyableness of Field Day activities.

INTERPRETATION AND CONCLUSION

The results of the study indicated that the Field Day Program is beneficial to student learning and attitudes, and also revealed some surprising ideas about the design of activities and evaluations. The data support the effectiveness of the Field Day Program. Students demonstrated that they learned new concepts during their experiences at Barn Beach Reserve. Even the discovery that students did not learn what we intended to teach them about bird vocalizations indicates that Field Day activities, separate from their classroom teacher's instruction, influence their learning. In addition, the majority of students understood the topic that we addressed the most, field marks, after the Field Day Program.

The student baseline knowledge data suggest a few areas where we could adjust our programming. For example, most students already knew what plants need to survive. Our focus could shift to adaptations of plants for seed transportation, or emphasize pollination (which would tie to the bird theme) or sustainable agriculture (in alignment with Washington State's Environmental and Sustainability Education Standards, which have been increasingly emphasized in the education community).

Other areas the data suggest we could reexamine and emphasize are field guide organization (index vs. table of contents) and vermicomposting (is it merely an exercise, or do the observations emphasize the point that redworms help plants grow?). Data from

multiple sources also indicates that we need try to find ways to work more time into all activities, but especially those that use equipment, as students are so excited to try out microscopes and binoculars that they have a hard time focusing on written and spoken directions.

The misconceptions revealed by the data are helpful in determining concepts that need further emphasis or clarification. For example, I suspect that the reason students incorrectly thought amphibians were arthropods, even on the post-test, was that we showed them a crayfish and discussed other aquatic arthropods. It will be important next year for us to incorporate a comparison of the other classes of animals for clarification. Although the data suggested that the misconception that birds migrate north in the winter was not corrected, we talked a lot about birds migrating north for the summer, which I believe explains the confusion. We can also emphasize that birds' feet can be considered as field marks, and define in more detail what scientists mean when they refer to "the field."

Student attitudes improved overall during the Field Day program, but not to the extent I had anticipated. The most noticeable difference was that more students described science as "easy" after the Field Days instead of "kind of hard." However, there didn't seem to be any correlation with the idea of science being fun, or students' perception of their abilities to do well in science. Few students wanted to be scientists; however, asking a third grader what she wants to be when she grows up usually results in answers like, "a singer" or "an astronaut" or "a unicorn wrangler." One student circled "I don't want to be a scientist," but wrote below, "I want to be a veterinarian." Third grade students may not yet realize how many different kinds of things scientists do, and I am curious to find

out what students imagine a scientist to be. This would be an interesting question to include in future evaluations, and could be something we focus on by inviting more specialists to lead activities and share how they use science every day.

I was also surprised at the decrease in positive responses to the outdoors, but upon reflection, a person's desire to go outside is highly variable depending on mood and weather conditions. I also wonder if the teachers' negative attitudes towards rainy weather influenced students' feelings. We need to do more to prepare students for going outside in all weather, which may alleviate the concerns of teachers as well.

Responses to the teacher survey indicated that the third grade team is invested in the program and takes the Field Day experience seriously and as an extension of the classroom. Teachers indicated that they pre-teach topics as much as they can, but that they could use help developing classroom resources. One teacher asked for "clear communication about how the groups will be traveling," because "we often have students placed in groups strategically…we need to know where the teacher needs to be, so we can support the volunteers."

Teachers did not indicate concern at the lack of activities meeting the standards. Although one teacher responded that the microscope lab didn't fit the classroom curriculum, she qualified her answer by noting that activities that utilize equipment such as microscopes and binoculars are "worth keeping due to the connection to the bird unit or general science." One teacher simply indicated, "I am satisfied with all the activities." "All are VERY valuable," wrote another teacher, and added that "the state expectations are changing – who knows what will fit?!" However, I plan to approach them before next year to determine if they would appreciate more activities that directly connect to

their classroom curriculum. The new proposed science standards may necessitate a reworking of all our grade-level programs.

Teacher responses implied that students like to see or keep the results of their efforts. I plan to look closely at our worksheets and data sheets and explore ways to share them with teachers sooner and help them find ways to use them in the classroom. A volunteer also observed that while students seem to enjoy planting seeds and flowers on the first Field Day, they lost interest in checking on their plants, possibly because the petunias did not flower and the wildflower and pumpkin seeds did not sprout until after the last Field Day. The pumpkin seeds were a new addition this year, as an effort to plant something in the spring that students could harvest in the fall, reaping the benefits of their hard work. One of our volunteers, a passionate gardener, suggested that potatoes would be a fun crop to try in coming years. A local native plant nursery has also offered to help us acquire early-spring blooming plants to replace the usual petunias.

I was not surprised that the data revealed that sunny day activities were more popular than rainy day activities. Cold, rainy weather on the morning of the first Field Day resulted in the decision to have the morning class join with the afternoon class, and sparked a conversation with teachers about an official weather policy. The teacher bringing her students that morning, as well as some Wenatchee River Institute staff, didn't want to deal with the inconvenience of wet clothing if students forgot to dress in layers and wear rain gear (as often they did, even when reminded). However, the general sentiment amongst volunteers, other Wenatchee River Institute staff, and parents and community members consulted after the fact, was that students would not be in any danger, or even much discomfort, if they got a bit wet or cold. In fact, this could be a

valuable learning opportunity. Additionally, I would be interested to know how the students felt - I collected data from the teachers' perspectives, but I don't have data describing what the students felt about the weather.

The research process revealed ways to improve the evaluations to solicit more useful information. For example, students tended to answer neutrally on the more vaguely worded questions. On future evaluations, they will only be given two choices, and have to choose the one for which they have the strongest affinity. I will also change the wording and graphics of some questions, and eliminate the open-ended questions, as they were difficult to analyze. It was impossible to know if a blank box meant the student didn't know the answer, or they were unable to complete the test because they were called away, had to use the bathroom, or didn't have enough time.

Through the evaluation process I also became aware of classroom logistics that had changed since I designed the evaluation. Early in the planning process, I had considered comparing scores by classroom, and gave each teacher a different color test. However, a situation arose that made me rethink this approach. In the end, it wouldn't have mattered - the groups of students who took the pre- and post-tests (divided by homeroom) were not identical to the groups that visited Barn Beach Reserve (divided by reading groups). I would not have been able to look for correlations as I had initially planned.

The gathering of Volunteer Reflection data absolutely did not go as planned. I did not anticipate how busy I would be setting up and cleaning up activities, or chasing down school buses (due to ongoing construction on the roads to Barn Beach Reserve). The few times that I was actually able to sit down with volunteers during the lunch break or in the

afternoon following the Field Day, I was advised by my supervisor that this was to be social time, not work time. I respect this sentiment, as many of our volunteers regard helping at Barn Beach Reserve as an opportunity to meet others in the community. Obviously, I need to design a different method to collect this valuable information in the future.

VALUE

The action research process was valuable to me in several ways. It gave me confidence and data to support long-overdue adjustments to our Field Day activities. This comes at a time when I have the opportunity to make changes, as I will be taking over the coordination of the Field Day program this summer. This study also demonstrated to me the importance of setting program and daily goals, and communicating those goals to activity leaders. We have tried to do this informally during training the morning of the Field Days, but it may be prudent to create written descriptions of activities and learning goals to be distributed to our Field Day volunteers. I have no doubt that students learned a lot about bird songs and calls, however, the important point about the function diversity of bird vocalizations was neglected. I didn't stress to the activity leader that that was a learning goal, or mention that it was on the evaluation. However, the evaluation should reflect the information that the classroom teachers and our staff think is most important to get across.

The lack of control over when, where, and how students completed the questionnaires was frustrating, but realistic, in my informal teaching situation. This process revealed that in order to be sustainable by classroom teachers and Wenatchee

River Institute staff, an evaluation must be simple, and if possible, integrated into the Field Day activities.

Finally, it was gratifying to realize the support of coworkers, partner teachers, volunteers, and students as I completed this process. I am lucky to have stumbled across the opportunity to work in a small community that cares that students have learning opportunities outside the classroom, and believes in the importance of connecting children with nature. I have a sense of ownership and of the value of the Field Day Program that I didn't feel last year. One teacher describes this feeling beautifully: "Barn Beach Reserve is a wonderful privilege and opportunity for our students to deepen and broaden their learning and interests in science, our community and the world!"

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APPENDICES

APPENDIX A

PRE- AND POST-FIELD DAY STUDENT QUESTIONNAIRE (THIRD GRADE)

Pre- & Post-Field Day Student Questionnaire

Circle the letter of the one **best** answer for each question.

1. Which of these is NOT a **field mark?**

   A. You saw the bird in a field.
   B. The bird has a curved, yellow beak.
   C. The bird has a black cap on its head.
   D. The bird has webbed feet.

2. If you wanted to look up a Great Blue Heron in a field guide, you would turn to the index in the back of the book. **What letter would you look under?**

   A. The letter G for Great
   B. The letter H for Heron
   C. The letter B for Blue
   D. I don't know

3. Many of the birds we see in this area in the summer **migrate** somewhere else for the winter. Where do they go?

   A. West across the Pacific Ocean to Asia
   B. East across the Atlantic Ocean to Europe
   C. South to Central and South America
   D. North to Canada and Alaska

4. Why do birds **sing** or **call**?

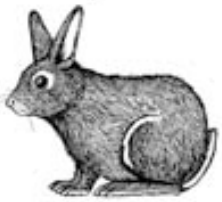
   A. To find a mate
   B. To warn other birds of danger
   C. To let other birds know where they are
   D. All of the above

Name three things that **plants** need to survive.	What do **redworms** make that can help plants grow?

Circle the five kinds of animals that are **arthropods.**

Spiders	Reptiles	Crustaceans
Mammals	Insects	Birds
Centipedes	Amphibians	Millipedes

Draw a line from each **beak** to the **food** it is adapted to eat.



Draw a line from each **foot** to the **behavior** it is adapted for.

Paddling in water

Climbing trees

Perching

Circle the names of the **three rock types.**

Quartz	Granite	Igneous
Limestone	Sedimentary	Crystal
Metamorphic	Basalt	Sandstone

<table>
<tr><td colspan="2"><u>Read each group of sentences carefully.</u>

<u>Circle the sentence in each group that you agree with the most.</u></td></tr>
<tr><td>I am really good at science.
I am kind of good at science.
I am bad at science.</td><td>Science is really hard.
Science is kind of hard.
Science is easy.</td></tr>
<tr><td>Science is fun.
Science is kind of fun.
Science is boring.</td><td>I really like to go outside.
I kind of like to go outside.
I don’t like to go outside.</td></tr>
<tr><td colspan="2">I want to be a scientist when I grow up.
I’m not sure if I want to be a scientist when I grow up.
I don’t want to be a scientist when I grow up.</td></tr>
</table>

APPENDIX B

VOLUNTEER REFLECTION

Volunteer Reflection

Date: _____ AM/PM (circle)

Describe any “A-HA!” moments you observed by the students in your groups.

Describe any concepts that were hard for the students in your groups to grasp.

How would you rate the attitude of the students in your groups?

1 – Disruptive 2 – Bored 3 – Interested 4 – Engaged 5 – Excited

Anything else of note?

APPENDIX C

POST-FIELD DAY TEACHER SURVEY

Post-Field Day Teacher Survey
(Google Docs)

Activities:

Please rate the quality of the field day activities on a scale of 1 (poor) to 5 (great) and share any concerns or suggestions for improvement.

Which 3 activities were the most valuable to you as a teacher?

Which 3 activities were the least valuable to you as a teacher?

Which 3 activities fit best with your classroom science curriculum?

Which 3 activities did not fit well with your science curriculum?

Which 3 activities did your students enjoy the most?

Which 3 activities did your students enjoy the least?

Please share any additional feedback about field day activities.

Resources and Logistics:

Have you used or plan to use the data sheets & photos in your classroom? If so, how?

Which provided resources (binder, posters, books, etc.) did you use in your classroom?

What resources and information would help you connect the field day experience to your classroom activities?

Logistically, is there anything we can do on our end to help you plan for your field day experiences?

Any additional comments or suggestions?

APPENDIX D

MATRIX OF QUALITIES OF FIELD DAY ACTIVITIES

Matrix of Qualities of Field Day Activities

	Location	Duration	Format	Equipment/ materials used by students	Props used by leader	Physical activity	Take-home materials generated
Intro to field marks and field guides, beaks and feet	Inside (Barn)	30 min.	Presentation, demo	Field guides	Specimens, tools, field guides, images	Sitting	
Bird skins worksheet	Inside (Barn)	30 min.	Hands-on, guided worksheet	Rulers, field guides, specimens	Specimens, tools, field guides	Sitting, some moving around	Worksheet (individual, sent back to classroom)
Planting seeds and flowers	Outside (Barn yard)	30 min.	Demo, hands-on, full body	Trowels, rakes, seeds, plants	Seed packets	Standing, squatting, moving between stations	
Redworms lab	Outside (Barn porch)	30 min.	Hands-on, guided worksheet	Petri dishes, droppers, live worms, rulers, calculators	Images, worm bin	Sitting	Worksheet (individual, sent back to classroom)
Citizen Science Birding - Celebrate Urban Birds	Inside (sunroom), Outside (Barn porch)	45 min.	Presentation, hands-on, full body	Field guides, images, binoculars	Images, count data sheet, binoculars	Sitting, standing, short walk between stations	Count data sheet (group, kept by WRI)
Intro to binoculars	Inside (sunroom)	15 min.	Demo, hands-on	Binoculars	Binoculars	Standing	
Microscope lab	Inside (Barn)	60 min.	Hands-on, guided worksheet	Microscopes, slides, specimens, field guides, rulers, petri dishes, magnifying lenses	Images, slides	Sitting, moving between stations	Worksheet (individual, sent back to classroom)
Analog birds - back-to-back drawing	Outisde (meadow)	40 min.	Hands-on, full body	Binoculars, field guides	Field guides	Sitting, standing, moving between stations	Drawings (pairs, sent back to classroom)
Arthropod hunt	Outside (Barn yard)	40 min.	Demo, hands-on, full body	Magnifiers, forceps, trowels, collecting jars, rulers	Forceps, collection jars, trowels, rulers	Standing, squatting, moving around	
Arthropod presentation (Dr. Mark Oswood)	Inside (Barn)	45 min.	Presentation		Magnified live animals, tarantula exoskeleton	Sitting	
Live birds of prey (Sarvey Wildlife Center)	Outside (River Haus)	60 min.	Presentation		Live birds, feathers	Sitting	
Bird songs and calls	Outside (lawn)	30 min.	Presentation, full body	Written songs/calls, blindfolds	Images, sounds, written songs/calls, clock	Sitting, standing, moving around	

Dancing with Birds (migration)	Inside (Barn)	30 min.	Presentation, demo, full body		Images, Dancing with Birds music	Sitting, standing, dancing	
Rocks and minerals (BLM's Brent Cunderla)	Outside (Barn yard)	30 min.	Presentation, hands-on	Egg cartons, rock samples	Rock samples, music, handout	Sitting, some moving around	Rock collection (individual, sent back to classroom)
Bird walk with binoculars	Outside (grounds)	30 min.	Demo, hands-on, full body	Binoculars, field guides	Binoculars, field guide	Short walk, standing	Count list (group, kept by WRI)
Flowering shrub scavenger hunt with digital cameras	Outside (grounds)	30 min.	Demo, hands-on, full body	Digital cameras, field guides	Digital camera	Sitting, standing, short walk	Data sheet, photos (group, delivered to classroom)
Migration data of the Swainson's Thrush	Inside (Barn)	30 min.	Presentation, hands-on	Maps	Images, maps	Sitting, some moving around	Map (group, recycled)

APPENDIX E

MATRIX OF SPECIFIC QUALITIES OF FIELD DAY ACTIVITIES

Matrix of Specific Qualities of Field Day Activities

	Group Size	Adult to student ratio	Weather
Intro to field marks and field guides, beaks and feet	12 total (4/25) 24 total (4/26)	1:3 (4/25) 1:8 (4/26)	4/25: Cloudy, 54-65 degrees 4/26 (PM): Rainy, 48-57 degrees
Bird skins worksheet	12 total, working alone (4/25) 24 total , working in pairs (4/26)	1:3 (4/25) 1:8 (4/26)	
Planting seeds and flowers	6 total, 2 groups of 3 4/25) 12 total, 2 groups of 6 (4/26)	1:3 (4/25) 1:6 (4/26)	
Redworms lab	6 total, working alone (4/25) 12 total, working alone (4/26)	1:6	
Citizen Science Birding - Celebrate Urban Birds	12 total	1:4	5/3: Rainy, 42-48 degrees 5/4: Cloudy/windy, 51-56 degrees
Intro to binoculars	12 total	1:4	
Microscope lab	12 total, working alone and in pairs	1:4	
Analog birds - back-to-back drawing	12 total, working in pairs	1:3	5/8: Sunny, 56-78 degrees 5/11: Sunny, 46-66 degrees
Arthropod hunt	12 total, 3 groups of 4	1:4	
Arthropod presentation (Dr. Mark Oswood)	24 total	1:8	
Live birds of prey (Sarvey Wildlife Center)	24 total	1:6	5/17 (PM): Sunny, 65-66 degrees 5/18 (AM): Sunny, 55-60 degrees
Bird songs and calls	12 total, working in pairs	1:3	
Dancing with Birds (migration)	12 total	1:6	
Rocks and minerals (BLM's Brent Cunderla)	6 total	1:6	5/23: Cloudy/windy, 52-56 degrees 5/24: Cloudy, 50-63 degrees
Bird walk with binoculars	6 total, groups of 3	1:3	
Flowering shrub scavenger hunt with digital cameras	6 total, working in pairs	1:3	
Migration data of the Swainson's Thrush	6 total, working in pairs	1:6	