

OUTDOOR EDUCATION: THE EFFECTS OF
OUTDOOR LEARNING ON
STUDENT SUCCESS

by

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DEDICATION

I would like to dedicate this paper to my sweet, curious, nineteen Kindergarten students who provided data for this project, and expanded my love for the outdoors as well as my enthusiasm for being an outdoor education teacher. I'd also like to dedicate this project to former teachers Mr. Joe Zaiman of Madison, Wisconsin, and Mr. Gary Loertscher of Belleville, Wisconsin, who planted the seed for my interest in outdoor learning. I would like to thank all of the MSSE professors, MSSE advisor Diana Paterson who was my guide through this entire process, and fellow students who have enhanced my teaching abilities, and have given me a support system for bettering myself as a teacher.

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ABSTRACT

This project focused on involving students more in the outdoors as part of their regular classroom curriculum. Outdoor educational activities, as well as guest speakers from the community were used to supplement current curriculum. The purpose was to investigate student motivation and attitude towards learning science, their opinions of being outdoors and outdoor learning, and level of concern for the environment. Students participated in water quality monitoring at a local stream, learned about native Montana wildlife in a greenhouse at our local community garden, went on a nature hike, and collected and identified macroinvertebrates at the Woodson Ranch in Laurin, Montana. Results showed that student interest and attitudes towards the outdoors, as well as test scores, increased significantly after being exposed to outdoor learning.

INTRODUCTION AND BACKGROUND

I currently teach kindergarten in Sheridan, Montana, which is a small town in the southwestern part of the state. Our school district is not very diverse, with a majority of students being White (non-Hispanic) 98%, 1% Asian, and 1% Hispanic. There are 89 students in grades K-6, and 87 in grades K-12. Almost half of our students participate in the free and reduced lunch program. The Sheridan School District has a four-day school week, which has been very successful. Our school day is a little longer, 8 AM to 3:45 PM, and we go a few weeks longer than other schools as well. More information about the Sheridan School District can be found at www.sheridan.k12.mt.us.

This action research-based classroom project looked at the benefits of outdoor education on student learning. The problem focused on is that students at our school have limited opportunities to be involved with their community and the outdoors. Although we live in a very rural area with mountains outside our back door, the curriculum at our school does not emphasize learning in nature. The questions I focused on are: what impact outdoor education has on student learning, how outdoor learning affects students' perception of science, including interest and engagement, and how outdoor education impacts current curriculum. I supplemented our current curriculum with a variety of experiences in nature, and opportunities to learn from experts in our community. This project took place with the Kindergarten class where I currently teach in Sheridan, Montana. The Sheridan community is very rural, and there are endless places to get outside and learn.

This project is meaningful to me for a number of reasons. Growing up on a small dairy farm in southern Wisconsin, I was able to spend most of my childhood outdoors exploring, and caring for the land. For me, being in nature brought a sense of serenity, grounding, and appreciation for the outdoors that I would like to share with my students. My most influential classes and teachers were those who taught me environmental education, and those lessons learned have truly shaped who I am today. One of my goals as a teacher is to instill in children a love and concern for our natural world, so they may be the land stewards of the future.

CONCEPTUAL FRAMEWORK

Many children today lack an essential connection with nature and the outdoors. “Children used to play outside on their own for hours at a time. That just doesn’t happen anymore.” (Cleaver, 2007, p.22). As educational focus on standards and testing increases, a number of schools are not willing to justify spending time outside the classroom. However, outdoor education can be incorporated into all other subject areas, and can enhance current curriculum leading to an increase in student test scores. As Ferreira, Grueber, and Yarema (2012) stated, “Research indicates that when schools use the environment as an integrating theme across the curriculum, their students test scores in the traditional subject areas such as reading, writing, mathematics, and science go up” (p.61). Helping students make connections with what is real and relevant in their lives can lead to greater participation, effort, and interest in subject material. The purpose of the following literature review is to demonstrate the importance of including outdoor educational experiences in schools. The following areas of interest will be focused on in

this review. First, the impact outdoor education has on student learning is considered. Then, how involving children more in the outdoors affects their perception of science, as well as their interest and engagement in current curriculum will be explained. Finally, strategies for implementing quality outdoor educational experiences and curriculum are discussed.

Often, teachers feel there isn't time to add environmental education to their curriculum with an already rigorous schedule designed to help students achieve test scores. It has been shown that outdoor education can be integrated into all subject areas, and often student participation and motivation is greater when doing hands-on activities that are applicable to real life situations (Reeves, & Emeagwali, 2010, p.35). In 2005, a study was done by the California Department of Education and the American Institutes for Research, to measure the impacts of outdoor education programs on students' social skills, appreciation of the outdoors, and understanding of science curriculum. The participants were 255 sixth grade students from four elementary schools in California, who were involved in three outdoor education programs from September until November of 2004. Results showed that, "Children who attended outdoor school significantly raised their science scores by 27 percent" (American Institutes for Research, 2005, p.vi). In addition, students who participated in the program showed an increase in concern about conservation, attitude towards science, and environmental behaviors.

Besides the academic benefits of engaging students in nature, children gain social emotional skills as they learn how to relate to each other and their environment. In 2009, sixteen teachers from seven elementary schools in Michigan were involved in a

partnership between a local school, local university, and the Greening of Detroit non-profit organization, to more effectively use environmental and outdoor curriculum. Researchers found that, “Students who learn core subjects within the context of the outdoors are more motivated, have fewer discipline problems, and develop a sense of belonging and ownership in their school” (Ferreira et. al., 2012, p.61). According to Christine Kiewra, a preschool teacher in Lincoln, Nebraska, learning in nature “requires children to negotiate, share, work together to solve problems, and consider the perspective of others” (Wilson, 2014, p.1). As a result, students become more able to adapt to life situations. Most children have an innate curiosity about the natural world, and are interested in discovering and exploring the outdoors. These outdoor experiences can be some of their most memorable later in life. At a teacher training course in Antioch New England, adult students were asked to recall some of their favorite childhood memories, and “in all cases, memories involve a special place or treasure, almost exclusively nature related” (Paloni, 2007, p.1).

Engaging students in outdoor activities develops empathy, makes kids more aware of environmental issues, and helps them develop a sense of stewardship for the land. Wilson (2014) contends that educators “can foster children’s sense of wonder and instill in them respect and caring for the world of nature. The result will be healthier children, a more wholesome society, and a more sustainable world” (p.48). Outdoor education promotes in children a love for the environment, and sparks a passion for becoming more environmentally conscious. The children of today will be our future land stewards, and will be the ones to conserve and protect the natural world. As Wilson

(2014) stated, “the fundamental lessons children learn from nature- inquiry, compassion, observation- are skills students will carry with them into adulthood” (p.48).

In a study about the effects of an ecology-based nature education program on elementary students, Erdogan (2011) found that “students’ gain on knowledge, attitude, and behavior regarding the environment improved as a result of nature and outdoor activities” (p. 2234). This study involved 64 elementary students in a summer natural education course in Ankara, Turkey. The purpose was to determine if an ecology-based nature education program would increase students’ environmental knowledge, environmental affect, and responsible environmental behavior. In addition, Paloni (2007) reminds teachers that they “are forging instructional memories for kids to draw from as they become the land stewards of the future” (p.2).

Incorporating outdoor education within a school setting opens doors for parent and community involvement, and can lead to service learning projects which may benefit the environment. As Wallace contends, “It is difficult to conserve and protect what you don’t understand” (Cleaver, 2007, p.23). Furthermore, “Instead of simply teaching an appreciation of nature, today’s environmental education programs concentrate on comprehension and preservation” (Cleaver, 2007, p.22).

Children not spending quality time in the outdoors has contributed significantly to health related issues, and “because of sedentary, indoor lifestyles, doctors treat more and more children for diabetes, obesity, attention disorders, and depression” Cleaver, 2007, p.22). Recently, a great emphasis has been placed on children’s health, and it is recognized that many young people today lack physical activity. “In addition to

maintaining a healthy weight, physical activity contributes to children's psychological well-being and assists in bone development" (Burris, & Burris, 2011, p.5). Cleaver (2007) states that, "the percent of adolescents who participated in daily physical activity decreased from 42% in 1991 to 28% in 2003" (p.21). When children spend time in the outdoors they are more adaptable to life situations, experience less stress and anxiety, and "children who spend time outdoors are healthier, happier, and smarter" (Cleaver, 2007, p.21). There are a number of reasons for the decline in children spending time outdoors. Often children do not have unstructured play time outdoors available to them. After school, kids have more homework, extracurricular activities, and often play computer games rather than spend time outdoors. In addition, there are fewer safe places for kids to play outdoors in many communities. "Children are often separated from nature as a result of where they live since "many children today-especially those who live in urban areas-are growing up without opportunities for frequent, positive interactions with the natural world" (Wilson, 2014, p.45).

Besides the physical benefits of spending time in nature, "Outdoor settings and green environments also have a calming effect on children with attention disorders; children as young as five showed a decrease in ADD symptoms when they were engaged with nature" (Cleaver, 2007, p.22). The outdoors provides a place for children to learn social skills, freedom of thinking, problem solving, and cooperation. It builds students' confidence in themselves, their instructors, and their connection with the world around them. Being in nature is "what kids do naturally when the screens are shut down and the doors left open" (Paloni, 2007, p.2).

Providing environmental education opportunities involves finding an outdoor location to conduct classes. This outdoor facility can be something as small as a bench outside, and does not need to be anything elaborate or costly. According to Wagner et al. (2010), “school grounds may contain useful instructional habitats such as wetlands, woodlands, and meadows. They may also have gardens from which herbs, flowers, and vegetables are harvested” (p.3). Outdoor spaces can include nature trails, porches, pathways, a simple grassy area, stream, or even a roof top garden if necessary. Spaces for outdoor learning can be varied and flexible. Once a site is established, decisions need to be made about how to structure student learning, how to best use the available space, and who will maintain the site. Much of the planning and design can be done by students. For example, in Texas a REAL School Gardens program works with elementary students to “design, install and sustain urban gardens which serve as outdoor classrooms for students to learn some very important lessons about community, family, nature, and sustainability” (Reeves, et al., 2010, p.35). Inviting parents and community members to be part of this process can be a way to increase support for the school and involvement.

There are many resources available to help teachers design and implement an outdoor education curriculum. Some examples can be found through the Environmental Protection Agency’s Office of Environmental Education, the National Wildlife Federation’s “Schoolyard Habitats” program, and the “Learning Through Landscapes” website. Other examples of useful resources for teachers include Project Wild Aquatic, and MEECS, Michigan Environmental Curriculum Support. Some important features when looking for environmental curriculum include: teaching students how to think

instead of what to think, problem solving, authentic assessments, cooperative learning, being able to integrate into all areas of the curriculum, and being in line with Common Core State Standards, as well as National Science Standards.

Feeling confident in the ability to teach outdoor education is of utmost importance for a program to be successful. Studies done with preservice teachers show that having a solid background in teaching outdoor education, and having multiple opportunities for being trained in outdoor learning situations, encouraged teachers and increased their confidence in teaching science. A group of preservice teachers in their junior year of college participated in a field experience on a local forest ecology preserve in the southeastern US. This preserve encompassed an outdoor classroom, pond, and 110 acres of wooded trails. Reflections about this experience showed that “the preservice teachers’ experiences with students excited about learning science empowered their feelings that they could effectively teach science to elementary students” (Carrier, 2009, p.44).

Oil City Elementary School, in Oil City, Louisiana, implemented a school-wide environmental science program in an effort to increase school performance scores, increase parental and community involvement, and to make the content of curriculum more applicable to students. The results of their efforts showed that, “Oil City’s approximately 385 students and 28 teachers are engaged in hands-on, environmentally focused learning that has boosted test scores, increased attendance, and spurred parent and community involvement” (Irvin, 2007, p.1). Their teachers were trained in Project Wet, Project Wild, and Project Learning Tree, which are environmental education programs that provide resources, training, and examples of how to teach in the outdoors.

In addition, Irvin (2007) emphasizes that these programs, “draw on the natural environment to teach across the curriculum, as well as to foster students’ critical thinking, collaboration, and problem solving abilities” (p.2). Since implementing an outdoor education program, a greater number of students are attending Oil City School, more teachers are requesting to be transferred there, and test scores have improved.

This literature analysis demonstrates the benefits of including outdoor education in school systems. Many children today do not have adequate opportunities to spend time in the outdoors. At the same time, there has been an increase in childhood obesity, attention deficit disorders, and other problems associated with inactivity. Implementing an outdoor education program in schools will not only benefit children physically, but socially, and emotionally as well. Students are more interested in learning when subject matter is relevant, hands-on, and they can make connections with their own life. When students are happy and engaged, learning and retention increases, and test scores go up. Finally, immersing children in nature helps them develop a love and concern for the outdoors, become more environmentally conscious, and eventually become the future stewards of the land.

METHODOLOGY

This portion of the study will describe the methods used to conduct my research. The purpose of this study was to demonstrate the importance of including outdoor education experiences in schools. I determined the impact outdoor education has on student learning, how outdoor learning affects students’ perception of science, including interest and engagement, and how outdoor education effects current curriculum.

Strategies for implementing a quality outdoor education program are also discussed. The students participating in this study were the 2015-2016 kindergarten class at Sheridan Elementary School in Sheridan, Montana. As there is only one kindergarten class with 19 students this year, I used the same class as the control group and intervention group. Students were evaluated at the beginning of the study during a science unit that did not involve outdoor education, and then again after including outdoor education as part of the curriculum.

This classroom research project used the methods described to determine the benefits of including outdoor education as part of current curriculum. Outdoor learning areas were selected and established. Meaningful and relevant lessons were implemented that correlated with curriculum being used. I examined student interest and participation, their attitudes towards learning, and test scores. The research methodology for this project received an exemption by Montana State University's Instructional Review Board and compliance for working with human subjects was maintained. Finally, data was collected to see whether or not students' concern for the environment increased.

Intervention

I supplemented the current science curriculum at our school with outdoor educational opportunities in our local area. The pre-treatment unit was, "How Do Plants and Animals Grow and Live" and the treatment unit was "Water on Earth." I talked with local community members to arrange for guest speakers, and to discuss locations for outdoor learning to take place. We worked with our local watershed committee on current projects, and partnered with our local community garden, using their

knowledgeable staff as a resource. Garden experts who assisted us were Jim DeBoer and Janet Marsh of Sheridan, Montana. Project WET (2011) activities were incorporated into outdoor lessons including the “Blue Traveler” game and “The Water Cycle Activity,” which teach students vocabulary words to help them better understand the water cycle, and allow them to follow water’s journey through the water cycle from clouds, to lakes, rivers, plants, animals, ground water, glaciers, soil, and more.

Students tested water at two different locations on Mill Creek in Sheridan, Montana. Tests performed were pH, DO (dissolved oxygen), temperature, and turbidity. These tests were done using an Earth Force “Watershed Field Trip” kit. Students performed each of these tests with teacher guidance, and recorded their answers. The two test sites were only a few blocks apart, within walking distance from the school. Macroinvertebrates were collected during an outdoor learning trip to the Woodson Ranch located in Laurin, Montana. Our guides at the ranch were Les Gilman and Dave Delisi who are in charge of a ranch management service called Ranch Resources in Sheridan, Montana. This study took place during the months of February, March, and April of 2016.

Data Collection

To conduct this classroom research project I used both quantitative and qualitative data. Students were given pre and post-tests about science knowledge, before and after the treatment unit. I used this data to determine any misconceptions students had, so I could be better prepared to change their thinking. I also collected my data by using student interviews, closed-ended surveys, and Likert scale surveys to determine students’

environmental concern, and interest in science curriculum. When selecting students for the closed-ended survey, I included 50% of my student population, with three students selected from low, middle, and high achieving groups. These surveys were given to students before and after outdoor education was included as part of their science curriculum. In addition, all nineteen students were interviewed about their interest in being outdoors, outdoor learning, and willingness to help the environment.

Observational data also helped me determine the level of success of this project. The impacts outdoor education had on current curriculum was recorded by teacher journaling. I noticed and recorded student enthusiasm, interest in learning, engagement in, and hesitations towards the outdoors. I looked for patterns and themes with this data, and examined how the results support each other in a triangulation matrix (Table 1).

Table 1

Triangulation Matrix

Focus Question: How does incorporating outdoor education with current curriculum benefit student learning?			
Subquestions	Data Source		
Subquestion 1: What impact does outdoor education have on student learning?	Pre-test	Formative Assessments	Post-test
Subquestion 2: How does outdoor learning affect students' perception of science?	Closed-ended survey items	Likert survey	Interviews
Subquestion 3: How does outdoor education impact current curriculum?	Teacher Journal	Observation Data	

DATA AND ANALYSIS

Data collection for this study focused on my three research questions, while student test scores, surveys, and interviews were examined. Students' attitudes and enthusiasm for outdoor learning were analyzed and interpreted throughout the study.

My first research question involved the impact of outdoor education on student learning. The results of data collected showed students' test scores went up considerably when involved in outdoor education. I began by giving the Kindergarten students a pre-test assessing their knowledge about water on Earth (Appendix A). This test gave me an understanding of students' background knowledge, and helped me identify possible misconceptions they had. Of the nineteen students who took the test, only five knew that approximately 71% of the Earth is water, nine thought the Earth was 50% water, three believed it was 25% water, and two students thought the Earth was entirely water.

Another question asked if our water comes from the ground, a sink, or the store. Most of the kids knew that water comes from underground with twelve answering correctly, while six thought water comes from a sink, and one said that water comes from a store. A big misconception was revealed when students were asked to circle the things we could find in water. Of course, everyone circled fish, but only three of the nineteen students thought macroinvertebrates (bugs) live in the water. I was told that "Bugs do not live in water, they fly in the air." I was very excited to be the one to dispel this misconception for them. More than half of the students thought that a majority of the water on Earth is salt water, with ten students answering incorrectly. When asked what things can pollute the water, again ten students, 53%, said that boats do not pollute water, and fourteen out of

nineteen, 74%, thought that cattle do not pollute the water. Four students, 21%, thought the best way to check for water quality was to taste it.

The second research question focused on students' perception of science and the outdoors. The Likert surveys and student interviews given before and after the treatment unit, showed a definite increase in students' views about outdoor learning. First students were given a Likert survey to determine their attitudes and opinions about science, the outdoors, and learning in the outdoors. The same survey was given to them after the treatment unit, and a positive growth was shown both in students' view of science, and learning in the outdoors.

Table 2
Likert Survey: Pre and Post Questionnaire (n=19)

						
	Pre	Post	Pre	Post	Pre	Post
I like science.	79%	100%	10.5%	--	10.5%	--
I like doing things with my hands.	68%	89%	21%	11%	11%	--
Enjoy being outdoors.	74%	100%	16%	--	10%	--
Learning outdoors is fun.	74%	100%	21%	--	5%	--
I like doing things to help the world be better.	84%	100%	11%	--	5%	--

A sub-population consisting of nine students, three in high, medium, and low achieving groups students was interviewed before the treatment unit to assess their views

of science and outdoor learning (Appendix C). Of the nine students interviewed, eight thought of science as fun, while one student disagreed. All nine students said they preferred to spend time outdoors rather than indoors. When asked, *Do you like learning outdoors?* Three students were unsure, one did not, and the remaining five said they did like learning outdoors. Two students thought their friends liked learning outdoors, while the other seven were unsure. All of the nine students said they would like to do things that help the environment, while five said they do things right now, such as picking up garbage on the playground and recycling.

We began our outdoor adventures with a trip to our local community garden, called Jackson's Garden, which is a short mile from our school. Before going there, students rolled pine cones in peanut butter and bird seed to hang in the trees for local birds. They were very excited to be running through the snow, finding the perfect spot for their homemade "feeders" for the birds. Then we gathered in a greenhouse for hot cocoa, stories, songs, and a presentation by local wildlife specialist, Jim DeBoer, about animals that live in the outdoors in our area (Figure 1). Students were shown animal hides and skulls, and were included in a fantastic discussion about Montana wildlife. All of those present were engaged, excited, and learning.



Figure 1. Greenhouse at Jackson’s garden in Sheridan, Montana.

Next, we began our “Water on Earth” unit by discussing where our water comes from. Students watched a short YouTube video clip called “Clean Water: A Long Journey from the Source to Our Tap”, which describes how water gets to our homes, as well as things that pollute the water (Greentreks, 2013). We discussed that about 71% of the Earth is made of water, and how most of that water is salty. We talked about how only 3% of the water is fresh usable water, and why it is important to keep our fresh water clean. Then we used Project Wet resources to learn what a watershed is, and about the water cycle. Students participated in a game called the “Blue Traveler”, which helped them discover the many places water can go, and the various forms it can take. (Project WET Foundation, 2016). We talked about where our watershed is in the Ruby Valley and about ways to determine if water is healthy or not.

During our next few science classes we learned about how to test the temperature, pH, turbidity, and oxygen content of water. Students were shown the equipment we would be using to take water samples, and the procedures for doing so. We talked about how this data would tell us if the stream was healthy. Following these discussions we walked to the Forest Service Station on Mill Creek, which is a short, three-block walk from our school. Each student had a clipboard to record their data, and on the first page students were instructed to write their name, site number, and group number at the top of the page, and then sit quietly and draw everything they observed (Figure 2). We talked about things they could hear, see, smell, and feel. Students were excited, pretending they were “real scientists,” and were drawing each other’s attention to what they were noticing.



Figure 2. Observations page.

Next, students were divided into groups of three to take the water temperature, test the dissolved oxygen, determine the pH, and check the turbidity of the water. All students recorded their findings on their second data sheet (Figure 3). Again, students were engaged, excited, and seemed to be very much enjoying their data collection. One student commented “I just love nature,” while another mentioned “I love being outside learning things.” It was apparent that the group was having fun. I was pleasantly surprised that such young students were more than capable of performing these tasks. After gathering our data, we returned to the school to discuss our numbers and what they meant. We made a plan to test the water in the same creek at a second location.

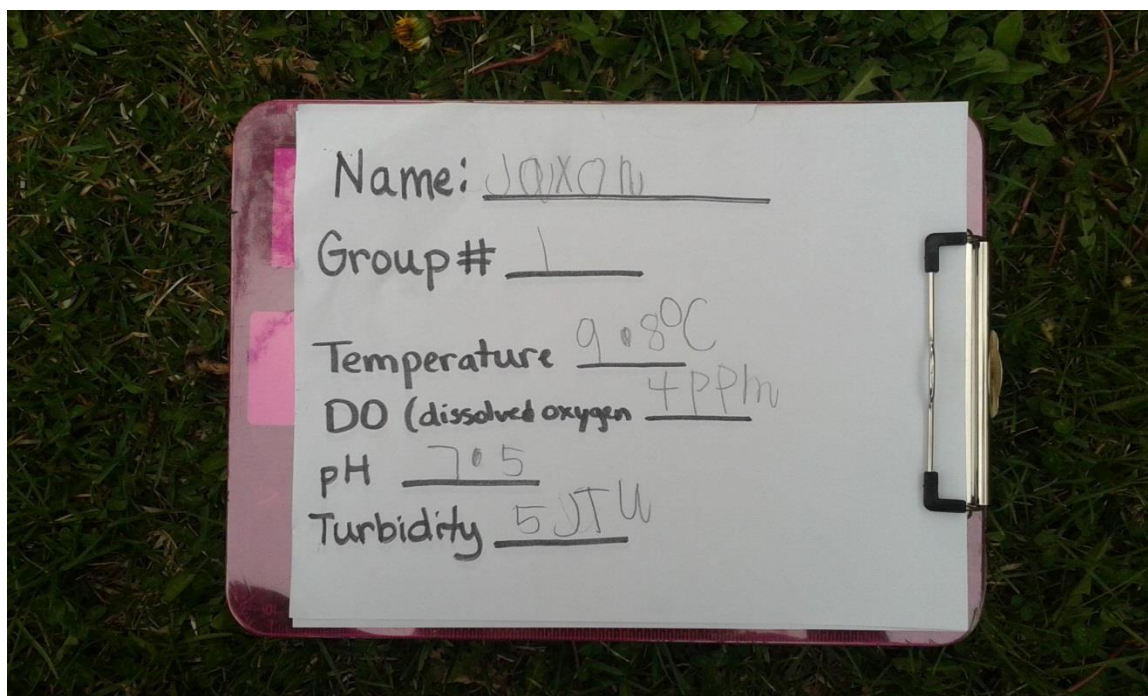


Figure 3. Data collection sheet for water testing.

The following week we tested the water in Mill Creek at Site 2, which was just upstream a few blocks from the first site (Figure 4). All day long students were excited

about going to the creek again, and kept asking if it was time to go. As we got ready to go, the group enthusiastically lined up at the door with their clipboards and pencils. A few asked to help carry the testing equipment. Once at the stream site, students again sat on a high creek bank observing and drawing everything they saw. Students helped each other test the temperature, pH, dissolved oxygen, and turbidity, this time with less teacher guidance (Figure 5).



Figure 4. Testing the water at Mill Creek Site 2.



Figure 5. Testing pH Mill Creek.

We discussed our findings, which were very similar to the first site. To further assess understanding, students were asked to communicate their findings by presenting what they had learned at an all-school assembly. The kids did a fantastic job demonstrating the concepts they had learned. We also reported our data to the Ruby Watershed Council.

The Water on Earth pre-test that students were given at the beginning of the treatment unit made me aware of a misconception that most students had, which was that bugs do not live in water. We planned a trip to the Woodson Ranch near Laurin, Montana, which began with a nature hike guided by Les Gilman and Dave Delisi of Ranch Resources in Sheridan, Montana. Students hiked a trail along the Ruby River, learning about wetlands, birds, wildlife, and riparian zones (Figure 6). They found many “treasures” along the way, and were busy trading pieces of bone, rocks, and bird feathers as they walked. We smelled the dirt of a freshly plowed field, and learned that this smell

actually causes the release of endorphins, which are chemicals in our body that make us feel good.



Figure 6. Nature hike at Woodson's Ranch.

After our hike, we enjoyed a picnic lunch near a little log cabin where previous Kindergarten classes had built bee boxes, and planted wildflowers for native pollinators. All of the kids appeared to be very excited to be eating their lunch outdoors. After lunch I put on waders, grabbed a D-net and five-gallon pail, and asked if anybody wanted to see what was in the water. The kids enthusiastically followed me to a creek where I stepped into highly turbid water moving my feet back and forth on the bottom while holding the D-net downstream. Students were expecting me to pull up a net full of fish, and when they looked into the net full of wiggly squirming macroinvertebrates they shrieked and screamed running away from the creek. It was the first step towards dispelling their

misconception. They were back in seconds, asking to see it again, and asking me to catch more. I teased them saying, “I thought you said bugs do not live in the water!” They laughed and asked questions about the kinds of bugs we’d collected. We transferred the macroinvertebrates into our pail to look at back at the school. I announced that it was time to go, and the kids did not want to leave. Parent volunteers were also enjoying our outdoor learning adventure, and commented on how interested and involved the kids were with what they were learning.

The next day at school, students were divided into groups of four at stations where they had eye droppers, magnifying glasses, tweezers, a chart with pictures and descriptions of types of macroinvertebrates, and a four-section plastic tray for their specimens (Figure 7).

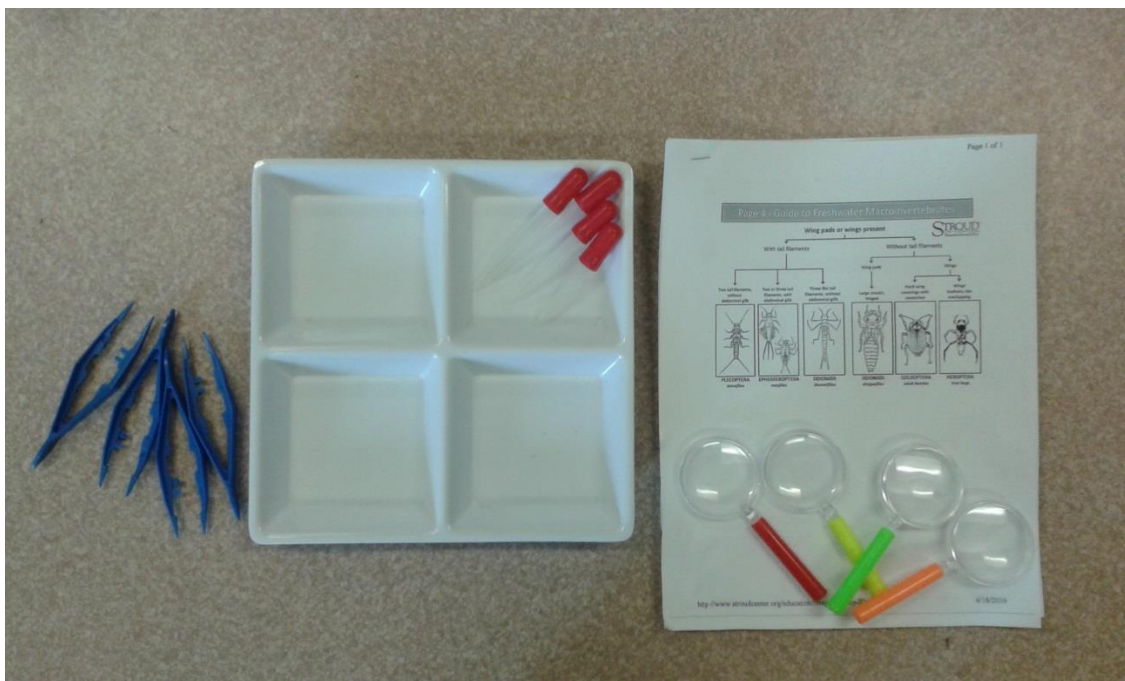


Figure 7. Macroinvertebrate identification tools.

I put a cup full of water and macroinvertebrates into one section of each tray asking them to use their tools to transfer the bugs to one of the empty sections of their tray (Figure 8).



Figure 8. Macroinvertebrate identification.

Students were completely engaged with this activity for over an hour, and kept asking for more bugs. Even the kids who had turned up their noses about collecting bugs at first were now complaining that I hadn't given them enough. They then transferred some of their finds to microscope slides, and were very amused and surprised when they saw them enlarged (Figure 9). One said "Look Miss Konopacki, I have a mayfly! It has 3 tail parts!" Another exclaimed, "I found a snail," and all the other students had to run over and see his find. A few of them were naming the bugs, things like speedy and squirmy. They identified leeches, mayflies, caddisflies, snails, water mites, and scuds. I was overjoyed to see students so excited about learning. They wanted to share what they had seen with other kids, and a number of them showed students in other grades what we had

been doing. One student brought his Dad and brother in after school and told them all about the macroinvertebrates and they took turns catching and identifying them.



Figure 9. Looking at macroinvertebrates under microscopes.

Following this treatment unit I again had students take the “Water on Earth” test to see what students had learned (Appendix A). This time students scored much higher, with thirteen of the nineteen students tested scoring 100%. The remaining six students only had one answer wrong each, still receiving a score of 95%. All of the students were able to identify the things we could find in water, and I was very pleased to see they no longer held their previous misconception that bugs do not live in the water. One student did not identify plants as being in the water, and his reasoning was that “I didn’t see any at the creek.” Only one student thought water initially comes from the sink, while the other eighteen knew it comes from the ground. All students knew that the Earth is approximately 71% water, although three students, 16% thought a majority of the water on Earth is fresh water. All students correctly answered the question asking them to

circle things that pollute the water, and all knew to determine stream health we must test the water and not taste it. A comparison of pre-test and post-test scores is shown in the following table.

Table 3
Pre/Post Test Scores: Water on Earth (n=19)

Pre-Test Scores	Number of Students	Post-test Scores	Number of Students
85%	1	100%	13
80%	3	95%	6
75%	3		
65%	6		
60%	2		
55%	3		
45%	1		
Pre-test mean = 66.84		Post-test mean = 98.42	
Standard deviation = 10.7		Standard deviation = 2.39	

I again interviewed the nine students representing high, middle, and low ability groups about their views of science, the outdoors, and outdoor learning. Compared to the first interview, all nine students thought of science as fun, all of them preferred spending their time outside rather than inside, all nine stated that they like learning outdoors, and they all were interested in doing things to help the environment. When asked, *Do your friends like learning outdoors?* Six students out of nine said yes, while three were unsure. All students but one said that they do things now to help the environment, such as recycling, picking up garbage, and testing water.

The last issue addressed with this action research project was how incorporating outdoor education would impact current curriculum. In my experiences, supplementing current curriculum with outdoor learning opportunities enhanced student learning, making it more valuable and meaningful. I feel students gained a better understanding of science concepts taught when able to see things with their own eyes, and do things with their hands. Involving kids in outdoor adventures did not in any way take away from their learning. I found that a new science curriculum was not necessary, rather current curriculum needing to be reconstructed to include outdoor education. During the treatment unit students began asking, “Can we do our reading in the outdoor classroom today?” I realized that the enthusiasm I had seen in science could be directed towards any subject area.

INTERPRETATION AND CONCLUSION

After completing and analyzing the data collected I concluded that students’ perception of science, the outdoors, and outdoor learning improved as a result of supplementing current curriculum with outdoor learning adventures. Before implementing the treatment unit students were unsure how they felt about science and outdoor learning. This was understandable since it is their first year of school, and many of them have probably never been involved in anything of this nature. As they answered the Likert survey and interview questions it was obvious that there was not much excitement in their tone, or in their expressions. However, after the treatment unit involving students in outdoor education, their attitudes changed significantly. While 79% of the group said they thought science was fun before the treatment, 100% of students

agreed after including outdoor education. Student enjoyment of being outdoors and learning outdoors increased from 74% to 100% as well. When asked if they enjoy doing things with their hands, all but two students agreed, and one of those that didn't said "I kind of liked doing things with my hands, but not too much because I didn't get enough turns to collect the water samples." As I read the surveys to each student, their excitement and enthusiasm was apparent. There was no hesitation at all as they circled their answers.

The impact outdoor education has on student learning is also demonstrated. Pre and post-test scores showed significant growth in science content after the treatment unit. Students' misconceptions about what could be found in water were acknowledged and changed, as was shown with 100% of students marking their post-test answers correctly. As Llewellyn (2014) stated when writing about the conceptual change model, "Children are personally and emotionally attached to their beliefs and do not easily give them up." (p.88). Long-held misconceptions often will not be changed by simply telling students what is correct, and must be addressed by guiding students through a process of exposing their belief, confronting it, accommodating the belief, and if possible extending the concept in other ways. By catching macroinvertebrates with students, identifying them and looking at them under microscopes, I feel confident they will always remember that bugs live in the water.

Another way I determined an increase in student learning was through journaling. I observed students' excitement preparing to take the classroom outdoors, as well as their enthusiasm and engagement while in the field. As we walked to Mill Creek, kids were

skipping and singing with clipboards in hand. Sitting on the creek bank drawing observations, students drew each other's attention to the things they were noticing including mountains in the background, trees, birds, a barn, the creek itself, rocks, deer, and cattle. Interestingly, a number of them drew a group of kids on the stream bank to represent themselves being there, which was not something I had expected. Each time we were involved in outdoor activities kids became more comfortable with their environment. At first students hesitated to sit on the ground or put their hands in the water, but toward the end of the treatment unit they appeared to be in their element.

Based on the evidence gained during this study, I realize the importance of including outdoor education as part of my curriculum. I would like to provide more outdoor opportunities for my students in years to come, and in multiple subject areas. I recommend teachers interested in attempting to include outdoor education as part of their current curriculum begin with a few outdoor lessons, and see the difference it makes in their students. An space to provide outdoor learning does not need to be elaborate, and can most likely be found right out your school's door.

VALUES

This action research project was valuable for me in a number of ways. I remember how I felt as a young student in environmental studies classes, planting prairies, building nature trails, and going on Sandhill crane counts. In a high school science class we camped, bathed in a lake, cooked meals over a fire, and drew everything we noticed in our science journals while sitting quietly in the woods. I remember the lessons learned during those times more than I remember anything else about my

schooling, and they've had a great impact on the person I am today. When initially starting this project I wondered if my experiences were common, or if I would find that students in today's world of computer games and technology would perhaps not be as interested in the outdoors. It brings me great joy that I could see the spark in students' eyes, and be part of the excitement they experienced while learning outdoors.

This process had also helped better me as an educator. I was able to see how different learning styles were enhanced by including kinesthetic strategies. The use of pre-tests and surveys helped me determine what my students knew about subject matter, and what I needed to emphasize the most in my teaching. I realize that long-held misconceptions can be very hard to dissolve, and have become more comfortable with using the conceptual change model for doing so.

Of greatest value for me is that I will continue to provide outdoor education opportunities for future classes, and will hopefully encourage the land stewards of our future. I realize that even five and six year-old students can develop an awareness and sense of caring about their community and the environment. Involving students in outdoor learning can be as simple as taking a lesson outside and sitting in the grass, or as involved as stream restoration. Being in nature can bring serenity and awareness to both teachers and students, and I encourage all teachers to begin planning some outdoor adventures.

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APPENDICES

APPENDIX A

PRE/POST TEST: WATER ON EARTH

PRE/POST TEST: WATER ON EARTH

1. About how much of the Earth is water?

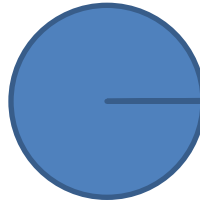
25%



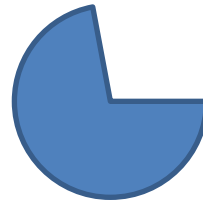
50%



100%



71%



2. Where does the water we use come from?

A = Ground

B = Sink

C = Store

3. Circle the things that can be found in water.

Fish



Bugs (macroinvertebrates)



Plants



Soil and rocks



4. Color only the water in these pictures.



5. Most of the water on earth, 97%, is ...

- A. Salt Water
- B. Fresh Water

6. The water we use for drinking, washing, gardens, cooking, is...

- A. Salt Water
- B. Fresh Water

7. Circle the things that can pollute our water...

Garbage



Boats



Plants



Cattle



8. How can we test for water quality? Circle all of the correct answers.

A. Dissolved Oxygen Test

B. pH Test

C. Turbidity Test

D. Water Temperature

E. Taste it

APPENDIX B

LIKERT SURVEY FOR STUDENT ATTITUDES

LIKERT SURVEY FOR STUDENT ATTITUDES

1. I like science.



2. I like doing things with my hands.



3. I enjoy being outdoors.



4. Learning outdoors is fun.



5. I like doing things to help the world be better.



APPENDIX C
STUDENT INTERVIEW QUESTIONS

STUDENT INTERVIEW QUESTIONS

1. Do you think science is fun?
2. Would you rather spend your time inside or outdoors?
3. Do you like learning outdoors?
4. Do your friends like learning outdoors?
5. Would you be interested in doing things that help the environment?
6. Do you do things to help the environment right now?

APPENDIX D
STUDENT PHOTO RELEASE DOCUMENT

STUDENT PHOTO RELEASE DOCUMENT

SHERIDAN PUBLIC SCHOOLS

PO BOX 586, SHERIDAN, MT 59749

406-842-5302

June 13, 2016

MSU-Bozeman MSSE Master's Department

PO Box 172805

Bozeman, MT 59717-2805

RE: Photo Release

To Whom It May Concern:

Sheridan School District #5 allows Jennifer Konopacki to use any photographs of her students taken during the school year in her writing projects.

Sincerely,

Michael S. Wetherbee

Superintendent