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Effect Of A Short-Term Field Experience On Student Outdoor Environmental Knowledge, Comfort Levels, Attitude, And Action Scores

Brandi Niccole Silvey

EFFECT OF A SHORT-TERM FIELD EXPERIENCE ON STUDENT OUTDOOR ENVIRONMENTAL KNOWLEDGE, COMFORT LEVELS, ATTITUDE, AND ACTION SCORES

A Master's Thesis

Presented to

The Graduate College of

Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Biology

By

Brandi Niccole Silvey

December 2016

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Biology

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ABSTRACT

Many children today may not be familiar with nature due to lack of experience and education in the outdoors. If they are not exposed to nature, then they will not be as comfortable in the outdoors. This study evaluates the effectiveness of educational activities at the Watershed Center in Springfield, Missouri on high school students' and college level pre-service teachers' knowledge, comfort levels, attitudes, and actions toward the outdoor environment. Post-field trip responses of students who came to the Watershed Center were compared to students who did not participate in a field trip. Teachers were also surveyed to assess why they brought their classes to the Watershed Center. This study found significant differences in knowledge, action scores, and attitude scores between field trip participants and non-field trip participants. Approximately 50 percent of teachers responded saying they enjoyed the hands-on activities the Watershed Center provides. The natural environment depends on people caring. Short-term experiences in the outdoors can make differences in students' attitudes and future actions.

KEYWORDS: environmental education, outdoor education, green school, field experiences, environmental attitudes

This abstract is approved as to form and content

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The topic of environmental decline is becoming more prevalent in the news (Louv, 2008). This decline may be partially because many people are not aware that their actions are affecting the planet in a negative way. If more people were aware of this, then the steps that we are taking to try to be more environmentally conscious may be more successful. Many children today may not be in touch with nature due to lack of experience and education; therefore, they are unlikely to be as comfortable in the outdoors and will be less apt to take environmental action.

One way to get more people to connect with the environment, or to get them outside, is to educate them through outdoor activities beginning at a young age (Louv, 2008). More and more teachers are realizing how important an outdoor experience is to a child's education (Louv, 2008). Ergo, it is very important that not only children be more environmentally conscious, but also teachers. Knowledge is not the only factor that influences positive environmental behavior change (Prabawa-Sear & Baudains, 2012). In order to become more comfortable in the outdoors, children and teachers need a place that they can go to submerse themselves in nature.

Lack of concern about and comfort in the outdoors is becoming more common (Charles & Wheeler, 2012). A recent study of almost 10,000 adolescents from 1976 to 2005 revealed that environmental concerns have declined over the last three decades (Charles & Wheeler, 2012). Children are losing opportunities to experience the outdoors – which could have consequences for the overall health of the plant (Blanchet- Cohen & Elliot, 2011). Many adolescents were unwilling to participate in conservation behaviors

such as driving less or reducing the amount of electricity that they use (Charles & Wheeler, 2012).

The Watershed Center is a local educational resource that is available to southwest Missouri schools and residents. The theme of the Watershed Committee of the Ozarks, which supervises the area, is that, "Every drop of rain that falls is precious – a resource to be safeguarded," and they wish to connect people to their watersheds by educating them through interpretive programs in outdoor classrooms (Watershed Center, 2015). They provide several field trip options for educators.

The site is owned by City Utilities and leased to the Springfield-Greene County Park Board (Watershed Center, 2015). The site consists of a 6.88-hectare man-made lake. A 4.02 km trail loops around the lake with various habitats that include wetlands, spring-fed stream, caves, sinkholes, glades, and forests. The Missouri Department of Conservation performs routine water testing and electro fishing surveys in the spring and waterway of the Watershed Center. The lake is managed under a cooperative agreement between the Watershed Committee of the Ozarks and the Missouri Department of Conservation (Valley Water Mill Park, 2016).

The Watershed Center's main structure is an energy - and water - conserving LEED certified building with outdoor water quality demonstrations that include rain gardens, pervious pavement, wetland filters, and a vegetated "green" roof (Watershed Center, 2015). These demonstrations can be part of the education field trip in addition to the outdoor classroom lessons.

Along the 4.02 km walking trail that loops around the entire site, there are five major outdoor classroom settings: spring, lake, wetland, forest, and stream (Watershed

Center, 2015; Figure 1). In addition to the trail, other recreational activities include fishing in the lake and bird watching. Schools from surrounding communities come to the Watershed Center so their students can get hands-on experience through activities, such as collecting and identifying macroinvertebrates, to further their knowledge and appreciation of nature.

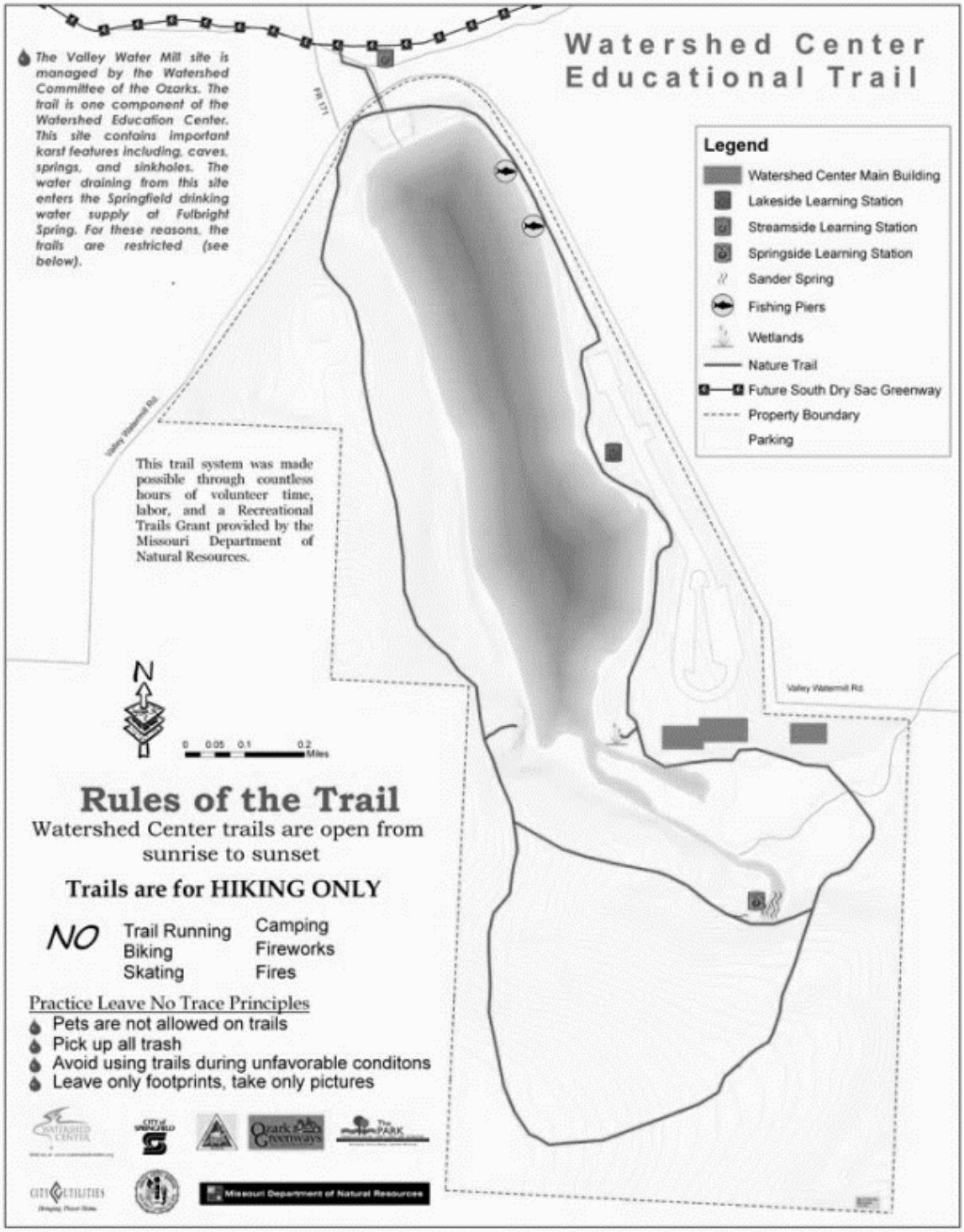

Figure 1: A map of the trails at the Watershed Center in Springfield, MO
Photo Credit: http://watershedcommittee.org/wp-content/uploads/2016/07/wc-trails-LARGE.pdf

LITERATURE REVIEW

Environmental/Outdoor Education

Environmental education and outdoor education are similar, but there are differences between them. Outdoor education is defined as education in and about the outside, including processes involving direct learning experiences. Environmental education refers to education about the total environment, which includes population growth, pollution, resource use and misuse, urban and rural planning, and modern technology with its demands upon natural resources (Ford, 1986). Many people like to combine these terms into the term "outdoor/environmental education" (Ford, 1986).

The Tbilisi Declaration-which is one of the most important, original documents in environmental education (Hungerford et al. 2001)-states that the ultimate objective of environmental education is increasing people's active involvement in working toward the resolution of environmental problems (Chawla & Cushing, 2007). Bogner (1998) states that in order to help raise more concern, we should put students in an outdoor setting to learn; i.e., contact with nature can affect environmental concern. However, environmental concern is not the only benefit for outdoor learning. Another goal of environmental education is to develop students' awareness about the total ecosystem and its associated problems. This knowledge can help to shape students' current and future behavior concerning the environment and conservation (Bogner, 1998). What better way to promote environmental understanding, concern, and awareness than to get students outside? Awareness through experience is the first step toward creating stable, positive environmental attitudes (Bogner, 1998). From these stable attitudes we can hopefully get

changed behavior. Ideally, if a person experiences inclusion with nature, then they will be more apt to care about protecting it. Conversely, if a person experiences exclusion from nature, that person will protect themselves over nature (Cheng & Monroe, 2012).

Many students do most of their learning in the classroom, and while they learn scientific principles, they may not develop the appreciation that they could if they were to venture and learn outside. When a student learns outside, they are increasing their educational, physical, emotional, and social well-beings, as well as developing a deeper level of learning (Waite, 2010). If students were to develop appreciation for nature, then that should lead to changed behavior as well. Studies show that students remember outdoor visits and fieldwork for many years after they visit (Dillon et al. 2006). Nature is unpredictable; it is that unpredictability that makes learning so exciting for students. Educators have the ability to harness that excitement and use it to refuel a student's curiosity and provide a starting point for positive environmental attitudes and academic development (Waite, 2010). Students that are taught about nature in a natural setting connect directly with what they are learning, and develop a deeper relationship with nature (Martin, 2004).

Connecting directly with nature has many other benefits as well. Outdoor and adventure education has been positively correlated with developmental outcomes, including personal growth, enhanced interpersonal skills, and group development (Passarelli et al. 2010). Outdoor education has also been shown to have a positive impact on children's motor and verbal skills, increased variability of emotions, promote more positive communication, and increase physical activity (Fiskum & Jacobsen, 2012). Studies show that interaction with the outdoor environment enables one to do better on

tasks and with improve attention and memory because outdoor environments are more restorative than urban environments (Berman et al. 2008).

Unfortunately, many classrooms have turned to using technology in the classroom because of familiarity, to cut down on the added costs of taking field trips, and to avoid the added behavior management pressures that many teachers may face (Dyment, 2005). A nationwide survey of American children's connection with nature by the Nature Conservancy found that children spend most of their time occupied by electronic media and revealed that 88% of children used a computer almost every day; whereas only 11% of children reported visiting a local park or natural area (Charles & Wheeler, 2012). Children who have had meaningful experiences outside are more likely to want to spend time outdoors, express concern about environmental issues, identify with being a strong environmentalist, and express interest in studying the environment or pursuing an environmental career (Charles & Wheeler, 2012). Children reported that they did not spend more time in nature because of feelings of discomfort (with bugs, heat, etc.), and lack of access to natural areas (Charles & Wheeler, 2012). Thus, improving access to environmental areas may provide educational benefits.

Students And Environmental Education

It is through a connection to nature that children develop an understanding, appreciation, and respect of the wildlife and human community (Blanchet-Cohen & Elliot, 2011). Unfortunately, children are spending less and less time outdoors. Many children, especially those in urban areas, simply do not have access to environmental areas, or parents prohibit them from going outside because they themselves do not have

an understanding of nature and are concerned for their children's safety (Cheng & Monroe, 2012). If fears and doubts concerning nature are carried on to future generations, then we could lose environmental citizenship.

More than half of humanity lives in urban environments; and this number is expected to exceed 70% by 2050 (Bratman et al. 2015). Children who live in urban environments and have views of nature or are outdoors everyday exhibit better working memory, impulse inhibition, concentration, and selective attention than children lacking exposure to nature (Bratman et al. 2015). When children are outside, their senses have the opportunity to come "alive" and to be challenged. Children can feel, hear, see, smell, and sometimes even taste what they are investigating; which caters to every type of intelligence (Harrington, 2009). Being outside gives children the opportunity to develop a positive relationship with nature, have a higher level of cognitive functioning, and improve psychological well-being (Cheng & Monroe, 2012). Nature can calm children who are able to see, for example, a field of wildflowers outside their window.

It is important for children to feel at ease in the outdoor environment. When children are educated and feel comfortable in the outdoors, their episodic memory (person's specific memory of an event; Zimmermann, 2014) improves; this type of learning can be provided by field trips. In addition, field trips provide a long-term, stable, and correct knowledge basis for scientific understanding (Harrington, 2009). Field trips not only provide children with the ability to move freely (Maynard & Waters, 2007), but also the opportunity to learn about plants, animals, and the dynamics of interacting with them (Harrington, 2009). Children that directly observe natural phenomena (sunsets,

weather changes, and shadows) develop a deeper understanding and appreciation of the natural world (Maynard & Waters, 2007).

Educators And Environmental Education

An increasing number of children are spending the majority of their time with educators in early childhood programs (Blanchet-Cohen & Elliot, 2011). It is ultimately an educator's responsibility to help children on their journey to developing a deeper understanding and appreciation of nature. Children learn by observing role models which is an important theme in outdoor education (Paisley et al. 2008). Many environmentalists frequently mention their childhood role models that let them play outside and explore freely. It was these role models that showed the value of nature and were motivators for the children to choose an environmentally-conscious career (Blanchet-Cohen & Elliot, 2011). However, educators that do not have the comfort levels or knowledge required to teach in outdoor settings may place little value on the outdoor environment as a place for learning (Blanchet-Cohen & Elliot, 2011). Lack of appreciation for outdoor learning may explain why most environmental education takes place in the classroom (Martin, 2003) which disconnects students from what they are learning about.

Educators, also, may not have the ability to take their students on field trips and/or may face various obstacles when doing so. Field trips are often reduced or absent because of budgets, time issues, access to locations, safety concerns, liability concerns, transportation costs, and time and distance constraints (Çalişkan, 2011/Martin, 2003). Many educators see all of these obstacles and simply give up trying to take their students on a field trip to learn. In addition to the obstacles mentioned, other obstacles include

requirements of school curricula (mandated curriculum and standardized testing leaves little space for outdoor learning), and wider changes within the education sector (larger class sizes) make it more difficult to organize and manage field trips (Dyment, 2005).

Virtual Field Trips

Due to the barriers presented, educators often turn to virtual field trips as a way of learning. Virtual field trips offer students the chance to explore environments that they normally would not. For example, students can explore places such as the rain forest, the arctic, and the Great Barrier Reef (Harrington, 2009). There are two kinds of virtual field trips – one where the students simply listen and watch, and one with a more interactive approach. The more interactive approach allows students to participate in the field trip with pictures and films. They can also act according to their own preferences because many can be played like a computer game, sometimes with audio aids through the use of headphones (Çalişkan, 2011). Virtual field trips depend on the internet or CD-ROMs and display all the aspects of the field. There are no time, weather, distance, or physical limitations with a virtual field trip (Çalişkan, 2011). While it may not seem like using a virtual field trip has disadvantages, Qui and Hubble (2002) found that there is (Table 1).

Ideally, virtual field trips should not replace real ones if they are available (Harrington, 2009). The entire purpose of environmental/outdoor education is to get students outside so they can experience nature first hand; a virtual field trip completely negates that. If environmental education programs seek to promote change, then they need to address the barriers and motivators that influence participants (Prabawa-Sear & Baudains, 2012).

Green School Grounds

Many barriers to actual field trips can be counteracted with green school grounds. Which are defined as outdoor places on school grounds to conduct informal and formal learning (Dyment, 2005). When students are outside, they can interact with nature and complete science investigations on a first person basis. This allows them to not only work on their social skills with other students, but being outdoors improves student performance by improving focus, attention, cognitive control, working memory, and concentration (Bratman et al. 2015) while also increasing positive feelings (Blanchet-Cohen & Elliot, 2011). Students, who do not do well in a classroom setting, also feel more motivated and inspired because a green school ground provides opportunities to make direct connections to and learn about the subject being taught (Dyment, 2005). Students are not only connecting to the subject being taught, but they are also able to connect to nature as a whole. In addition to science, writing, math, art, health, social studies, and drama can be taught on green school grounds (Dyment, 2005).

Not only does having green school grounds help students, but it helps educators as well. Many educators have reported that green school grounds provide opportunities for unique learning experiences and decrease classroom management complications (Dyment, 2005). However, only a small percentage of educators are using green spaces for education. Because of this, the potential to maximize learning opportunities is lost (Dyment, 2005).

Study Purpose

The purpose of this study was to evaluate the effectiveness of educational activities at the Watershed Center on high school students' and pre-service teachers' knowledge, comfort levels, attitudes, and action scores toward the outdoor environment. This study compared the post-field trip responses of students who came to the Watershed Center to students who did not participate in a field trip. The null hypothesis for this study was that there will be no difference in knowledge, comfort levels, attitudes, and action scores between students who participated in and those who did not participate in a field trip to the Watershed Center. The research hypothesis was that there will be higher scores in knowledge, comfort levels, attitudes, and action scores for students who participated in a field trip to the Watershed Center vs those who did not participate.

Table 1: The advantages and disadvantages of virtual field trips (Qui and Hubble, 2002)

The advantages of virtual field trips	The disadvantages of virtual field trips
• Integrate diverse types of data in instantly available ways	• Do not convey the true three-dimensional nature of objects
• Present images from a variety of viewpoints and at many different scales	• Do not convey the non-visual and aural feelings of touch, smell,etc.
• Display non-visual data (geochemistry, etc.)	• Less beneficial than really being in the field
• Helpful for presenting trips to inaccessible areas	• Lack the serendipitous nature of discovery
• Provide an alternative of fieldwork, when time, expenses, and/or logistics are real issues	• Having limited interaction with a computer
• Enable presentation of extensive field trips and great variety of landform diversity	• Not interacting with people in a flexible manner
• Enhance and expand students' experience	• CD-ROMs can only provide a finite limited amount of information
• Enable flexibility of access (time and place)	• Visiting a website can be difficult and depends on many factors, such as availability of computers, load on the network, number of connections, reliability of service provision, etc.
• Provides a repeatable experience which can be used to reinforce concepts in class	• Easy for students to get lost among lots of websites
• Provides an easily experienced preview or review of real field trips	• Many websites are ephemeral rather than permanent
• CD-ROMs are convenient to acquire and use	• Often difficult to find a suitable one for teaching and learning
• Information rich	• The abundant websites are not quality controlled
• Hold abundant materials and information	• It is easy for students to wallow, or obsess over particular sites, which raises the problem of time management
• Offer rich resources of learning and teaching	
• Available for users of different levels and demands	
• Interesting and attractive to students and an alternative experience for users	

METHODS

All teachers of high school classes and college-level classes for pre-service teachers from Missouri State University, who had field trips scheduled at the Watershed Center were contacted. A letter was then emailed to each of the teachers explaining the study (Dillman 1978; Appendix A), and a follow-up email was sent to verify that they wished to participate. If teachers of the high school groups wished to participate, parental consent forms were sent to the teacher (Appendix B) to distribute to their students. All consent forms were collected before proceeding with the study. Assent forms were also distributed to students (Appendix C). High school students and pre-service teachers were chosen because no evaluation of this age group has ever been conducted at the Watershed Center.

The interpretive education programs at the Watershed Center included lessons about watersheds in general including the flow of water and springs. Students also learned about karst features such as sinkholes, various Ozark habitats (including bottomland forests and glades), pollution, and recycling. Some macroinvertebrate sections were taught as well; however, since not all classes learned about macroinvertebrates they were not included in the survey. Lessons were conducted on the trails at the Watershed Center and an overview of each lesson is notated in Table 2.

The Missouri State University Institutional Review Board and Springfield Public Schools (Appendices D and E) approved this study. After students completed the interpretive education programs, they completed a post-survey. Additional students, from

the same school who did not participate in a field trip also were given a survey. These students served as a control.

The survey consisted of four sections - knowledge, comfort levels in the outdoors, attitude, and action scores (Appendix F). The knowledge section consisted of 14 multiple-choice questions assessing the student's knowledge of watersheds and various Ozarks ecosystems. The comfort levels and attitude sections consisted of ten questions each, while the action score section consisted of six questions. The comfort levels in the outdoors, attitude, and action score sections used a Likert scale response; each question was rated on a scale from 1-5; with 5 being the highest environmentally-friendly response. Knowledge and attitude questions from a previous Missouri student study (Greene et al. 2000) were used as a guideline in the development of the survey. Students wrote directly on the test as to avoid possible errors transferring information to another sheet. School name, gender, grade, and name of class were also collected.

A short four-question survey was given to the teachers (Appendix G). This portion asked question about why they took their classes to the Watershed Center. The name of the school and specific class were collected.

All statistical analyses were completed using the statistical software Minitab 16. Means were calculated for the surveys of each student, and also for each section (knowledge, comfort levels, attitude, and action scores) for the students who participated in the field trips and those who did not participate in the field trips. The comfort levels section was combined with the attitude section for some statistical analysis due to their similarity. All blanks for the knowledge section were counted as wrong and changed to a

0. When the action scores section was incomplete, or the surveys were blank for gender and grade level, they were not included in the analysis.

For overall participation, two-sample *t*-tests were used to compare the average action scores and average attitude-plus-action scores between genders. Two-sample *t*-tests were also used to compare the average action scores and average attitude plus action scores between field trip participants and non-participants. Due to the data not being normally distributed, a non-parametric Mann-Whitney U test was performed for all comparisons of knowledge, attitude, and comfort levels. Standard deviations were included in the tables.

Next, students at the college level from Missouri State University were compared to each other. Two-sample *t*-tests were used to compare the average action scores and action scores plus attitude scores between field trip participants and non-participants. Due to the data not being normally distributed for the attitude, comfort levels, and knowledge sections, a Mann-Whitney U test was used to compare those scores between field trip participants and non-participants.

Effect sizes were calculated to facilitate interpretation of significance tests with marginal *p*-values and small sample sizes. Cohen's *d* was the effect size test used for this. Effect sizes were interpreted arbitrarily as small (d=0.20), medium (d=0.50), and large (d=0.80) (Lakens et al. 2013).

Table 2: Overview of lessons at the Watershed Center in Springfield, MO

Lesson	Topic(s) Covered	Where Lessons Are Taught
Watersheds	What a watershed is The flow of water	At the main building
Springs/Streams	Average temperature Where springs originate from Recharge areas Stream Confluence	On the hiking trail
Karst Features • Sinkholes	What a karst feature is How sinkholes are formed Sinkholes as a direct connections to the underground aquifer	On the hiking trail
Ozark Habitats • Wetlands • Bottomland Forests • Glades	What features these specific habitats are composed of Benefits of a wetland Benefits of glades Enemies of glades	On the hiking trail
Pollution	Why dumping trash in sinkholes is bad Benefits of rain gardens and pervious pavement Effects of pollution Preventive measures	On the hiking trail
Recycling	Green roofs, features, buildings Recycled plastic Recycled plastic lumber Benefits of recycling Glassphalt	At the main building
Macroinvertebrates	Why macroinvertebrates are important Macroinvertebrates as bioindicators Why we use macroinvertebrates Identifying macroinvertebrates using a dichotomous key Pollution tolerant vs intolerant	At the stream

RESULTS

Of the 153 students who took the survey, there were 55 field trip participants (six male, 47 female, and two unknown genders). There were 98 field trip non-participants (10 male, 85 female, and three unknown gender). All students surveyed were enrolled in a science course. Field trip participants included GRY 240 (Earth Science for Teachers) classes from Missouri State University and Nature Unhooked classes from Parkview High School. Non-field trip participants included BIO 100 (Biological Science for Educators) classes from Missouri State University and General Chemistry classes from Parkview High School. Selection bias may have occurred because high school students who participated in the field trips were already enrolled in Green Team at Parkview High School. However, all pre-service students were studying to be elementary teachers. Grade level distributions of participants are in Figure 2.

Knowledge/Action Scores

There was no significant difference in knowledge scores between genders for all survey participants (d=0.00, Table 3). However, there was a significant difference in knowledge scores between field trip participants and non-participants ($p < 0.001$, d=1.15, Table 3). Between knowledge scores of college students that participated in field trips vs those that did not, there was a significant difference ($p < 0.001$, d=1.21, Table 4). Knowledge scores were consistently higher for students that attended field trips (Table 5).

When comparing all survey participants, there was no significant difference in action scores between genders (d=0.29, Table 6). There was a significant difference in action score for field trip participants and non-participants (d=0.43, Table 6). There was no significant difference in action scores of college students that participated in field trips versus those that did not (d=0.41, Table 7). Means for each question between field trip and non-field trip participants are located in Table 8.

Attitude/Comfort Levels

When comparing all survey participants, there was no significant difference between genders in attitude scores (d=0.57, Table 9). However, the differences between field trip participants and non-participants approached significance (d=0.50, Table 9). College students that participated in field trips had a medium effect size (d=0.54) and consistently higher attitude scores than those that did not participate in a field trip (Table 10). Means for each question between field trip and non-field trip participants are located in Table 11.

There was no significant difference between gender and comfort levels (d=0.09, Table 12) for all survey participants. There was also no significant difference between field trip participants and non-participants when comparing comfort levels (d=0.19, Table 12). The mean comfort level for college students who participated in field trips was higher, but not significantly different from the mean for those that did not participate (Table 13). The effect size was medium for college participants (d=0.57, Table 13). Means for each question between field trip and non-field trip participants are located in Table 14.

Overall Attitude, Action Scores, And Comfort Levels

When the scores of attitude, action scores, and comfort levels were combined for all participants to obtain an overall score, there was no significant difference between genders (d=0.33, Table 15). Field trip participants at the high school and college level had higher scores than non-participants overall (d=0.41, 0.43 consecutively, Table 15 & 16).

Teacher Surveys

Approximately 50 percent of the teachers responded to the teacher survey. They all stated that they plan to bring a class to the Watershed Center again. They all heard about the Watershed center through other teachers or from a trip to the center themselves. Two of the teachers stated their favorite aspect of the watershed center was that the field experiences taught directly aligned with course goals. The other teacher stated that you could bring one class to the Watershed Center multiple times and always have something different to do. They also stated the reason they come to the Watershed Center is because they love the hands on experience their students get.

Table 3: Knowledge means and standard deviations, and *p*-values with effect size (derived from a Cohen's *d* analysis*)* overall for gender (16 males/132 females) and field trip participants (55 students) and non-participants (98 students) derived from Mann-Whitney U tests

	Mean	**Standard Deviation**	***p*-value**	**Effect Size**
Gender			*0.97*	0.00
M (n)	0.64	0.13		
F (n)	0.64	0.13		
Field Trip Participants			*< 0.001**	1.15
Yes (n)	0.71	0.14		
No (n)	0.57	0.10		

Table 4: Knowledge means and standard deviations, and *p*-values with effect size (derived from a Cohen's *d* analysis*)* overall for college students for field trip participants (50 students) and non-participants (90 students) derived from a Mann-Whitney U test

	Mean	**Standard Deviation**	***p*-value**	**Effect Size**
Field Trip Participants			*<0.001**	1.21
Yes (n)	0.71	0.10		
No (n)	0.57	0.13		

Table 5: Percent correct for each knowledge question for field trip participants (55 students) and non-field trip participants (98 students)

Question	Field Trip Participants'	Non-Field Trip Participants'
Water flows from…	0.91	0.87
What environmental services…	0.96	0.77
A watershed is an area of land where …	0.71	0.73
What types of trees…	0.18	0.20
What is the average temperature…	0.20	0.33
A lake, stream or wetland is…	0.89	0.68
Forests aid in the control of floods by…	0.91	0.80
One way to make water cleaner …	0.71	0.43
Karst topography includes…	0.87	0.18
The recharge area of a watershed…	0.82	0.80
An intermittent stream is …	0.65	0.69
Reptiles love glades because…	0.35	0.44
Plastic lumber…	0.51	0.19
Sinkholes are…	0.85	0.83

Table 6: Action score means and standard deviations of students, and *p*-values with effect size (derived from a Cohen's *d* analysis*)* overall for gender (16 males/132 females) and field trip participants (55 students) and non-participants (98 students) derived from two-sample *t*-tests

	Mean	**Standard Deviation**	***p*-value**	**Effect Size**
Gender			*0.35*	0.29
M (n)	3.81	0.71		
F (n)	3.99	0.52		
Field Trip Participants			*0.01**	0.43
Yes (n)	4.12	0.51		
No (n)	3.89	0.54		

Table 7: Action score means, standard deviations and *p*-values with effect size (derived from a Cohen's *d* analysis*)* overall for college students for field trip participants (50 students) and non-participants (90 students) derived from a two-sample *t*-test

	Mean	**Standard Deviation**	***p*-value**	**Effect Size**
Field Trip Participants			*0.02**	0.41
Yes (n)	4.14	0.50		
No (n)	3.93	0.53		

Table 8: Action score means for each question for field trip participants (55 students) and non-field trip participants (98 students). Scores are on a Likert scale ranging from 1-5 with 5 being the most environmentally friendly. 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree Reversed codes were used for some questions.

Question	Field Trip Participants' Mean	Non-Field Trip Participants' Mean
I would not pick up trash to help clean up my neighborhood	4.54	4.27
I would collect natural things such as butterflies, and rocks	3.41	3.21
I would use recycle bins if they were provided for me	4.61	4.56
I would not practice "catch and release" fishing	4.31	3.79
I would participate in bird watching	3.24	2.91
I would go hiking on a local trail	4.56	4.61

Table 9: Attitude means and standard deviations, and *p*-values with effect size (derived from a Cohen's *d* analysis*)* overall for gender (16 males/132 females) and field trip participants (55 students) and non-participants (98 students) derived from Mann-Whitney U tests

	Mean	Standard Deviation	*p*-value	Effect Size
Gender			*0.16*	0.57
M (n)	3.87	0.50		
F (n)	4.15	0.45		
Field Trip Participants			*0.06*	0.50
Yes (n)	4.27	0.43		
No (n)	4.05	0.48		

Table 10: Attitude means and standard deviations, and *p*-values with effect size (derived from a Cohen's *d* analysis*)* overall for college students for field trip participants (50 students) and non-participants (90 students) derived from Mann-Whitney U tests

	Mean	**Standard Deviation**	***p*-value**	**Effect Size**
Field Trip Participants			*0.04**	0.54
Yes (n)	4.35	0.46		
No (n)	4.10	0.46		

Table 11: Attitude means for each question for field trip participants (55 students) and non-field trip participants (98 students). Scores are on a Likert scale ranging from 1-5 with 5 being the most environmentally friendly. 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree. Reversed codes were used for some questions.

Question	Field Trip Participants' Mean	Non-Field Trip Participants' Mean
I do not worry about animals becoming extinct	4.16	3.94
I would like to live where there are a lot of native plants and animals	4.12	3.81
I like to spend a lot of my time outdoors	4.20	3.96
I would be interested in bird watching	3.25	2.82
I do not worry about habitats disappearing	4.42	4.01
It's up to humans to protect our natural habitats, like forests and streams	4.51	4.55
We should worry that our society is becoming too dependent on technology	4.13	4.17
Remaining habitats in Missouri should be protected	4.59	4.63
Concern about extinction is over-exaggerated	4.15	4.11
It is not important to restore natural habitats such as glades and wetlands	4.47	4.43

Table 12: Comfort level means and standard deviations, and *p*-values with effect size (derived from a Cohen's *d* analysis*)* overall for gender (16 males/132 females) and field trip participants (55 students) and non-participants (98 students) derived from Mann-Whitney U tests

	Mean	**Standard Deviation**	***p*-value**	**Effect Size**
Gender			*0.92*	0.09
M (n)	0.64	0.57		
F (n)	0.64	0.53		
Field Trip Participants			*0.12*	0.19
Yes (n)	4.20	0.53		
No (n)	4.10	0.52		

Table 13: Comfort level means and standard deviations, and *p*-values with effect size (derived from a Cohen's *d* analysis*)* overall for college students for field trip participants (50 students) and non-participants (90 students) derived from a Mann-Whitney U test

	Mean	**Standard Deviation**	***p*-value**	**Effect Size**
Field Trip Participants			*0.07*	0.57
Yes (n)	4.40	0.51		
No (n)	4.10	0.54		

Table 14: Comfort level means for each question for field trip participants (55 students) and non-field trip participants (98 students). Scores are on a Likert scale ranging from 1-5 with 5 being the most environmentally friendly. 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree. Reversed codes were used for some questions.

Question	Field Trip Participants' Mean	Non-Field Trip Participants' Mean
I am comfortable taking a walk in my neighborhood	4.44	4.55
I am comfortable swimming in a lake	4.02	3.91
I am not comfortable around bees	2.80	2.12
I am comfortable taking a walk in the woods.	4.38	4.20
I am not comfortable standing in a stream	4.33	3.89
I am comfortable around plants in a natural area	4.44	4.50
I am not comfortable looking for birds in the woods.	4.35	4.12
I am comfortable around butterflies	4.65	4.56
I am not comfortable going fishing in a lake	4.56	4.35
I am comfortable camping in a tent overnight	4.10	4.14

Table 15: Overall Attitude, Action score, and Comfort means and standard deviations, and *p*-values with effect size (derived from a Cohen's *d* analysis*)* overall for gender (16 males/132 females) and field trip participants (55 students) and non-participants (98 students) derived from two-sample *t*-tests

	Mean	**Standard Deviation**	***p*-value**	**Effect Size**
Gender			*0.29*	0.33
M (n)	3.89	3.89		
F (n)	4.05	4.05		
Field Trip Participants			*0.02**	0.41
Yes (n)	4.15	0.46		
No (n)	3.97	0.46		

Table 16: Overall Attitude, Action scores, and Comfort means and standard deviations, and *p*-values with effect size (derived from a Cohen's *d* analysis*)* for college students for field trip participants (50 students) and non-participants (90 students) derived from a two-sample *t*-test

	Mean	**Standard Deviation**	***p*-value**	**Effect Size**
Field Trip Participants			*0.03**	0.43
Yes (n)	4.18	0.44		
No (n)	3.99	0.45		

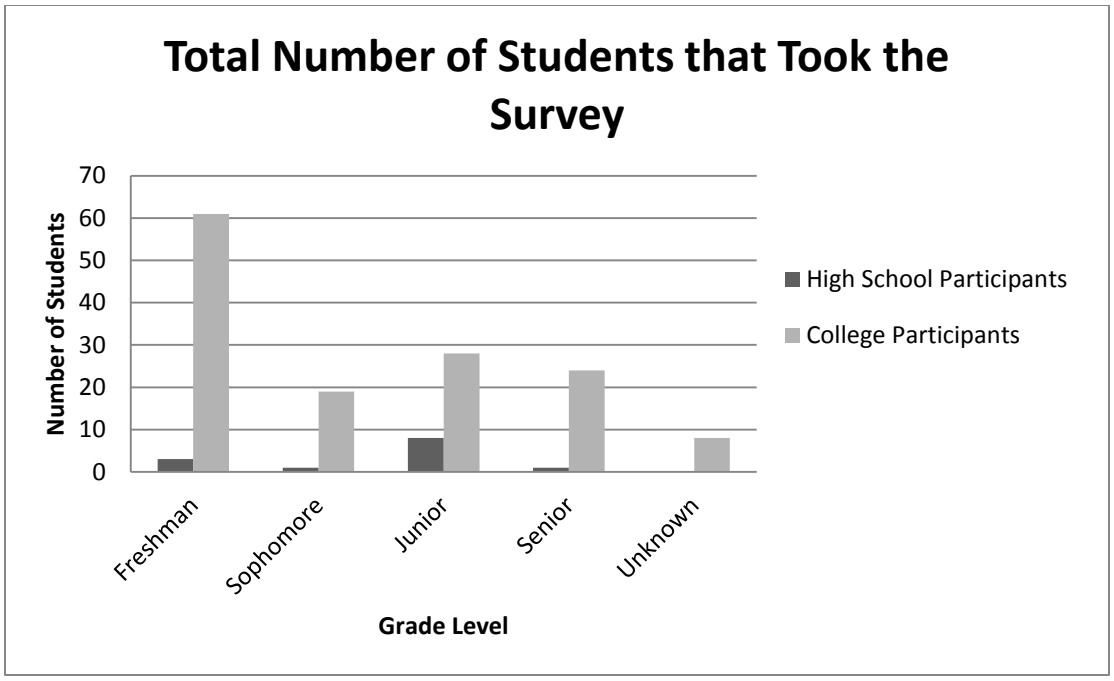

Figure 2: The total number of student participants that completed surveys

DISCUSSION

Short-term outdoor experiences can influence a student's thoughts, feelings, and ultimately actions toward the environment. These outdoor hands-on activities allow students to make a direct connection to nature. As a result of this, students who have more experiences in nature are going to be more likely to have pro-environmental attitudes (Cheng & Monroe, 2012). In a study of 2,000 adults, Wells & Lekies (2006), found that environmental activities such as hiking, camping, hunting, and gardening had a positive correlation with pro-environmental behaviors (Cheng & Monroe, 2012). If students are able to see and experience what they are learning about and make a strong connection, then environmental attitudes can improve.

Students can learn more in an outdoor classroom than they do in a traditional classroom setting because they are more engaged (Martin, 2003). I found that knowledge was greater for students that participated in the activities at the Watershed Center over those that did not participate. This also agrees with a study by Parrish (2005) of at-risk sixth grade students who attended three outdoor education programs over the course of several months. This study revealed not only an increase in mastering science concepts, but also enhanced cooperation and conflict resolution skills, improved classroom behavior, and motivation to learn (Parrish, 2005).

Environmentally responsible actions can result from emotional connections to the outdoor environment (Martin, 2004). When students are more comfortable in nature, they can develop an emotional connection that leads to changed actions (pro-environmental behaviors) (Martin, 2004). Studies have found that simply being outside and having good

role models (parents, teachers, etc.) can make positive memories (Chawla & Cushing, 2007). These memories can stimulate an interest in pro-environmental actions (Cheng & Monroe, 2012). Students with a connection to nature can increase their interests in pro-environmental practices (Cheng & Monroe, 2012). Mayer & Frantz (2004) found that student's connection to nature was a direct predictor of their environmental behaviors (Mayer & Frantz, 2004).

Teachers with a passion for the outdoors can be an important mentor for students (Louv, 2008). When teachers have an enthusiasm for nature, it can help the student feel more enthusiastic about the outdoor environment as well (Blanchet-Cohen & Elliot, 2011). This shows that teachers who are comfortable in the outdoors are more likely to motivate students. If teachers may not be as comfortable in the outdoors, may be less apt to take their students outdoors to learn. In my study, the participating teachers stated they were comfortable being outside. They participated in all of the activities at the Watershed Center along with their students and that could have motivated the students to learn more by participating more. Rachel Carson explained it when she wrote, "If a child is to keep alive his inborn sense of wonder, they need the companionship of at least one adult who can share it, rediscovering with him the joy, excitement, and mystery of the world we live in" (Carson, 1956/1998).

Many educators enjoy being outdoors with students because it renews the student/teacher relationship (Blanchet-Cohen & Elliot, 2011). Blanchet-Cohen & Elliot (2011) also revealed that teachers liked being outside because they were able to use their imaginations and explore more; they enjoyed seeing which direction their students' discoveries in the outdoors would lead them. In my study, most of the teachers stated that

they enjoyed the hands-on activities their students participated in and that their students would always have the ability to do something different - even if they came to the Watershed Center multiple times.

We were able to see greater knowledge, action scores, attitude, and comfort levels in students that came to the watershed center compared to students who did not. Future studies should include testing a larger sample size. Students may learn new things during the field activities, so possibly a pre-and post-test should be conducted. The Watershed Center has the ability to expand on different subjects that they teach, so surveys could be given for just one specific topic at a time. This would give educators the opportunity to come just for one specific topic that they might be covering in class. Post-surveys could be given two months after the field trip to assess whether or not knowledge was retained for a longer period of time. A case study could be conducted as well; students who complete the survey could be contacted later (if given permission) to assess their environmental attitudes.

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APPENDICES

Appendix A: Letter to the Teachers

Dear Teacher,

Thank you for scheduling your field trip to the Watershed Center. As you may know, many young people are becoming disengaged with nature, and comfort with the outdoors is also being reduced. Teenagers, in general, are not participating in outdoor or nature-related activities as much as previous generations. As a result, many students have poorer attitudes, less comfort, and will be less apt to take environmental action.

For a Master's Degree research project at Missouri State University, I am evaluating the effectiveness of educational activities at the Watershed Center by comparing the knowledge, comfort levels, attitudes, and actions of high school and MSU students who have participated in activities at the Watershed Center in Springfield, Missouri to students who do not visit the center. This Study has been approved by Springfield Public Schools.

If you choose to participate, I will give the post-survey after students complete the interpretive education programs in the outdoor classrooms at the Watershed Center. I would also like you to administer the survey to a similar group of students who have not come to the Watershed Center. This could be any similar aged class. There will also be a very short survey that will be directed toward you and why you take your classes to the Watershed Center. I will bring copies of the survey and consent forms, so you do not have to worry about printing any out. I can also provide copies of the consent letter to the parents or guardians. I will contact you in a week if I do not hear from you.

Your participation in this study is extremely important because you are one of the supporters of the education programs at the Watershed Center. Your participation will help ensure we get a representative sample of students. I will contact your regarding your participation. If you participate, I will send parent permission slips for those going and the class not going to the Watershed Center and the surveys for a class not going to the Watershed Center. I will give the field trip class surveys when they go to the Watershed Center.

You may be assured of complete confidentiality. Identifying demographic information will not be collected – the only information that will be collected on the survey is which high school your student is attending, gender, grade, and name of class. The High School name nor your name will be disclosed in any publication.

As teachers who care about our environment, and our future generations, please consider participating. You may contact me via email atBrandi638@live.missouristate.edu or my cell phone number at 417-689-4730 to let me know if you wish to participate or if you

have any questions. You may also contact my advisor, Dr. Janice S. Greene, at 417-836-5306 if you have any questions. I look forward to hearing from you.

Sincerely, Brandi Silvey

APPENDICES

Appendix B: Consent Letter to Parents or Guardians

Consent Letter to Parents or Guardians

Missouri State University
Department of Biology

Dear Parent or Guardian:

Your student will be participating in a field trip to the Watershed Center for class. The Watershed Center is interested in finding out how the students respond to field trip experiences. As part of my Master's Degree, I am conducting a short evaluation of the experience.

Purpose of the research study:
The purpose of this study is to evaluate the effectiveness of educational activities at the Watershed Center on high school students' knowledge, comfort levels, attitudes, and actions toward the outdoor environment. This study will compare the post-field trip responses of students who came to the Watershed Center to students who did not participate in a school field trip.

What students will be asked to do in the study:
After completion of the field trip program in the outdoor classrooms at the Watershed Center, students will complete a short survey. The survey will consist of four sections – knowledge, comfort in the outdoors, attitude, and action

Confidentiality:
Identifying demographic information will not be collected. Participation is voluntary and there is no penalty for participating.

Whom to contact if you have questions about the study:
You may contact the researcher via email at Brandi638@live.missouristate.edu if you have any questions. You may also contact Dr. Janice S. Greene at 417-836-5306 if you have any questions.

Please return this page as soon as possible.

I give permission for _____ to participate in the survey after the Watershed Center field trip. I understand that no identifying information will be reported.

Parent/Guardian _____ Date: _____

APPENDICES

Appendix C: Student Assent Form

Informed Consent for Students

Missouri State University
Brandi Silvey, Brandi638@live.missouristat.edu

Please read this consent document carefully before you decide to participate in this study

Purpose of the research study:
The purpose of this study is to evaluate the effectiveness of educational activities at the Watershed Center on high school students' knowledge and attitudes toward the outdoor environment.

Your participation in this study is completely voluntary, and you may stop at any time. There is no penalty for not participating. No information will be reported that can identify you or your school in any way.

Agreement:
I have read the procedure described above. I voluntarily agree to participate in the procedure.

Participant: _____ Date: _____

Appendix D: IRB Approval Email

From: MSU IRB

Date: 3/03/2016

RE: Notice of IRB Exemption
Exemption Category: 1.Educational setting
Study #: 16-0325

Study Title: An Evaluation of Knowledge and Comfort Levels Gained by High School Students Through Activities at the Watershed Center in Springfield, MO

This submission has been reviewed by the Missouri State University IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Investigator's Responsibilities:

If your study protocol changes in such a way that exempt status would no longer apply, you should contact the above IRB before making the changes.

Appendix E: Springfield Public Schools Approval

Springfield Public Schools Exists For the Academic Excellence of All Students

To: Brandi Silvey

From: Jill Palmer

Date: March 15, 2016

Subject: Request to Conduct Research

Your request to conduct research proposal titled, *The Effect of a Student Field Trip on the Knowledge, Attitudes, and Comfort Level in the Outdoors: The Watershed Center Field Trip*, submitted for consideration has been approved with agreed upon participation from the teacher supervising the field trip to the Watershed Center.

Feel free to contact Jill Palmer at (417) 523-0301 if you have questions or need additional information.

Jill Palmer
Coordinator of Accountability
Springfield Public Schools

Appendix F: Post-Field Trip Survey

Student-Survey

Name of School: _____

Name of Class: _____

Gender (circle one): Male / Female

Grade Level (circle one): Freshman Sophomore Junior Senior

This survey will help to gather information about what you learned and how you feel. It is important that you answer each question to the best of your ability.

Knowledge Section – Correct Answers are Underlined

1. Water flows from low to high elevation
    a. True
    b. False

2. What environmental services do wetlands provide?
    a. They help control flooding
    b. They filter pollutants out of the water
    c. They provide food crops such as rice
    d. All of the above

3. A watershed is an area of land where all of the water that is under it or drains off of it goes into the same place.
    a. False
    b. True

4. What type of trees are usually found in bottomland hardwoods?
    a. Oak
    b. Maple
    c. Cedar
    d. Sycamore

5. What is the average temperature of spring water in Missouri?
   a. 45 – 48 degrees Fahrenheit
   b. 50 – 53 degrees Fahrenheit
   c. 58 – 60 degrees Fahrenheit
   d. 65 – 67 degrees Fahrenheit

6. A lake, stream or wetland is…
   a. unaffected by the status of the watershed around it.
   b. only as healthy as the watershed around it.
   c. healthier than the watershed around it.
   d. less healthy than the watershed around it.

7. Forests aid in the control of floods by…
   a. Reducing erosion and run-off.
   b. Reducing rainfall.
   c. Lowering air temperature.
   d. Increasing snowfall.

8. One way to make water cleaner is to run it through a wetland or marshy area.
   a. True
   b. False

9. Karst topography includes
   a. Caves and Sinkholes
   b. Rivers and Streams
   c. Meadows and Prairies

10. The recharge area of a watershed determines the water quality of springs
   a. True
   b. False

11. An intermittent stream is a stream that flows during wet weather
   a. False
   b. True

12. Reptiles love glades because
   a. They can sun themselves on the rocks
   b. They can eat the vegetation
   c. They can use crevices for shelter
   d. All of the above
   e. A and C only

13. Plastic lumber
    a. requires a lot of maintenance
    b. lasts longer than treated lumber
    c. is less expensive than treated lumber
    d. will leach chemicals into the environment

14. Sinkholes are
    a. A perfect place to dump trash
    b. A connection from the land's surface to the underground aquifer
    c. Where limestone has dissolved
    d. Both B and C

Comfort in the Outdoors Section

For this section, please circle the number that best corresponds with your level of comfort or the answer that sounds most like you and how you feel.

	Strongly Disagree	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
1. I am comfortable taking a walk in my neighborhood	1	2	3	4	5
2. I am comfortable swimming in a lake	1	2	3	4	5
3. I am <u>not</u> comfortable around bees	1	2	3	4	5
4. I am comfortable taking a walk in the woods.	1	2	3	4	5
5. I am <u>not</u> comfortable standing in a stream	1	2	3	4	5
6. I am comfortable around plants in a natural area	1	2	3	4	5
7. I am <u>not</u> comfortable looking for birds in the woods.	1	2	3	4	5

	Strongly Disagree	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
8. I am comfortable around butterflies	1	2	3	4	5
9. I am <u>not</u> comfortable going fishing in a lake	1	2	3	4	5
10. I am comfortable camping in a tent overnight	1	2	3	4	5

Attitude Section

For this section, please circle the answer that best corresponds to how you think and feel

	Strongly Disagree	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
1. I do <u>not</u> worry about animals becoming extinct	1	2	3	4	5
2. I would like to live where there are a lot of native plants and animals	1	2	3	4	5
3. I like to spend a lot of my time outdoors	1	2	3	4	5
4. I would be interested in bird watching	1	2	3	4	5
5. I do <u>not</u> worry about habitats disappearing	1	2	3	4	5
6. It's up to humans to protect our natural habitats, like forests and streams	1	2	3	4	5
7. We should worry that our society is becoming too dependent on technology	1	2	3	4	5

	Strongly Disagree	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
8. Remaining habitats in Missouri should be protected	1	2	3	4	5
9. Concern about extinction is over-exaggerated	1	2	3	4	5
10. It is <u>not</u> important to restore natural habitats such as glades and wetlands	1	2	3	4	5

Action Section
For this section, please circle the number that best corresponds with how likely you would be to participate in each action.

	Strongly Disagree	**Disagree**	**Undecided**	**Agree**	**Strongly Agree**
1. I would not pick up trash to help clean up my neighborhood	1	2	3	4	5
2. I would collect natural things such as butterflies, and rocks	1	2	3	4	5
3. I would use recycle bins if they were provided for me	1	2	3	4	5
4. I would not practice "catch and release" fishing	1	2	3	4	5
5. I would participate in bird watching	1	2	3	4	5
6. I would go hiking on a local trail	1	2	3	4	5

APPENDICES

Appendix G: Teacher Survey

Name of High School: _____
Name of Class: _____

This survey will help to gather information as to why you chose to bring your class to the Watershed Center

1. How did you hear about the Watershed Center?

2. What do you like best about the Watershed Center?

3. What made you want to bring your class to the Watershed Center?

4. Will you bring a class again?