SCIENCE OUTSIDE THE BOX

by

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STATEMENT OF PERMISSION TO USE

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.

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ABSTRACT

The impact of outdoor and environmental education on student motivation and achievement was studied in the high school biology classroom. Prior to this treatment, students spent the majority of their academic time indoors. In past years, students were becoming less and less motivated in their science courses as the school year wore on. Students seemed apathetic at times, disinterested, and did not believe that the science they were learning had any relevance to their daily lives.

The purpose of this study was to gather evidence from students who were frequently exposed to the outdoors to see if they will be more motivated and display higher levels of achievement than students who spend the majority of their academic time indoors. Data Collection Instruments for this study included an Outdoor Attitudes Questionnaire, a Science Motivation Survey, Time on Task Check Sheets, Pre and Post Assessments, informal Student Interviews, Student Journals, and a Teacher Field Journal with daily reflections and observations, all included in the appendices for review.

The data gathered from this study indicated that a positive relationship existed between the amount of time students were engaged outdoor activities and their level of motivation. Results from this study suggest that higher levels of student motivation lead to greater student achievement. The data from this study also support the conclusion that students felt less stress when exposed to the outdoors, and this reduction in stress resulted in more positive feelings toward their educational experience.

INTRODUCTION AND BACKGROUND

During eleven years teaching middle school and high school science, I have observed that I spend an inordinate amount of time trying to convince students why they should be interested in a particular science topic. After reviewing the literature on motivating students, there seem to be many competing ideas about how to motivate students, and it is difficult to navigate the various theories. However, I believe student motivation is the number one obstacle facing most secondary educators today. If students lack the motivation to drive their own education, ultimately they will have difficulty achieving academic success.

How do we motivate students so they want to learn? We have so much information readily available about effective teaching strategies, and yet our students still seem unengaged in the traditional classroom. Maybe the solution is outside the box; by outside, I literally mean outside, therefore I chose to explore the subject of student motivation for my action research-based project. My goal for this study was to reveal whether or not my students could be consistently motivated, regardless of the content being taught at the time. I also wanted to know if an increase in motivation led to higher achievement in science.

The idea for this research project came at a Northwest Aquatics and Marine Educators Conference (NAME) I attended in Florence, Oregon during summer 2010. The speaker at one particular breakout session kept referring to a term I had never heard before, “Nature Deficit Disorder.” The speaker drew our attention to a movement to get children outside, spurred by the book *Last Child in the Woods* (Louv, 2008). This bestselling book opened up a very engaging dialogue within the educational community,

including parents, teachers, and policy makers. As a result there is renewed effort by educators to get young people outside and encourage use of environmental education as a central theme to motivate students.

To begin my investigation of student motivation, I first conducted preliminary observations within my classroom. I wanted to see if this was just another passing fad in the educational community or if this topic held some merit for my classroom. During the spring 2011-2012 school year, I took students outside to enjoy the nice weather a few times each week. There was not a specific plan in place; I just thought they might want to conduct some schoolwork outside. I decided during this time to do some informal observations while they worked outdoors. Students have always asked me to go outside when the weather is nice, but honestly I rarely took them outdoors because I was fearful of losing control of my class. We began going outside when the weather was nice to take pre-tests, finish assignments started in class, or to start reading the next assigned chapter in our textbooks. I immediately noticed the majority of my students stayed on task and were very engaged most of the time outdoors. What was even more intriguing was that some of my students who typically have trouble focusing, were especially engaged and on task. Normally, I have to frequently remind these students to stay on task but in this case I did not have to say a word. After we spent a few class periods outdoors, I asked my students to reflect in their science journals about their experience outside. I asked them to write down whether or not they preferred doing their schoolwork outdoors or if they would rather continue doing their work inside. I emphasized that I really wanted to know what they thought and why they felt one way or another. After reading their responses, most students indicated they preferred spending time doing their school work

outside. The reasons they gave me were very insightful, for example, some of the things I heard over and over was “I feel more relaxed and peaceful.” Several students mentioned that they “felt more focused.” I even heard students emphasize they were “less stressed, and more engaged in their work.”

For my action research-based project I worked with sixty students in my two high school biology classes at Vision Charter School in Caldwell, Idaho during the spring semester 2012-2013. Vision Charter School is located in a rural community of Caldwell and the population from the most recent census in 2010 was 46,237 (Caldwell, Idaho, n.d.). Students attending Vision Charter School are primarily from Caldwell and Middleton, Idaho. In the 2010 census Middleton had a population of 5,781. Both areas are primarily rural areas with low median incomes. The most recent figures from 2009 state that the median income for Caldwell $34,002 is and the median household income for Middleton is $37,600 (Middleton, Idaho, n.d.). Overall the area is not very culturally diverse, for example, there is a high Hispanic population in and around Caldwell, but these demographics are not reflected in our school. There are 551 students enrolled kindergarten through twelfth grade, and 91% of enrolled students are Caucasian, 5% of the students are Hispanic, 2% are Asian, 1% are African American, and 1% are American Indian (W. OldenKamp, personal communication, September 25, 2012).

Our school strives to maintain very high standards in science and math. The graduation requirements for our school include more science and math than Idaho requires, and our students outperform most of the state on the Idaho Standardized Achievement Tests (ISAT). Students from our school have the opportunity to graduate with an advanced degree and many of our high school students will graduate with close

to 30 college credits through our dual credit program. Currently we have kindergarten through twelfth grade students enrolled at our school, and the class of 2013 was the first to graduate from Vision Charter School.

The purpose of this study was to determine the impact of outdoor education on student motivation and achievement. I also hoped to address the following secondary research questions: Do students exhibit greater levels of motivation and a more positive attitude as a result of frequent exposure to the outdoors? Does outdoor education increase student time on task and student engagement? Does outdoor education reduce student stress levels and improve their sense of well-being?

CONCEPTUAL FRAMEWORK

Many young people are facing new challenges in today's fast paced, technological world; in particular, they are increasingly disconnected from the natural world. In his bestselling book, *Last Child in the Woods*, Richard Louv (2008) referred to this disconnect as "Nature Deficit Disorder." Nature Deficit Disorder was a term used by Louv to describe the apparent disconnectedness between many young people and the natural environment. This disconnect is causing multiple problems, for example, young people are encountering physical, emotional, and educational difficulties as a result of the disconnect from nature. Furthermore, there are benefits to connections to nature, including: responsible behavior and environmental stewardship, greater student achievement and motivation, higher test scores and grade point averages (Bogo, 2003; Boss, 2001; Broda, 2007; Cronin-Jones, 2000; Dominguez & Schilling, 2001; Festeu,

2002; Lieberman & Hoody, 1998; Robinson & Kakela, 2006; Schilling et al., 2006; Swarbick, Eastwood & Tutton, 2004).

Nature Deficit Disorder is becoming an important issue to educators and politicians, at both the state and federal level, and there has been legislation introduced to address this problem. On September 18, 2008 the U.S. House of Representatives voted on and passed H.R. 3036, referred to as the "No Child Left Inside Act." There were eight main objectives to this bill including: the creation of professional development opportunities in environmental science, the alignment of environmental education programs with national and state content standards, collaboration of teachers and environmental professionals, the establishment of programs to help educators provide environmental education opportunities to their colleagues, and the establishment of outdoor education programs within the regular school curriculum (No Child Left Inside Act, Congress H.R. 3036, n.d.).

Outdoor and environmental education programs have been shown to motivate many students who are otherwise reluctant to learn. These programs also add variety to the learning environment and increase student engagement, where an increase in student engagement has been shown to lead to greater student achievement. Outdoor and environmental education programs have been shown to reduce discipline and classroom management issues (Berto, Baroni, Zainaghi, & Bettella, 2010). Outdoor education has also been shown to help students improve their communication skills, work as a team, and help students diversify their educational experience (Boss, 2001). Outdoor education helps students learn to ask quality questions, solve real world problems, and become lifelong learners. Some of the most common benefits include engaging all students,

developing self-motivated students, improving student achievement, and fostering classrooms with fewer behavioral problems (Bogo, 2003; Boss, 2001; Broda, 2007; Cronin-Jones, 2000; Dominguez & Schilling, 2001; Festue, 2002; Lieberman & Hoody, 1998; Robinson & Kakela, 2006; Schilling et al., 2006; Swarbick et al., 2004).

In addition, nature has been replaced with digital environments, and according to the Children and Nature Network (2007), young people who use electronic media have increased their usage over the past five years to over 50 hours per week. The Kaiser Family Fund found that young people ages 8-19 spend more than 7.5 hours a day on smart phones, computers, and watching television. That amounts to over 53 hours per week of being plugged into some form of electronic media. Although addressing these challenges should not be the sole responsibility of the educational system, schools that use outdoor education and/or environmental education as an integrating context have shown themselves to be effective in counteracting the negative effects of children immersed in electronic media (Ebbeling, Pawlak, & Ludwig, 2002).

As children are being exposed less and less to the natural world around them, there seems to be a corresponding increase in stress (Kahn, 1999). One of the potential benefits associated with a strong connection to nature is stress reduction. Nature can serve as a buffer for stress in children and this buffer is amplified in children who experience relatively high levels of stress (Wells & Evans, 2003). The Children's Hospital and Regional Medical Center in Seattle, Washington stated "each hour of television watched per day by preschoolers increases by 10 percent the likelihood that the child will have concentration problems" (Healey, 2004, p.917-918). The good news is

that nature has the potential to restore attention and reduce stress (Berto, Baroni, Zainaghi, & Bettella, 2010).

One major side effect of a generation that has reduced its activity to mostly media experiences is the reduced use of their senses. It is clear from Howard Gardner's research into multiple intelligences that students learn using a variety of modalities. In his original research, he only identified seven different intelligences, but recently he added an eighth intelligence (Louv, 2008). This intelligence is referred to as naturalist intelligence. According to Gardner, this type of intelligence is marked by the ability to recognize different plants and animals, other biotic and abiotic factors within the environment (Gardner, 1983). Some other unique markers of natural intelligence include developed sensory skills, the ability to notice and categorize things in the natural world, an enjoyment of being outdoors, noticing patterns in ones surroundings, an interest and care for plants and animals, keeping specimens in a journal or scrapbook, an interest in television or documentaries dealing with nature, a heightened concern for endangered species and the environment, and the ability to easily learn characteristics and categories of plants and animals (Louv, 2008).

Humans are sensory beings and therefore all their senses need to be engaged; however, during a typical child's day, they get to engage very few of their senses. Technology has narrowed the sensory experience down to two senses: sight and sound. Children need to be able to engage all of their senses, and the natural environment is a place where all the senses can be fully engaged. Children need the opportunity to engage in free unstructured play that will require the use of all of their senses so that they can develop an emotionally healthy life. Multi-sensory experiences in nature help students

build the cognitive constructs they need to continue to develop intellectually (Moore & Wong, 1997).

Environmental psychologists Rachel and Stephen Kaplan (1989) have shown that there is a link between a child's contact with nature and their ability to restore directed attention in other areas. In order to effectively process information we need to continually direct our attention to the process or task at hand. This directed attention requires continual conscious effort and can be susceptible to fatigue. Any prolonged mental effort directed at specific task can lead to directed attention fatigue. When students have to engage in problem-solving activities, they have to voluntarily control their attention. Without the ability to maintain this directed attention the student can become distracted and their perception can become impaired. One of the drawbacks of not being able to control one's direct attention is irritability. Directed attention is essential if we want to be academically successful. If our directed attention becomes fatigued, this can lead to major errors when it comes to problem solving. On the other side of directed attention is one's involuntary attention. Involuntary attention does not require any effort and it is resistant to fatigue. When students are in this involuntary mode, their directed attention should be able to rest. Kaplan and Kaplan's research has shown that students who frequently come into contact with nature are promoting recovery from the mental fatigue of their directed attention, and they are able to enhance their mental focus (Kaplan & Kaplan, 2005).

Kaplan and Kaplan go on to say that in today's modern world we have created a great divide between what we deem to be important and what we actually find to be interesting. It is difficult for today's child, or adult for that matter, to exert a tremendous

amount of mental effort towards what is important and to resist the distraction of the things they find interesting. This is not to say that we can't find something to be important and interesting at the same time, but there seems to be a division between the two in most cases. Kaplan and Kaplan use the concept of 'restorative experiences' or 'restorative environments' to refer to the opportunities for reducing the fatigue of directed attention (Kaplan & Kaplan, 1989). Hartig (1991) compared two groups of people and their ability to engage in activities that required directed attention. These two groups included those who vacationed in the wilderness with those who vacationed in urban areas. Those who vacationed in the wilderness showed a dramatic improvement in a proofreading task that they completed prior to their trip and after their trip. The groups of individuals who vacationed in urban settings showed a decline in the proofreading task from the pre-test that they took before the vacation (Hartig, 1991).

Students who have been exposed to environmental education or outdoor education programs often display more desirable behaviors and there are less classroom management problems (Lieberman & Hoody, 1998). They also display better attendance records and more environmentally responsible behaviors within their schools and their communities (Bartosh, 2003). The more students are exposed to outdoor and environmental education programs, the more they have a sense of place, the more they will continue spending time outdoors, the more they will be engaged in their communities, and the more likely they will take responsibility and take matters concerning environmental stewardship seriously (Duffin, Powers, & Tremblay, 2004). Environment-based education programs also help students in the area of cooperative learning and civic responsibility (Children & Nature Network, 2007).

Students learn more when using a curriculum with an integrated environmental context over a traditional curriculum within the traditional educational setting (Lieberman & Hoody, 1998). Outdoor education has also been connected with better performance on standardized tests (Broda, 2007). Studies of students in California and many other schools nationwide have shown that schools that use outdoor education, and other forms of experiential education, showed impressive gains in all academic disciplines. One of these programs showed a 27% increase in their science test scores (American Institutes for Research, 2005). When students are engaged with their schoolwork on a daily basis, they are more self-motivated and show greater achievement as a result of that engagement (Athman & Monroe, 2004). In a recent study in Florida, there were 400 ninth and twelfth grade students who were involved in either environment and outdoor education programs or traditional programs. After the environment and outdoor education programs, students filled out an Achievement Motivation Inventory (Athman & Monroe, 2004). At both grade levels it was shown that students who participated in the environmental and outdoor education programs scored much higher on the achievement motivation inventory when compared with students who participated in the traditional programs (Ernst & Monroe, 2004).

Many outdoor education programs require students to make use of their higher order thinking skills and their processing skills (Kenney, Militana, & Donahue, 2003). Some of the skills used frequently in outdoor education programs include observing, data collecting, recording, and measuring (Kenney, et al., 2003), these skills are necessary in a variety of classes across the curriculum. Many studies document the fact that students who participate in environmental education programs use the environment as an

integrated approach to education. These students score higher on standardized tests in subject areas including reading, writing, math, science, and social studies. Higher test scores are strongly correlated with schools that use environmental education programs, especially those programs that use environment as an integrating context (Lieberman & Hoody, 1998). Other studies have indicated that students also improve their overall GPA in addition to doing well on the standardized tests, and this leads to more scholarship awards. These students are perceived by their teachers to take more pride in their achievements, and show greater engagement and enthusiasm for learning (Duffin et al., 2004). Studies have shown that students also show a significantly greater ability to think critically about various problems (Ernst & Monroe, 2004).

Dr. Stephen R. Kellert (2005) of Yale University devotes an entire chapter of his book, *Nature and Childhood Development* to the subject of nature and its impacts on the developing child. He emphasizes that this time is necessary for a child to develop the capacity to be creative and have the ability to solve problems. He also states that nature contributes to the emotional and intellectual development of the child. It is clear from the literature that a child is impacted physically, emotionally, and educationally by nature. A child's exposure to nature or lack thereof will have a tremendous impact on his or her development.

METHODOLOGY

My goal during this action research based project was to gather both qualitative and quantitative data to answer my primary focus question and secondary research questions. The majority of the data collected for this treatment were qualitative in nature.

Prior to participating in this classroom research project based on the action research model, I received an informed consent exemption form signed by my administrator and an exemption by Montana State University's Institutional Review Board to ensure compliance for working with human subjects was maintained throughout the study.

The study was conducted with both of my high school biology classes at Vision Charter School. There were sixty students in total and the classes consisted primarily of ninth grade students, but there were also a few tenth and eleventh graders in each class. Both biology classes consisted of students with similar academic abilities. The independent variable for this treatment was the setting of the treatment class compared to the non- treatment class during a three-week portion of an ecology unit taught in April, 2013.

To avoid confusion, the non-treatment biology class will be referred to as the Gold Class, and the treatment class will be referred to as the Red Class. The Gold Class operated indoors, as it has the past three years that I have taught the course at Vision Charter School. The Red Class spent approximately 12-15 hours outdoors during the spring semester 2012-2013. The Gold Class worked on their daily journals, took notes, tests, quizzes, and participated in lab activities indoors. The Red Class spent the first five to ten minutes of each day walking outdoors before writing in their science journals, took notes outside, walked outdoors before tests and quizzes, and participated in the lab activities outdoors instead of indoors. Both classes were taught using the same content prescribed by my biology curriculum, and both classes covered the same Idaho Content Standards required by our state.

To begin, both classes took the Principles of Ecology Test at the beginning of the unit (Appendix A). Pre and Post Tests were used to collect qualitative data about content knowledge prior to the treatment and content knowledge as a result of the treatment. The pre-test enabled me to begin gathering quantitative data that would be compared to the data collected from students following the post-test at the end of the treatment period. This quantitative data allowed me to compare differences in student achievement between the Gold and Red classes and whether or not this achievement was directly correlated to exposure to the outdoor setting as opposed to the traditional indoor classroom.

The Science Motivation Survey was also used at the beginning and end of the treatment period to collect qualitative data concerning student motivation in the area of science (Appendix B). Clicker software was used to collect and calculate percentages of students who *never, rarely, sometimes, usually, or always agreed* with the statements on the survey. After students completed the motivation survey, the data was then used to determine the mean percent scores for each of the 5 categories for each class.

Student attitudes toward the outdoors were measured following the treatment period using the Outdoor Attitude Questionnaire (Appendix C). Again clicker software was used to collect responses and calculate percentages of answers given on the Outdoor Attitude Questionnaire. After students completed the questionnaire, the data was then used to determine the mean percentages of students who either *strongly agreed, agreed, disagreed, or strongly agreed* with the statements on the questionnaire. Several students who took the questionnaire were randomly selected for informal interviews to further explore responses given on the questionnaire (Appendix D).

During the second week of the treatment, the McCall Outdoor Science School (MOSS) came to work with the Red Class for 3 block periods, a total of 4.5 hours (Appendix E). MOSS worked indoors with this class for a portion of the first day. On the second and third day, students spent about 50 minutes of the period outdoors doing a water quality testing lab. Students were observed during this time to determine their level of engagement. Time on Task Check Sheets were used to determine student engagement during this time (Appendix G). The Gold Class covered the same content indoors during this time. Observations were also recorded in a teacher journal (Appendix F). Keeping a teacher journal allowed me to carefully note student reactions to being outdoors and their reactions on the days we were unable to be outdoors due to poor weather or other unforeseen circumstances. Student journals were used to collect qualitative information about student's thoughts during the treatment period (Appendix G).

Following their week with MOSS, students in the Red Class spent the next class period indoors working on an ecology case study. Students were informed that every 20 minutes we would take a break and go outside for a short five minute walk. Upon returning to the room students were asked to journal about the experience. We repeated this cycle three times during the period, a five minute walk followed by a three minute period of journaling. This took 24 minutes out of our block period and gave the students about 66 minutes to work on their case study.

The next class period students designed an experiment to test the abiotic factors in the drainage that borders our school property. They were asked to figure out how the abiotic factors might affect the biotic factors within the same drainage. Students in the

Red Class spent the whole period outdoors collecting data and testing their samples. We came back inside for the last 30 minutes of class so that students could use stereomicroscopes to inspect their water samples for various forms of life.

Times on Task Check Sheets were used throughout to collect quantitative data about student engagement during the treatment period (Appendix H). A quick survey of student engagement was observed about every ten minutes. If the class was on task, a plus sign was placed on that time slot. If students were off task, then a minus sign was placed in that time slot. The average percentage of time on task was then calculated for the class period. Students were observed and teacher field notes were collected throughout the treatment period to document observations. Students also answered poll questions throughout the treatment period on our class website about that day's activities. A triangulation matrix summarizing these data collection tools can be found in Table 1.

Table 1
Data Triangulation Matrix

Focus Questions	Data Source 1	Data Source 2	Data Source 3
Primary Question: Does frequent exposure to the outdoors increase student motivation and student achievement?	Teacher Journal	Teacher made tests (pre and post) and teacher made quizzes.	Motivation survey and student interviews.
Secondary Questions: Do students exhibit greater levels of motivation and more positive attitudes as a result of frequent exposure to the outdoors?	Student Questionnaires	Student and Teacher Journals	Motivation survey and student interviews.
Does outdoor education increase student time on task?	Time on task check sheets	Teacher Journals	Student surveys
Does outdoor education reduce student stress levels?	Student Interviews	Student Surveys	Student Journals

DATA AND ANALYSIS

On day 1 of the treatment, students in the Red and Gold classes took the Ecology Pre-Test (Appendix A). The Red Class averaged 63% on the pre-test. The average for the Gold Glass was 58%. The average score on the post-test for the Red Class increased to 71% with 19 students increasing their scores from 2% to 32%. Students in the Gold

class increased their average score to 67% with 15 students showing an overall increase ranging from a low of 1% to a high of 23% (Figure 1).

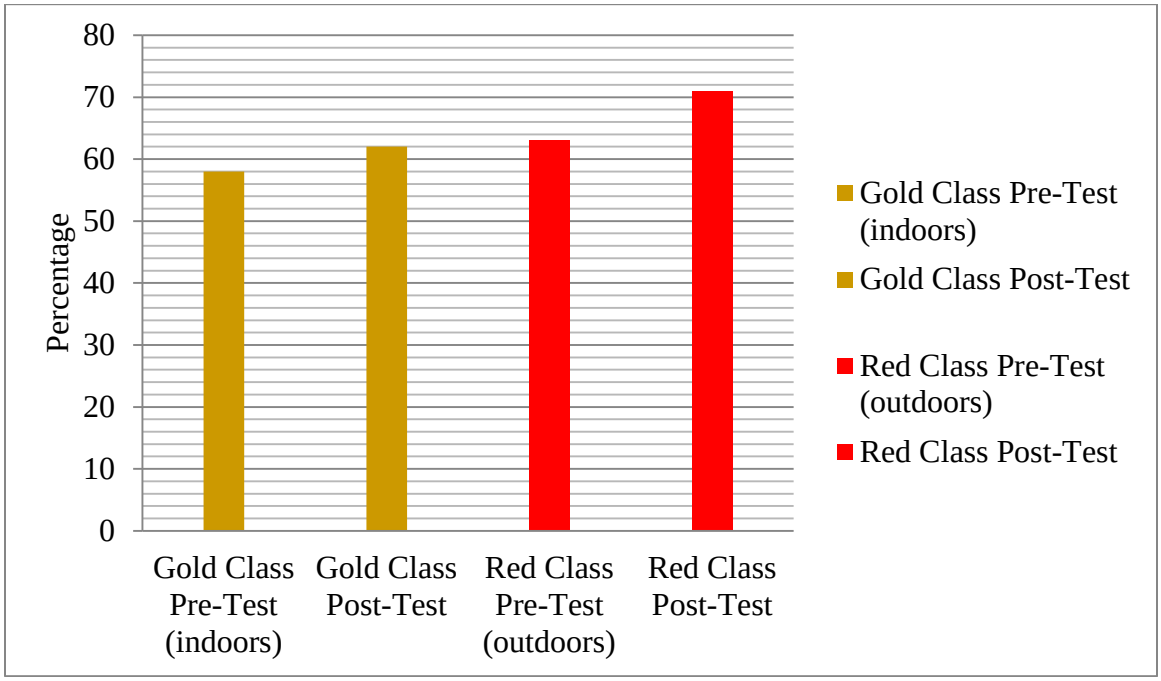

Figure 1. Pre and post ecology test scores, (*N* = 60).

Also prior to the treatment period, students were given a Science Motivation Survey to measure levels of motivation related to science (Appendix B). On the post survey the percentage of students in the Red Class indicating that they enjoy learning science increased by 8% compared to the Gold Class that did not show an increase in this area. In the Red Class there was a 10% increase in the number of students who believe that the science they learn has practical value for them, compared to a 2% decrease in the Gold Class. In the Red Class there was a 7% increase in the number of students indicating that they thought about how they would use science in the future, compared to a 20% decrease in the Gold Class. In the Red class the number of students who believed that science relates to their personal goals increased by 5% and increased by 3% in the Gold Class (Figure 2).

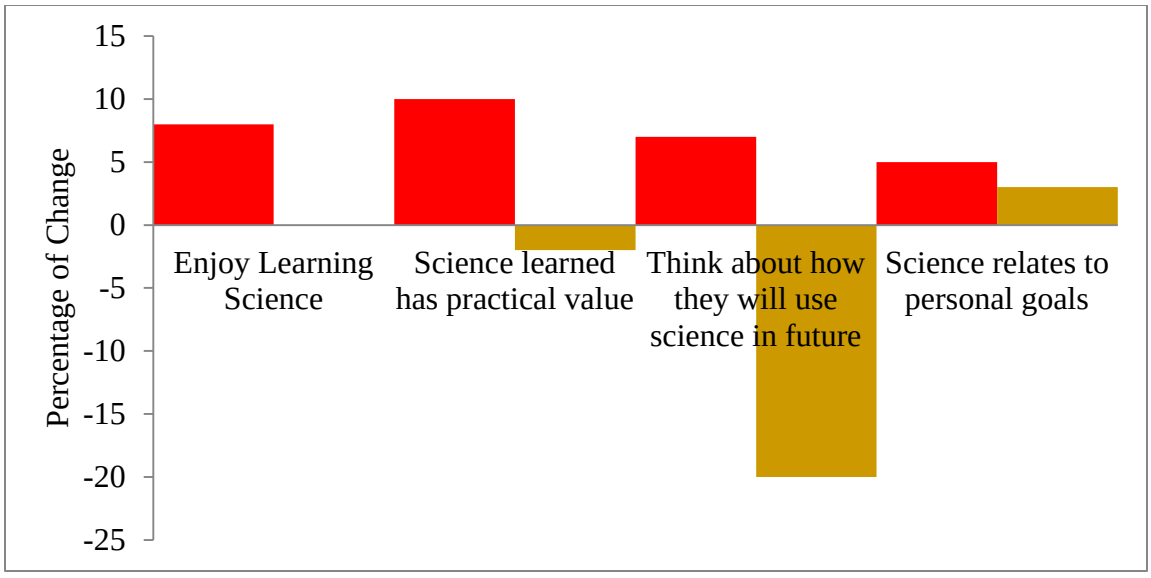

Figure 2. Science motivation survey: personal perspectives, (*N* = 60).

In the Red class there was an 8% increase in the number of students who stated that they like science that challenges them, compared to a 28% decrease in the Gold Class. In the Red class there was a 19% increase in the number of students indicating that if they were having trouble learning science they would try to figure out why, compared to a 10% increase for the Gold Class. In the Red Class there was a 7% increase in the number of students who stated that the science they learn is more important than the grade they earn, compared to a 1% drop for students in the Gold Class (Figure 3).

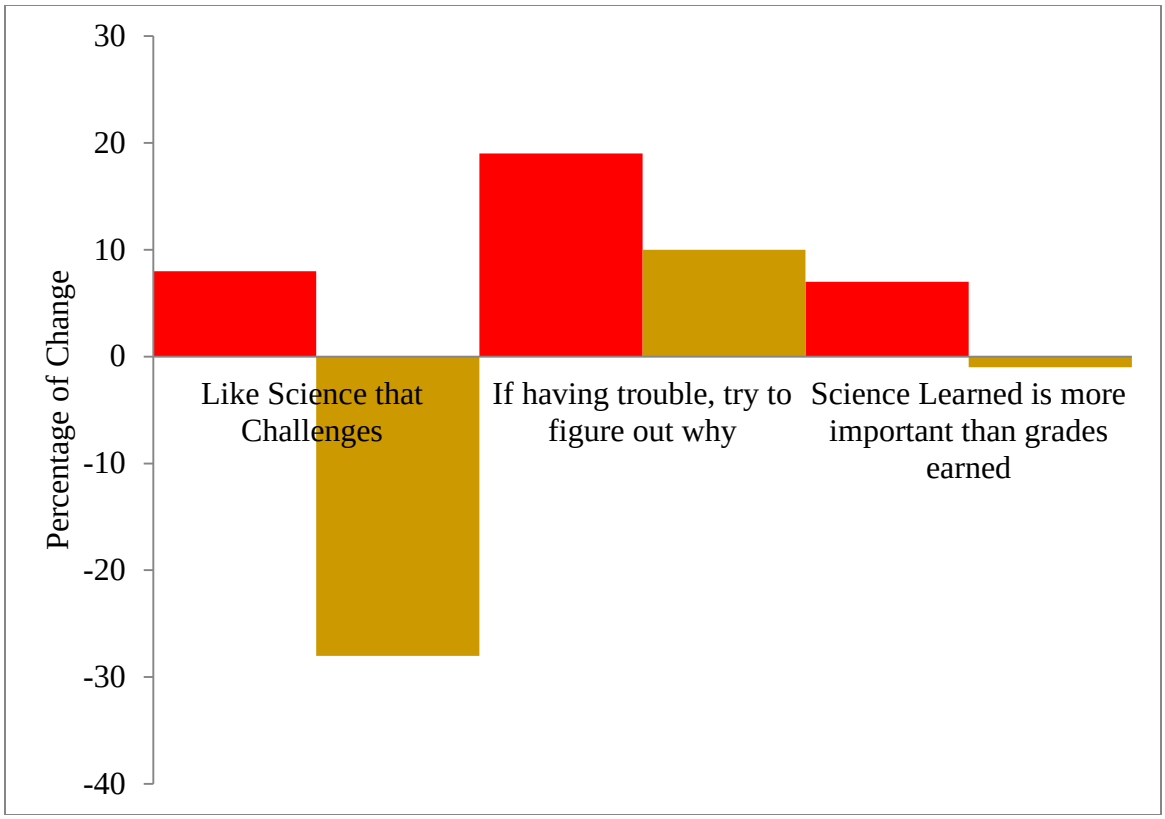

Figure 3. Science motivation survey: self motivation, (*N*=60).

In the Red Class there was a 12% increase in students who expected to do just as well or better than their peers in science, compared to an increase of 8% for the Gold Class. There was also a 16% decrease in the number of students who were concerned that other students are better at science than they are, compared to a 2% decrease in the Gold Class. In the Red class there was a 14% increase in the number of students indicating that they like doing better than their peers on their science exams compared to an 8% increase in the Gold Class (Figure 4).

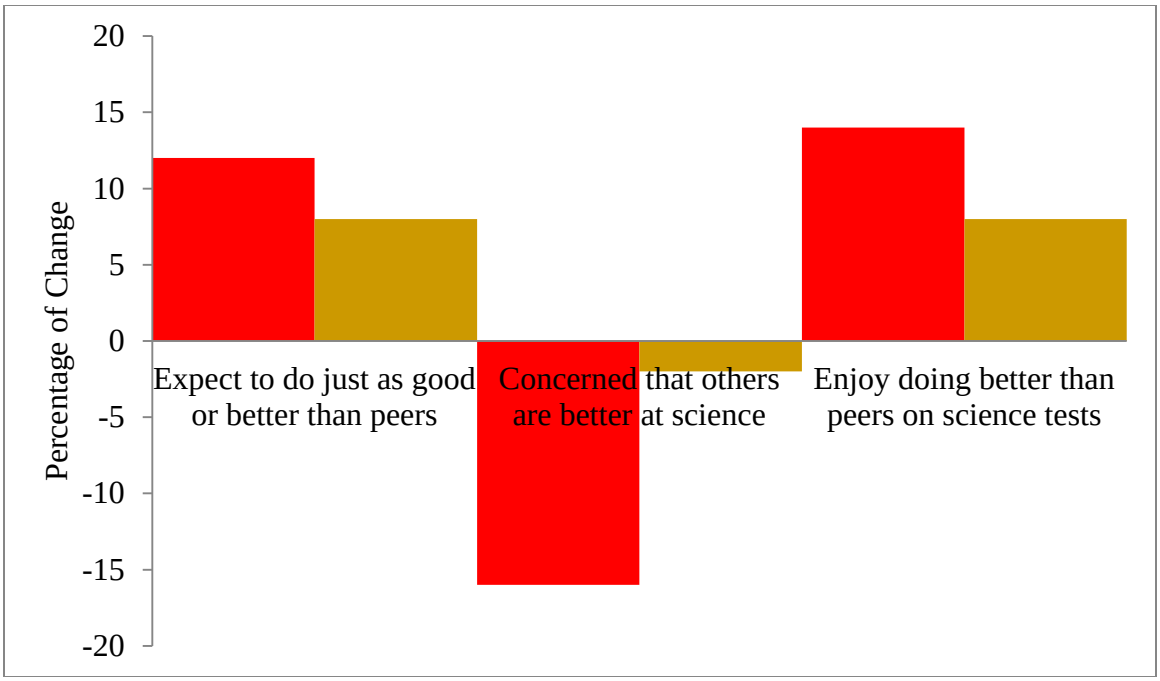

Figure 4: Science motivation survey: confidence, (*N* = 60).

In the Red Class there was a 21% increase in the number of students indicating that they were confident they will do well on their science tests, compared to a 9% decrease in the Gold Class. In the Red Class the number of students stating that they experienced anxiety over tests dropped by 1% compared to a 12% increase in the Gold Class. There was an 8% decrease of students in the Red Class who indicated that they worried about failing science tests following the treatment compared to a 2% decrease for students in the Gold Class. There was a 4% decrease in the number of students indicating they hate taking science tests in the Red Class compared to a 14% increase in the Gold Class. In the Red Class there was a 16% increase in the number of students who believed they can master the knowledge and skills in science compared to a 2% decrease in the Gold Class (Figure 5).

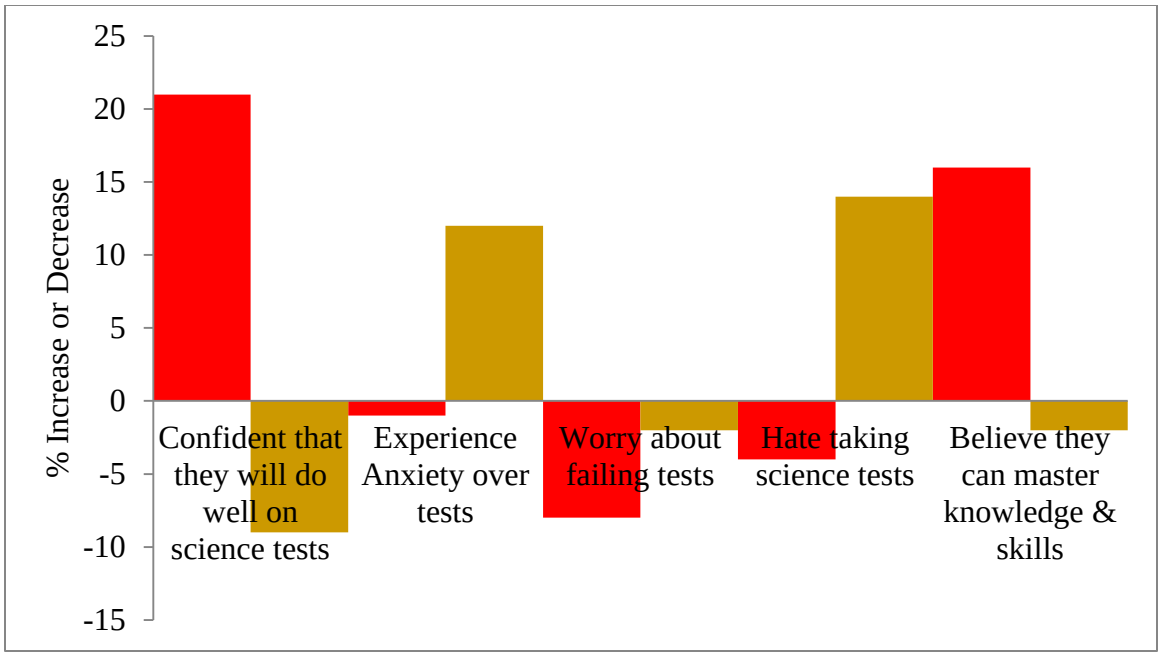

Figure 5. Science motivation survey: assessment confidence, (*N* = 60).

Both the Red and Gold Classes participated in an Outdoor Motivation Questionnaire following the treatment period (Appendix C). Eighty-nine percent of the students in the Red Class indicated that they prefer working outdoors and 92% of the Gold Class indicated the same. One student from the Red Class stated, “When I'm inside, I don't feel like I can pay attention, because I'm thinking about going outside and I can't focus.” Another student stated, “When I'm outside I feel more engaged.” Sixty-five percent of the Red Class and 70% of the Gold class indicated that being indoors makes them feel anxious. One student stated after going outside for just five minutes that “I wasn’t confined to a small classroom with lots of students.” Another student indicated after being outdoors that “I didn’t feel like I was trapped.” One student stated, “I find it much easier to concentrate outdoors.” Another student said, “I feel focused and good, I feel like I can remember stuff a lot easier when outside.” Seventy-nine percent of the Red Class and 78% of the Gold Class indicated that they would rather sit in the grass outside over sitting in a desk inside to do their schoolwork. Ninety-three percent of the

Red Class and 93% of the Gold Class indicated that they feel renewed when they are outdoors. One student stated, “I feel awake and refreshed.” Another student said “I feel rejuvenated when outside, nothing makes me happier than being outdoors.” Eighty-six percent of the Red Class and 81% of the Gold Class indicated that they felt more motivated when working outdoors. One student stated, “I work a lot faster and I am more productive than I have ever felt in the classroom.” Another student said, “Being outdoors helped me focus and I actually got the assignment done in class!” Yet another student indicated, “I get more work done, I work harder.” Eighty-six percent of the Red Class and 89% of the Gold Class indicated that they felt like they could accomplish undesirable tasks if they were allowed to spend some time outdoors first (Figure 6). One student stated that, “I feel like I can accomplish more and feel like I pay attention more and my mind doesn’t wander.”

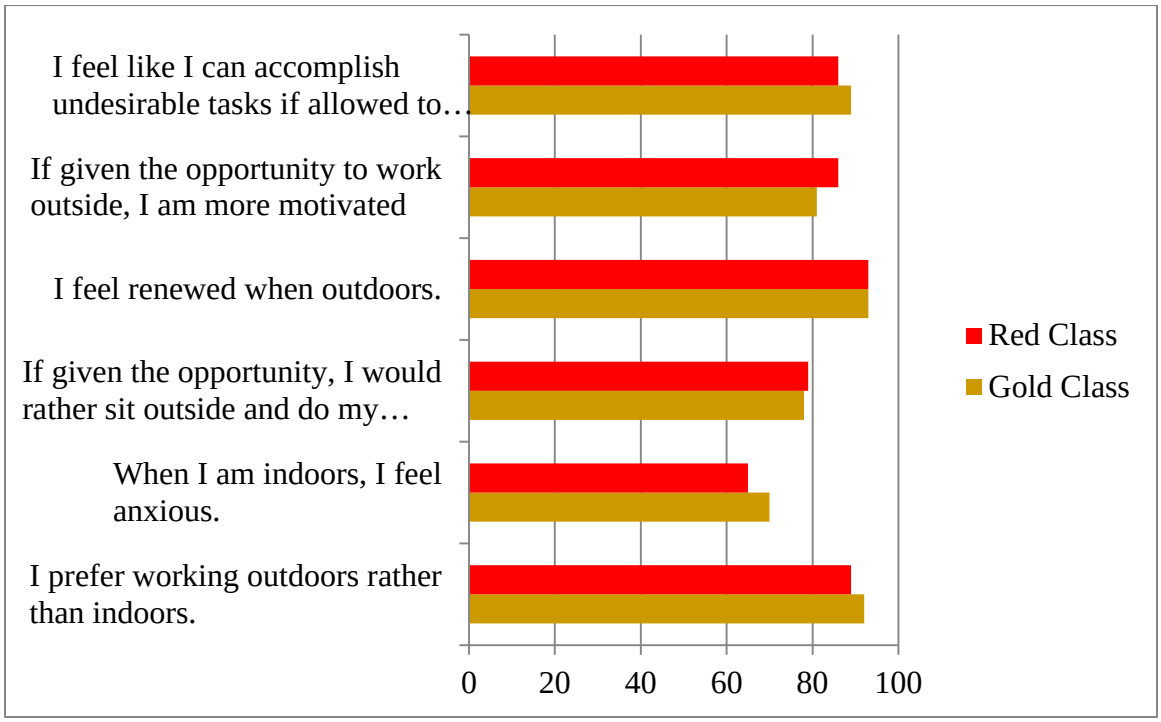

Figure 6. Outdoor motivation questionnaire, (N = 60).

Students were engaged an average of 95% of the time during their time outdoors. Some notable observations included observing students who typically do not take an active role in class, or who rarely speak up during class time indoors, taking on a more active role when the classroom was moved outdoors. Several of these students took on a leadership role and were very vocal within their lab groups. These students exhibited more confidence and were more engaged throughout the period than previously observed within the classroom. It was also observed during this time that very few if any management problems arose while students were outdoors. One student said, “My favorite thing about these lessons was that we got to go and do the activities outside.” Another student stated, “Today was different because we got to go outside for our activity and I really looked forward to doing that, I really enjoy going outside for at least part of the class.” Another student stated, “When I'm inside I don't feel like I can pay attention.” Another student stated that “when I'm outside I feel more engaged and informed because when I see science first-hand, I learn more than just reading in a book.” Another student mentioned, “It felt like we were actually investigating an ecosystem outdoors, whereas indoors we would have just been getting water from the sink. Outside we also felt clear to think, but inside we feel cramped and don't have the fresh air we need.”

Several days outside were cold and windy. One student responded that they would still rather be outdoors because “I feel more comfortable outside, I don’t feel as cramped up and my thoughts open up rather than close.” Another student responded, “Even though the weather was chilly, I had a lot of fun and found it all interesting. The reason I am happy we went outside is because I feel that I can understand.”

When students in the Red Class were asked which day of the three days with the McCall Outdoor Science School they preferred, 91% of the students picked either Day 2 or 3 which were both mostly conducted outside while 9% preferred Day 1 which was conducted mostly indoors.

The Gold Class was taught the same content indoors during this time. Using the Time on Task sheets and an outside observer, it was observed that the Gold class was also engaged during this time, but there were a few more management issues and the observed time on task was lower than the Red Class at 85%.

In response to the frequent trips outdoors students stated that “The break gave them something to look forward to.” They also stated, “They felt like they were able to focus more and get more work accomplished.” One student stated that they “actually got the case study done before class was over.”

Students were engaged and motivated the majority of the time; they drove the investigations without much teacher input. One student indicated, “I liked being outside, collecting data. We got to really be involved in it, and we weren't just sitting there. To me, science is about getting your hands dirty.” Another student stated, “I know that because of the days we have spent outside, my performance in science has increased.”

INTERPRETATION AND CONCLUSION

This study provides evidence that students, who were exposed to the outdoors on a regular basis, exhibited more confidence and were more engaged in the learning process. Ultimately, these factors over time could lead to increased student achievement. Many of my students, who were relatively unengaged when doing work inside the

classroom, really blossomed when we were outside and exhibited greater confidence in their ability to solve problems. These students also had more positive interaction with their peers. Outdoor education has also been shown to help students improve their communication skills, work as a team, and provide them with a diverse educational experience (Boss, 2001). I observed similar behaviors in my study. Student attitudes regarding science improved, as demonstrated through the Science Motivation Survey. More students in the Red Class indicated that they enjoy science and think about how it might be relevant to their lives. Students in the Red Class also indicated that they felt more confident concerning tests and mastery of science skills. Students in the Red Class displayed a more positive outlook toward science. This was clear based on students' responses on the Science Motivation Survey. In the Red class there was an 8% increase in the number of students who stated that they like science that challenges them, compared to a 28% decrease in the Gold Class.

Both classes indicated in the Outdoor Motivation Survey and in their journals that they prefer being outdoors whenever possible. Even brief exposure to the outdoors during the class period seemed to have a tremendous impact. Many of the students indicated that being outdoors was a stress release for them. It seems reasonable that student motivation and achievement may be hindered by the stress faced by today's teens within the traditional classroom. Most classrooms are overcrowded; students are packed into rooms like sardines. It is apparent from this study that these conditions add to rather than reduce the amount of stress students experience on a daily basis. It is possible that these factors may even exasperate pre-existing stress that is brought to school from various home environments and may reduce their levels of motivation, ultimately leading

to a decrease in student achievement. It is clear from the literature that students who frequently come into contact with nature are promoting recovery from the mental fatigue of their directed attention, and they are able to enhance their mental focus (Kaplan & Kaplan, 2005).

It is also clear from this study that students exhibited more confidence in science when exposed to the outdoors on a regular basis. There was a strong relationship concerning students who spent time outdoors and their confidence in science. On the Science Motivation Survey the Red Class showed a 21% increase in the number of students indicating that they were confident that they will do well on their science tests, compared to a 9% decrease in the Gold Class. Also, the Red Class showed a 16% increase in the number of students who believed that they could master the knowledge and skills in science compared to a 2% decrease in the Gold Class. Both of these survey items show a dramatic improvement in the students' academic confidence even after just 3 weeks of outdoor exposure during the treatment period. However, it is unclear what the exact connection between the outdoor environment and student confidence in science is. Understanding this relationship would be interesting to study in the future.

Although a clear relationship between outdoor education and student motivation exists, there are still several questions. Were the results from this study based on the fact that students just got to experience something new and different for a period of time? Sometimes changing the normal classroom routines, or having a guest speaker, can generate student motivation leading to greater achievement. Is it possible that my students were more motivated and showed improved academic achievement just because we changed things up a bit? I would also like to know whether or not consistent

exposure to the outdoors can be incorporated into the classroom on a daily basis and what kind of effect this consistent routine would have on students in the long term? There are so many variables that a yearlong study might be appropriate when trying to answer these questions.

VALUE

This experience has been extremely enlightening. I now see even more value in using surveys and questionnaires, along with some of the other data collection methods, on a more regular basis. I definitely believe that I will use the surveys and questionnaires used in this study at the beginning of each year. I can see extreme value in gathering baseline data on each of my classes at the beginning of the year if I want to address the many needs of my students. Use of these data collection techniques will help inform my teaching and this type of formative assessment is critical if I want improve as an educator. I also found great value in journaling at the end of a class period while my next class began working on their bell work. Journaling was not always possible, but when I was able to journal I found it to be very useful for reflection. Reflective teaching is not just semantics for me any longer. These first hand reflections were important, enabling me to remember what worked, what did not work, how my students reacted, and finally, what I would change in my approach. I also felt as though this study gave me a new appreciation for my students and more of an open mind that was willing to listen to them and place value in their opinions. I now see students as an asset to my professional development. I believe their feedback is critical if I want to improve on a yearly basis. I guess, intuitively, I already knew this, but this action research based project has forced me to apply this knowledge and see the benefits.

In relationship to what I learned about taking my students outdoors, there are several things that stand out to me. First of all, our students are so completely inundated with technology and screen time that they are losing something very valuable in their lives. It is my job as a science teacher to help them reconnect with this portion of their lives that seems to be rapidly disappearing. I think every teacher can use the environment, or the outdoors, as an integrating context for their curriculum regardless of the discipline area. The question is whether or not we are willing to give up some traditional ideas in order to better our teaching. Secondly, the outdoors help students cope with stress and it is to our benefit as teachers to help students deal with stress in a positive manner. Taking a few moments or just one or two class periods each week to take your students outdoors has far greater benefits than costs. Thirdly, confidence goes a long way towards helping students achieve great things. I have always tried to instill confidence in my students, but this seems to be a natural byproduct of taking them outdoors. I am still unsure of the exact relationship between the outdoors and student confidence, but there definitely seemed to be a relationship.

This action research based study enabled me to see the importance of a learning partnership that encourages both students and teachers to be vested at the same time. If students know you care and you are interested in their well being, they will be motivated to work hard for you. The simple act of taking them outside shows you care about their well being and you want to see them succeed both academically and personally.

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APPENDICES

APPENDIX A

PRINCIPLES OF ECOLOGY PRE/POST-TEST

Ecology Pre/Post-Test

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. What term is defined as the number of individuals that live in the same area at the same time?
a. Sample
b. carrying capacity
c. doubling time
d. population

____ 2. What do biologists call the rate at which reproduction increases the size of a population?
a. birthrate
b. density
c. mobility
d. mortality

____ 3. For which of these populations would you expect to find the rates of immigration and emigration to be nearly zero?
a. mice in a field
b. fish in a pond
c. bees on flowers
d. birds in a forest

____ 4. What two factors cause populations to decrease?
a. emigration and birthrate
b. immigration and birthrate
c. emigration and mortality
d. immigration and mortality

____ 5. What two factors contribute to an increase in the size of a population?
a. immigration and mortality
b. birthrate and immigration
c. emigration and birthrate
d. mortality and birthrate

____ 6. If the rates of immigration and emigration of a population are the same, what would cause the population to continue to increase in size?
a. if the mortality and birthrate are equal
b. this population could not increase
c. if the mortality is greater than the birthrate
d. if the birthrate is greater than the mortality

____ 7. What type of population change is altered when birth control is used?
a. emigration
b. mortality
c. immigration
d. birthrate

Use the terms listed in the Key to identify the following statements. Any one term may be used more than once or not at all.

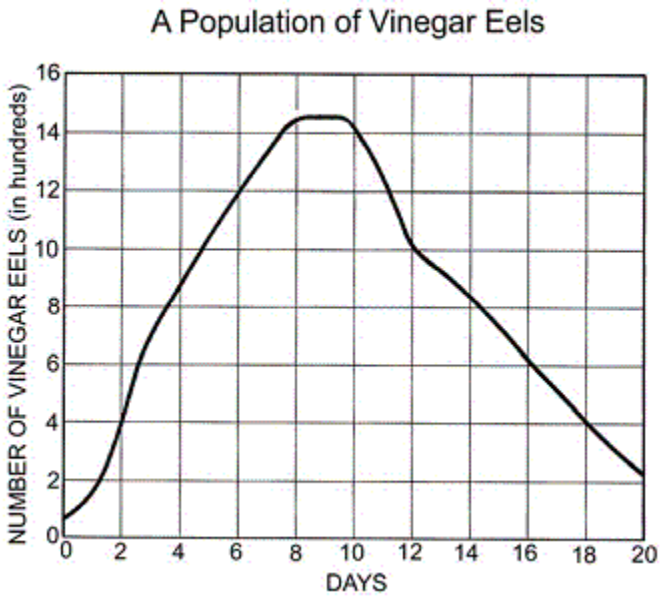
Key
A. emigration
B. immigration
C. mortality
D. birthrate

____ 8. The number of organisms that die in a population in a given time.
a. A
b. B
c. C
d. D

____ 9. The number of organisms that move out of a given area.
a. A
b. B
c. C
d. D

____ 10. The rate of reproduction in a population.
a. A
b. B
c. C
d. D

Use graph of a population of vinegar eels (a type of roundworm) to answer the following questions.



____ 11. On what day was the rate of change for the population zero?
a. Day 1
c. Day 9

b. Day 5
d. Day 12

____ 12. During which period did the rate of change increase the most?
a. Day 1–2
b. Day 2–3
c. Day 6–7
d. Day 8–9

____ 13. On which day was the rate of decrease of the population the greatest?
a. Day 9–10
b. Day 11–12
c. Day 14–15
d. Day 19–20

____ 14. If the decrease in the population continued at the same rate, on what day would the population cease to exist?
a. 22
b. 24
c. 26
d. 28

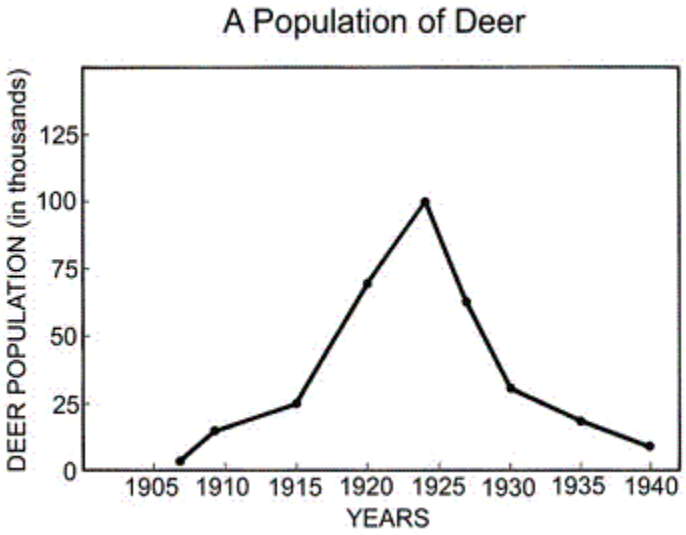
____ 15. How does weather affect the biotic environment?
a. It seldom is a limiting factor.
b. It does not affect the biotic environment.
c. It often is a limiting factor.
d. It affects only producers.

____ 16. What is true about the resources needed to support a population of animals?
a. usually constant
b. always increasing
c. unrelated to energy
d. always finite

____ 17. What factor usually is responsible for limiting the size of each population in the biosphere?
a. the density of decomposers
b. the opportunity to locate mates
c. the increase in individuals born each year
d. the carrying capacity of the ecosystem

The following story and graph are based upon a hypothetical study. Use this information to answer the following questions.

A 2,850-**km**^{2} area of land supported a population of deer and wolves. In 1915 a program was started that was intended to protect the deer by the elimination of the wolves. By 1925 all of the wolves had been removed. The deer population, at its highest point, reached 100,000 individuals in 1924. After that year, the number of deer in the area dropped as shown by this graph.



____ 18. What role did the wolves play in the control of the deer population?
a. migrating between different feeding areas
b. driving the deer from forested regions
c. limiting the total numbers of deer
d. eliminating the older deer of the herds

____ 19. The population crash continued after the middle 1920s. This probably occurred because grasses, shrubs, and trees were
a. killed by the hungry deer.
b. damaged by the wolf hunters.
c. destroyed by wild fires.
d. overfertilized by deer wastes.

____ 20. What change in the food chain might restore the balance in this system?
a. removing other plant eaters
b. reintroducing the wolves
c. providing food for the deer during winter
d. expanding the area where deer are able to roam

Read the selection below.

Every three to five years, lemmings march for miles, scarcely stopping to eat or rest. Eventually they eliminate themselves by plunging into lakes, rivers, or other bodies of water, where they drown. The cause of this behavior has been a mystery for a long time. In 1963, hordes of lemmings in Sweden moved southward. At the peak of their movement, 44 lemmings passed a certain point every minute. It could be that lemmings sense that their population is approaching the local environment's carrying capacity.

Now, analyze the selection using the key to characterize the type of information in the following sentences from the selection.

Key
A. problem (stated or implied)
B. hypothesis (possible solution to the problem)
C. statement of observations

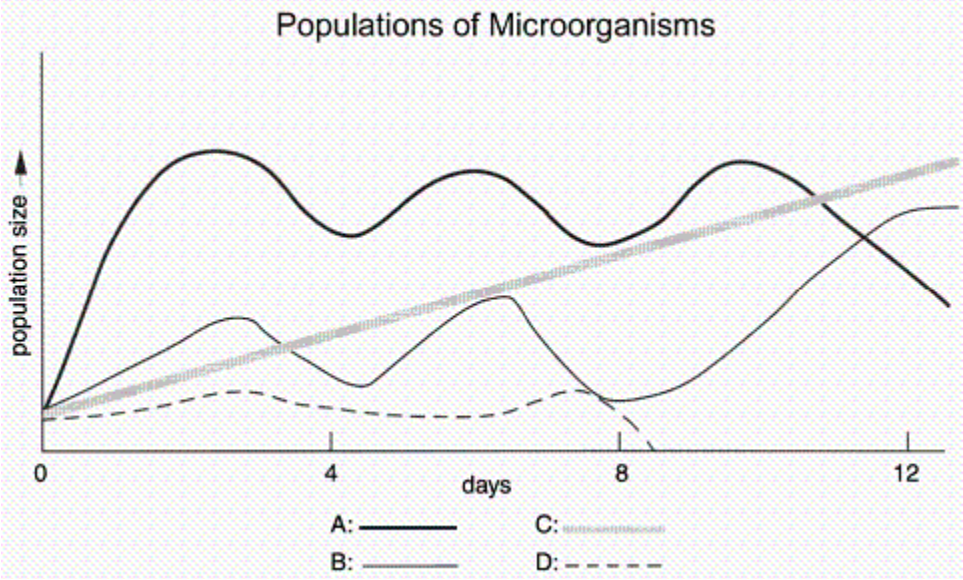
____ 21. Every three to five years, lemmings march for miles, scarcely stopping to eat or rest. Eventually they eliminate themselves by plunging into lakes, rivers, and other bodies of water where they drown. The cause of this behavior has been a mystery for a long time.
a. A
b. B
c. C

____ 22. In 1963, hordes of lemmings in Sweden moved southwards.
a. A
b. B
c. C

____ 23. At the peak of their movement, 44 lemmings crossed a certain point every minute.
a. A
b. B
c. C

____ 24. It could be that lemmings sense that their population is approaching the local environment's carrying capacity.
a. A
b. B
c. C

Use the graph and information to answer the questions that follow.



Four different species of microorganisms are added to a glass jar full of water and the jar is placed in a sunny window. Every day a sample of water is examined and the population of each species determined.

____ 25. Which species is the producer?
a. A
b. B
c. C
d. D

____ 26. Which species probably is a decomposer?
a. A
b. B
c. C
d. D

____ 27. Which species is the least affected by the population size of the other three species?
a. A
b. B
c. C
d. D

____ 28. The death of a food organism is disadvantageous to a
a. predator.
c. decomposer.

b. parasite.
d. producer.

Read the story below and study the chart. Then use the Key to answer the questions that follow.

Two types of insects, species X and species Y, look almost identical. Populations of these insects are grown in culture bottles that were prepared and maintained under the conditions indicated in the chart. Ten insects of each type were placed together in each bottle. The insects were adequately fed. After six months, the percentage of insects of each type present in each bottle was calculated, as shown below.

		CULTURE 1	CULTURE 2	CULTURE 3	CULTURE 4	CULTURE 5	CULTURE 6
% OF INDIVIDUALS AFTER 6 MONTHS	Species X	100%	10%	75%	15%	40%	0%
	Species Y	0%	90%	25%	85%	60%	100%
CONDITIONS	Temperature °C	30°C	30°C	22°C	22°C	15°C	15°C
	Relative Humidity	80%	20%	80%	20%	80%	20%

Key
A. insects of species X
B. insects of species Y
C. both kinds of insects
D. unknown from given information

____ 29. Which type(s) would survive freezing winters (<0°C)?
a. A
b. B
c. C
d. D

____ 30. Which kind(s) of insect would have the best chance of surviving in the tropics?
a. A
b. B
c. C
d. D

____ 31. Which kind(s) would you expect to find surviving at relative humidities of 40% to 60% and temperatures of 20°C to 22°C?
a. A
b. B
c. C
d. D

____ 32. Two types of predators that compete for food and habitats in their ecosystem are probably in the same
a. population.
b. niche.
c. species.
d. food chain.

The outcomes (responses) to several types of interactions between organisms have been categorized in the chart below. Use this information to match the following terms with the response (A, B, C, or D).

Response	Organism I	Organism II
A	harmed	benefited
B	benefited	benefited
C	benefited	unaffected
D	harmed	harmed

____ 33. predation
a. A
b. B
c. C
d. D

____ 34. parasitism
a. A
b. B
c. C
d. D

____ 35. symbiosis
a. A
b. B
c. C
d. D

____ 36. Which of the following is an example of competition?
a. An alga makes food used by a fungus.
b. A wolf eats a sheep belonging to a human who would have eaten the sheep.
c. A lynx eats a wild rabbit.
d. A remora eats bits of food that are missed by a shark.

____ 37. A house cat kills and eats a mouse. In this relationship the mouse is the
a. predator.
b. host.
c. prey.
d. parasite.

____ 38. What is true for predation AND parasitism?
a. The food source is killed as a result.
b. The relationship involves a carnivore and a herbivore.
c. The relationship is harmful to one of the organisms in the relationship.
d. all of these

Use the Key to identify the biological relationship in the following statements.

Key
A. competition
B. symbiosis
C. parasitism
D. predator-prey

____ 39. Termites eat wood but cannot digest it. Microorganisms that live in the termites' digestive tracts digest the wood. The microorganisms cannot live outside the termites' bodies.
a. A
b. B
c. C
d. D

____ 40. Two animals, a coyote and a snake, chase a gopher. The gopher escapes. The coyote and the snake encounter one another. The coyote and the snake back away from each other in a standoff. Describe the interaction between the coyote and the snake.
a. A
b. B
c. C
d. D

____ 41. An eagle sees a young rabbit and dives to catch it from aloft.
a. A
b. B
c. C
d. D

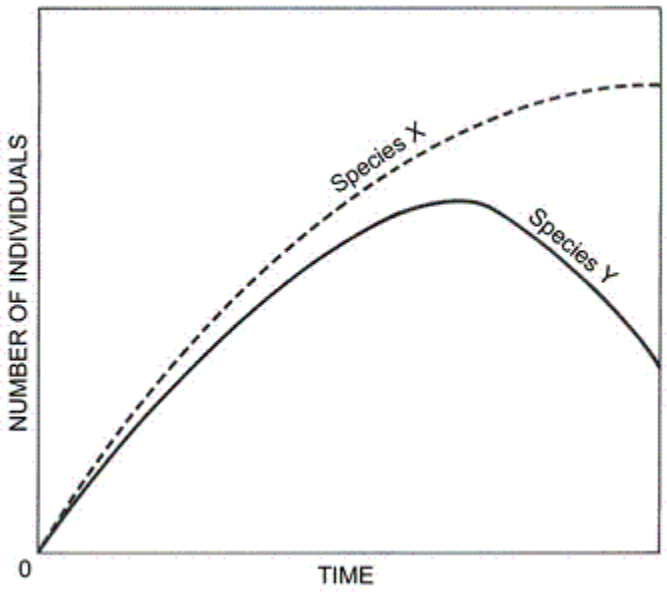
____ 42. Tapeworms live in animal intestines and grow new segments as they absorb digested foods. An animal may become undernourished as the tapeworms grow more new segments.
a. A
b. B
c. C
d. D

____ 43. A sea star attaches its tube feet to an oyster's shell and pulls until the oyster's fatigued muscles can no longer hold the shell closed. The sea star then eats the oyster.
a. A
b. B
c. C
d. D

____ 44. Garden seeds that sprout only inches apart are crowded, causing the plants' growth and fruiting to be reduced.

a. A
b. B
c. C
d. D

Study the graph of populations of two types of organisms in the same ecosystem. Based on the information in the graph, match the keyed responses to the observations that follow.



Key

A. The graph might represent the situation described.
B. The graph could not represent the situation described.
C. The situation described is unrelated to the graphed data.

____ 45. Species X is a herbivore that feeds exclusively on Species Y, a producer.

a. A
b. B
c. C

____ 46. Species X is a predator that eats Species Y and other species not shown on the graph.

a. A
b. B
c. C

____ 47. Species X and Y are competitors that use the same food until it becomes scarce, then seek other foods.

a. A
b. B
c. C

____ 48. Species X is a decomposer and Species Y a large carnivore.
a. A
b. B
c. C

____ 49. Individuals of Species X are smaller than those of Species Y.
a. A
b. B
c. C

____ 50. Species X and Y are dependent on each other and live in a symbiotic relationship.
a. A
b. B
c. C

APPENDIX B

SCIENCE MOTIVATION SURVEY

Name:_____Date:_____Grade:_____

01. I enjoy learning the science.
O Never O Rarely O Sometimes O Usually O Always
02. The science I learn relates to my personal goals.
O Never O Rarely O Sometimes O Usually O Always
03. I like to do better than the other students on the science tests.
O Never O Rarely O Sometimes O Usually O Always
04. I am nervous about how I will do on the science tests.
O Never O Rarely O Sometimes O Usually O Always
05. If I am having trouble learning the science, I try to figure out why.
O Never O Rarely O Sometimes O Usually O Always
06. I become anxious when it is time to take a science test.
O Never O Rarely O Sometimes O Usually O Always
07. Earning a good science grade is important to me.
O Never O Rarely O Sometimes O Usually O Always
08. I put enough effort into learning the science.
O Never O Rarely O Sometimes O Usually O Always
09. I use strategies that ensure I learn the science well.
O Never O Rarely O Sometimes O Usually O Always
10. I think about how learning the science can help me get a good job.
O Never O Rarely O Sometimes O Usually O Always
11. I think about how the science I learn will be helpful to me.
O Never O Rarely O Sometimes O Usually O Always
12. I expect to do as well as or better than other students in the science course.
O Never O Rarely O Sometimes O Usually O Always
13. I worry about failing the science tests.
O Never O Rarely O Sometimes O Usually O Always
14. I am concerned that the other students are better in science.
O Never O Rarely O Sometimes O Usually O Always
15. I think about how my science grade will affect my overall grade point average.
O Never O Rarely O Sometimes O Usually O Always
16. The science I learn is more important to me than the grade I receive.
O Never O Rarely O Sometimes O Usually O Always
17. I think about how learning the science can help my career.
O Never O Rarely O Sometimes O Usually O Always
18. I hate taking the science tests.
O Never O Rarely O Sometimes O Usually O Always
19. I think about how I will use the science I learn.
O Never O Rarely O Sometimes O Usually O Always
20. It is my fault, if I do not understand the science.
O Never O Rarely O Sometimes O Usually O Always
21. I am confident I will do well on the science labs and projects.
O Never O Rarely O Sometimes O Usually O Always
22. I find learning the science interesting.
O Never O Rarely O Sometimes O Usually O Always

23. The science I learn is relevant to my life.
    O Never O Rarely O Sometimes O Usually O Always
24. I believe I can master the knowledge and skills in the science course.
    O Never O Rarely O Sometimes O Usually O Always
25. The science I learn has practical value for me.
    O Never O Rarely O Sometimes O Usually O Always
26. I prepare well for the science tests and labs.
    O Never O Rarely O Sometimes O Usually O Always
27. I like science that challenges me.
    O Never O Rarely O Sometimes O Usually O Always
28. I am confident I will do well on the science tests.
    O Never O Rarely O Sometimes O Usually O Always
29. I believe I can earn a grade of "A" in the science course.
    O Never O Rarely O Sometimes O Usually O Always
30. Understanding the science gives me a sense of accomplishment.
    O Never O Rarely O Sometimes O Usually O Always

Science Motivation Questionnaire (SMQ)
(Glynn & Koballa, 2006)

APPENDIX C

OUTDOOR MOTIVATION QUESTIONNAIRE

Student Name:
Class/Grade:
Date:

Please respond to the following statements. Be as honest as possible, your input is extremely valuable and will be completely confidential. Circle the letters that correspond with your answer choice.

A=Agree TA=Tend to Agree TD=Tend to Disagree D=Disagree

Part 1	Agree	Tend to Agree	Tend to Disagree	Disagree
I prefer working outdoors rather than indoors.	A	TA	TD	D
When I am indoors, I feel less stressed.	A	TA	TD	D
When I am indoors, I feel anxious.	A	TA	TD	D
I feel safe inside and don't want to be outdoors.	A	TA	TD	D
If given the opportunity, I would rather sit and do my schoolwork in the grass than at a desk.	A	TA	TD	D
I feel like I think more clearly when I am indoors	A	TA	TD	D
I feel more distracted when I am outside	A	TA	TD	D
I feel renewed when I am outdoors	A	TA	TD	D
If I get the opportunity to work outside, I am more motivated.	A	TA	TD	D
I feel like I can accomplish undesirable tasks if I am allowed to spend some time outside first.	A	TA	TD	D

APPENDIX D

STUDENT INTERVIEW QUESTIONS

Name of Interviewer:_____Date:_____

1. How much time do you spend outdoors on a weekly basis? What do you do (i.e. relax, organized sports, camp, go for a walk, clear your head)?

2. What are your reasons for staying indoors?

3. Do your parents encourage you to go outside or do you do things outdoors as a family?

4. Do you feel better or worse when you have been outdoors for a long period of time? Why?

5. Can you recall a time where your teacher taught the lesson outside instead of inside? How did you feel after the lesson?

6. Do you feel stressed out at school?

7. When do you feel the most stressed at school?

8. Do you ever just go outside to relax or do you have to be doing something in particular?

9. What kind of "green space" (areas with grass, trees, nature, etc.) do you have at home?

10. Do you feel happier in the spring and summer months or do you prefer winter? Why?

11. Is there anything you would like to add?

APPENDIX E

MCCALL OUTDOOR SCIENCE SCHOOL LESSON PLAN

MOSS Three Day Outreach Lesson Plan

Objectives:

- Students will have a basic understanding of hydrology.
- Students will be comfortable with the scientific process.
- Students will be comfortable with the following Vocab:
    - Ecosystem
    - ABCs of life
        - Abiotic
        - Biotic
        - Cycles
    - Hydrology
        - Turbidity
        - pH (acids/bases)
        - Nitrates
        - Conductivity
        - Dissolved Oxygen

Essential Questions/ Guiding Questions:

- What is an ecosystem?
    - What do we find in ecosystems?
- What are abiotic versus biotic factors?
- What is the role of water in an ecosystem
- What affects water quality?
    - Where can we see that in Boise?
- What is the scientific process and who are scientists?

Monday:

- "Who is a scientist?" – Activity and Sandwich skit:
    - Introduce students to the concept of who a citizen scientist is. Empower students that everyone/anyone can be a scientist if they employ the scientific method and trust their observations and conclusions.
    - Introduce the Scientific Method.
- Overview of water quality characteristics:
    - Talk about measurements important to hydrology
    - Introduce vocab words and concepts:
        - pH, Dissolved Oxygen, Turbidity, temperature, conductivity, flow.
        - Define each characteristic, units, and tools for measuring.
        - Discuss plan for data collections days (Wed & Thurs).
        - Create hypotheses on how water characteristics will vary from two data testing points.

Wednesday:

- Collecting data from drainage near school:
    - "Suns Coming" water cycle game to start day
    - Collect data using scientific tools – students are responsible for recording data
    - Play a game to help solidify concept of conductivity.

Thursday:

- Collecting data from Creek near school:
    - Go over yesterday's data – activate prior knowledge
    - Start day by nature journaling by the creek (sense of place activity)
    - Collect data using scientific tools – students are responsible for recording data
    - Come back and debrief day/week.
        - Compare two sites to each other
        - Make connections with observations from nature journaling
        - Vocab knowledge assessment
        - Ending activity – "favorite things from the week"

APPENDIX F

SAMPLES FROM TEACHER FIELD JOURNAL

Teacher Field Journal Capstone Project

4/8: Today was cold so I took my students outside at the beginning of class and asked them to think about how they felt being outdoors as compared to being inside. I told them to think about this concept and then when we returned to class we would write about it. Some of the comments were as follows:

- I feel like things are less cluttered (several students said this).
- I feel like I can learn more because I am more comfortable.
- I feel more pleasant, I don't know why, I just do.
- I feel more focused
- I feel like I can breathe
- It is a nice refreshing change.

Students spent about 30-35 minutes either reading or working on an ecology worksheet after our discussion and then we went back outside again for about 5 minutes, and then returned to class to finish the assignments. Here is what they had to say about that experience.

- Fresh start
- Woke up
- Loosened up and could focus better
- Re-focus

4/15: Today the McCall Outdoor Science School came and did an introductory lesson in ecology with my the Red class. These instructors were very engaging and I can honestly say that my students were engaged and on task 100% of time they were here. We did take the students outside briefly today to look at the site where they would be collected their water samples. I am planning on teaching the same lesson tomorrow to the Gold class and I will look for any differences in the level of engagement. I believe that most of this engagement was due to a change in routine.

4/17: Today the students spent the first half of class indoors reviewing concepts introduced about testing water quality. Students were engaged, but look tired and looked like they were struggling a bit. Students reviewed important concepts related to the data that they were going to collect outdoors. They reviewed turbidity (tools, scale), dissolved oxygen, PH, and conductivity. Students went outdoors in two groups and each group had a specific type of data that they were supposed to collect. Students then brought their data back to class to share with the whole group. Some things that I noticed throughout the period is that students were continually engaged, but more energized once they went outdoors. Also, students who typically don't take on a leadership role in the classroom, stepped up as leaders when we went outdoors, it was as if they were different students all together. It was cold today and I asked the students if they still enjoyed being outdoors, all students I spoke with said they still loved being outdoors. When we came back to class for the remaining 5-10 minutes, students were relaxed and very engaged. I would

have thought that they would have a hard time coming down from being outdoors, but they settled right in and seemed even more engaged than before.

4/22: Today we worked on a case study inside. The catch was that I gave the students a 5 minute break about every 20 minutes of class. For the break the students walked around outside and then immediately upon re-entering the room students wrote for about 3 minutes in their journals. We were outside for a total of 15 minutes and spent another 10 or so minutes journaling. The amazing thing was that the students were very productive, consistently on task, and not distracted by the the constant change of scenery. It was actually one of the better work days we have had.

4/24: Students spent the whole period outdoors working on a different case study. They were allowed to get up and walk around any time that they wanted to take a break. Students didn't seem as productive today as they were with yesterday's format.

4/25: Today students spent about an hr outdoors collected data for some water quality testing they were doing. They were on task the whole period and seemed to enjoy themselves. Behavioral problems were not an issue and I didn't have to say one thing the whole period outdoors

APPENDIX G

SAMPLE STUDENT JOURNAL PROMPTS

Question: Do you feel connected to your environment or nature in general? When do you feel most connected?

We are going to take a short walk today before answering the journal question. Question: How is it different for you when you sit outside and do your work as opposed to be indoors all day? Be specific and talk about how you honestly feel.

We are going to take a short walk today before answering the journal question. Question: *Think about the living creatures you might encounter while walking outside (see and unseen), how do those living (biotic) creatures interact with the non-living things (abiotic) in the area?*

I want you to walk 2 laps outside and note how you feel. Write these things down when you get back to class.

Do you think that your generation spends way too much time "plugged in?" Why or why not?

We are nearing the end of our outdoor unit. Please write a short paragraph about the experience and turn that into me today.

APPENDIX H

TIME ON TASK CHECK SHEETS

Observer Name:_____Date:_____Class:_____

Choose at least three different time intervals 10 minutes apart and mark a symbol (+/-) indicating time on task/engaged behavior or off task behavior.

+=Time on task

0=off task behavior

2		4		6		8		10		12		14		16		18		20		22		24	
26		28		30		32		34		36		38		40		42		44		46		48	
50		52		54		56		58		60		62		64		66		68		70		72	
74		76		78		80		82		84		86		88		90		92		94		96	

Time on Task %_____

Time off Task %_____

Notes: