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Comparing the effectiveness of interactive field, interactive class and non-interactive class lecture teaching strategies to teach wetland ecology concepts to 6th grade science students

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COMPARING THE EFFECTIVENESS OF INTERACTIVE FIELD,
INTERACTIVE CLASS AND NON-INTERACTIVE CLASS
LECTURE TEACHING STRATEGIES TO TEACH
WETLAND ECOLOGY CONCEPTS TO 6TH
GRADE SCIENCE STUDENTS

by

April Marie Samson

Bachelor of Science
Brigham Young University
2000

A thesis submitted in partial fulfillment
of the requirements for the

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ABSTRACT

Comparing the Effectiveness of Interactive Field, Interactive Class and Non-Interactive Class Lecture Teaching Strategies to Teach Wetland Ecology Concepts to 6TH Grade Science Students

by

April Marie Samson

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This study tested the effectiveness of interactive teaching methods on the learning of wetland ecology concepts by 6th grade science students. 330 students from nineteen different 6th grade science classes were used in this study. These classes were separated into four different treatment groups, each containing presentations with varying degrees of student interaction. This was done in attempt to test the effect of interactive teaching methods on attitude about the environment and knowledge regarding wetland ecology concepts, specifically, on outdoor education as a process of learning by doing. Student knowledge of wetland ecology concepts and attitudes toward the environment were tested before, immediately after and one month after each presentation. Test results from each treatment group were used to compare the effect of different levels of interaction on the learning of wetland ecology concepts. Results show that there was no significant difference between treatments. We believe that these findings reflect problems with the study, rather than disprove the hypothesis. These findings resulted from treatment groups being unequal in their initial knowledge regarding wetland ecology. Although the results indicated there was no significant difference between treatment groups we did find that

all students retained information from Pretest to Posttest. We believe an improved experimental design outdoor education may prove to benefit those learning wetland ecology concepts.

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CHAPTER 1

DEFINING THE PROBLEM

In an article titled “Science Literacy For All in the 21st Century”, George Nelson (1999) reports that U.S. 12th grade students participating in the Third International Mathematics and Science Study (TIMSS) were among the lowest scoring students in general knowledge science and mathematics among the 41 participating nations. “The TIMSS study is compelling evidence of what we have known for decades: Most U.S. students, even the brightest, are failing to learn much that is useful in science, mathematics, and technology” (Nelson, 1999, p. 14). Science and technology are increasingly being recognized as central to our more global society and as a result scientific literacy has become a necessity for everyone. The American Association for the Advancement of Science (AAAS) has recently created *National Science Education Standards* (National Committee on Science Education Standards and Assessment, National Research Council, 1996) aimed at “developing a scientifically literate citizenry” who can contribute to society in productive and responsible ways (Weiss, 1993, p. 11). Yet with so much emphasis being placed upon science education it is surprising that K-12 science education in the United States is still failing to promote science achievement of its students. For example, the TIMSS study showed a decline in science achievement in the U.S. students from fourth to eighth grade (Schmidt and McKnight, 1998). As a result, students are leaving the school system with an insufficient understanding of science.

Many researchers suggest that one of the reasons students are not attaining a sufficient understanding of science is the way in which science content is presented. Traditionally science education has been characterized by passive learning, where

students act as passive participants that merely listen to what is being taught (Powell & Wells, 2002; Murray & Brightman, 1996). Zacharia & Barton (2004) define traditional science learning as scientific knowledge conveyed through textbooks, where passive receivers obtain information through lecture and observed activities. Kyle et al. (1988) state that traditional teaching focuses on students gaining knowledge through passive lectures, reading the text and completing worksheets. They say that science classes using these traditional teaching methods more closely resemble language art classes. Ogunsola-Bandele & Oyedokun (1998) further define the traditional teaching approach as story telling, where teachers use the chalkboard while students take notes and refer to the textbook. Other traditional teaching methods include teaching concepts and ideas outside the range of a students experience and the memorization of key terms and facts (Ogunsola-Bandele & Oyedokun, 1998; Zacharia & Barton, 2004; The National Science Teachers Association 1995).

Traditional teaching is problematic in that it is teacher centered. As the authority the teacher determines which topics, sequence and methods are to be utilized, while students passively participate (Yager & Akcay 2008). In addition, Kaya et al. (2007) suggest that traditional teaching “narrowly focuses on those who are verbally and mathematically inclined” (p. 12). They further state that if we as instructors believe in the notion that science is for every child, then we need to utilize teaching approaches that center on the individual abilities, needs and interests of the learner.

Murray & Brightman (1996) describe a growing opinion among educators that active participation in the subject material improves learning. Kyle et al. (1988) maintain that science programs developed during the 1960’s and 1970’s that focused on inquiry-

oriented textbooks need to be replaced. They suggest that many educators and researchers believe these traditional teaching methods to be outdated and that a revitalization of science education is now in order. To increase retention and knowledge students must be “actively engaged” in the learning process.

One tool that is being implemented by educators in attempt to involve students more in the learning process is “interactive teaching”. Interactive teaching involves the active participation of students in the learning process. During interactive teaching students participate in learning activities as opposed to passively listening and receiving the information. Researchers argue that when students actively participate and put learned concepts into practice, they understand and retain those concepts better. Students become engaged in learning through an “active learning” process (Ferguson, 1999).

Interactive teaching takes many different forms. Four main forms include: (1) Interactive discussion involving communication between “teachers and students talking together to promote conceptual change in science learning” (Alvermann, Hynd & Qian 1995, p. 146), (2) Educational games engaging the participant in the material presented allowing for enjoyment and learning to take place (Prensky, 2002), (3) Interactive science centers that provide a “hands on” experience (Rix & McSorley, 1999), (4) Experiential learning or learning by doing, where students are active participants in the learning process by going on field trips, hands-on activities etc (Powell & Wells, 2002, The National Science Teachers Association, 1995). In this study we used the fourth category, experiential learning or learning by doing to define “interactive teaching”.

Current science teaching methodology is not providing students with the content knowledge and skills necessary to be competitive in the world market. In addition

traditional styles of passive learning are negatively influencing student attitudes toward science (Simpson & Oliver, 1990). It is therefore necessary for science teachers to implement other teaching methods within science courses. This study suggests implementing interactive teaching methods. Interactive teaching methods have been implemented in various subjects including engineering, sex education, social science and drug education (Murray & Brightman 1999, Hines 1995, Ferguson, 1999, Orme & Starkey, 1999). We felt that interactive teaching (experiential learning or learning by doing) was a perfect fit to teaching wetland ecology, as students would have direct contact with the subject matter. Experiential learning is defined as learner-centered, where knowledge is gained through experience and interaction in the learning process (Powell & Wells, 2002). Mittlestaedt et al. (1999) define experiential environmental education as learning through hands-on experience outdoors. They claim that indoor or formal classroom instruction places limits on teaching and learning about the environment. Taking the lesson outside of the classroom allows students numerous opportunities to engage themselves in the lesson and link concepts together. Mittlestaedt et al. (1999) further argue that learning outdoors is a perfect match for teaching concepts regarding the environment. “Natural settings provide a context for teaching and learning with which no textbook or computer-based learning environment can compete” (Tanner, 2001, p. 64). As Sharp (1952) suggests, it is only when we put ourselves in the appropriate location that we begin to see the interconnectedness of our surroundings. “Outdoor education forces the issue of integration in the curriculum, to study and experience things in their total relationships-one thing to another” (Sharp, 1952, pp. 20-21).

Donaldson and Donaldson (1958) proposed one of the earliest definitions of outdoor education as “education in, about and for the outdoors” (p. 63). Priest (1986) further refined this definition as “an experiential process of learning by doing, which takes place primarily through exposure to the out-of-doors. In outdoor education the emphasis for the subject of learning is placed on relationships, relationships concerning people and natural resources” (p. 13). It is this interconnectedness that we hope will engage the students in the learning process, while at the same time help them understand their personal relationship with the environment.

Mand (1967) promotes the idea that outdoor education gives the participant a full sensory approach to the subject matter rather than merely the abstract. This full sensory approach involves using the eyes, ears, nose and muscles in the process of learning. This is one of the most important advantages to teaching and learning outside. Being able to use all of our senses together allows us to better assimilate the experience we are engaged in, which allows various avenues for understanding the material presented. In the classroom we are often limited to our visual and audio senses (i.e. seeing a picture of a wetland and hearing the teacher lecture on wetland ecology). When we are at a wetland we listen to the sound of a bird, we see the cattails surrounding the pond, we touch the soil or plants at the wetland, we smell flowers in bloom. Combining these sensory experiences gives us the opportunity to better understand the lesson at different levels. “It is always the person who sees, discovers, or explores a situation who gets the most out of it. This, in short, is the whole thesis of outdoor education (Sharp, 1952, p. 19).”

The objective of this study was to test two hypotheses: 1. Interactive teaching methods are more effective for promoting learning about wetland ecology concepts than

traditional-classroom based teaching methods. 2. Interactive teaching methods are more effective at producing positive attitudes toward the environment than traditional teaching methods. Interactive teaching for the purpose of this study will be defined as learner-centered, where the student actively participates in the presentation. Actively ranges from participating in the discussion, to a more hands-on approach where the student physically participates in the activity. Many researchers have observed that students are more excited about learning environmental concepts when interactive classroom and field approaches are taken (e.g., Rix & McSorley 1999, Ferguson 1999, Wendling & Wuensch 1985). It has been stated that outdoor education with classroom instruction is more effective than either approach alone (Disinger 1987). However, many of the reports on the value of field education are anecdotal. There have been few rigorous studies on the effectiveness of field education in a traditional classroom context (e.g., Leeming, Dwyer, Porter & Cobern 1993). Our study will evaluate the effectiveness of interactive field education in the traditional classroom context.

We choose to focus our research on 6th grade students (11 and 12 year olds) and their learning of wetland ecology concepts. We were interested in using 6th graders in our study because of their capability to link concepts together. Dimopoulos & Pantis (2003) conducted a study on 5th and 6th graders to test knowledge and attitude regarding sea turtle conservation. They selected 5th and 6th graders because of their ability to use deductive reasoning. Dimopoulos & Pantis (2003) further added that 5th and 6th graders would most likely be influenced by such a study and, because of their youth they would have a longer period to influence environmental quality and promote environmentally responsible behaviors in others. They suggested that when using 5th and 6th graders it is

best to use local problems and real situations. Since we were interested in teaching about local wetland ecology, we felt that the information would be appropriate for 6th graders and that by teaching them in their youth they would be able to influence others.

Another reason for choosing 6th graders was that it had been suggested that the beginning of middle school (6th grade) is a critical period where most individuals develop their attitudes about science (Simpson & Oliver, 1985). Cachelin, Paisley & Blanchard (2009) noted that outdoor experiences during youth are critical. Ogunisola-Bandele & Oyedokun (1998) define attitude as a student's belief and understanding about a subject/object. Shrigley et al. (1988) further describe attitude as something liked or disliked. Simpson & Oliver (1985) insist that during this critical period if students' first experience with science is not favorable it is likely that students will turn away from science. They claim that this is a result of minimal science instruction in elementary school. Consequently, most adolescents enter their first science courses in middle school with little background and mixed feelings regarding science. Evidence suggests that early childhood experiences serve as major influence of academic interest and achievement (Simpson & Oliver, 1990). Shrigley et al. (1988) state that attitude is learned not inherited. Furthermore our attitudes are a reflection of our experiences. If attitudes are learned than they also can be taught (Shrigley et al., 1988). It is therefore important that educators provide students with favorable experiences so as to help students' develop positive attitudes toward science.

We were also interested in testing students' attitudes toward science, specifically toward the environment. Olarewaju (1988) suggests that student's attitudes toward science are one of the most important goals of research in science education. It is

important to improve attitude in science learning while children are young. In a longitudinal study done by Simpson & Oliver (1990), testing attitudes toward science, they found that from 6th to 10th grade students' attitudes toward science decreases or become more negative. They project that this increase of negative attitudes toward science that begins in adolescence continues into college students and adults. It is therefore essential that science educators focus on improving science experiences that occur in these critical years of adolescence. Science curriculum in most schools presently is not producing students with positive attitudes. If attitude toward science is a major goal of educators then science curriculum must be reshaped to meet the needs of adolescents (Simpson & Oliver, 1985; Olarewaju, 1988). "That people see the importance of attitude in science learning from different perspectives makes research in the area worthwhile" (Olawajun, 1988, p. 284)

In addition to the increase of more negative attitudes during middle and junior high school years, there is also evidence that there is a steady decline among adolescents in motivation to achieve in science (Simpson & Oliver, 1985; Zacharia & Barton, 2004). Powell & Wells (2002) define learning as the interaction between the learner and the experience. Ogunola-Bandele & Oyedokun (1998) state that attitude exerts a significant influence on student learning. They suggest that a person who has a positive attitude toward a subject will perform better than a person with a negative attitude. Dimopoulos & Pantis (2003) argue that it is unclear if knowledge leads to attitude or if attitude leads to knowledge. For this reason it is important to study both the acquisition of knowledge as well as the production of attitude in adolescents. Attitudes and achievement are important variables to consider in the education of adolescents (Simpson & Oliver, 1990). Both

knowledge and attitudes must be improved in order to stimulate positive attitudes about science (Dimopoulous & Pantis, 2003).

Our study is extremely important for several reasons. First, there are standards such as the *National Science Education Standards* that advise teachers and administrators what students should know (National Committee on Science Education Standards and Assessment, National Research Council, 1996). It is imperative that teachers know the most effective methods to achieve these standards (Powell & Well, 2002). If we want our students to achieve and develop positive attitudes toward science, we need to provide educators with the most effective teaching methods. Secondly, Zacharia & Barton (2004) and Haladyna & Shaughnessy (1982) state that there have been several studies focused on evaluating students attitude toward science, but a lack of studies that evaluate how students attitudes toward science may be influenced by how science is taught (instructional activities and methods). This study looks at two different teaching methods: traditional and interactive. It is vital that we evaluate the effectiveness of traditional and interactive teaching methods on knowledge acquisition (learning) and positive attitude promotion, so that students, specifically 6th graders, receive the method most conducive to increasing these variables. Lastly, it is important to test the effectiveness of field-based teaching methods on knowledge acquisition and development of positive attitudes. Research has shown that students involved in field-based science programs achieve better and have a better attitude in science when compared to students not receiving such field-based programs (Disinger, 1984). Landis (1996) argues that studies involving field-based methods require more attention.

Many researchers have observed that students are more excited about learning

environmental concepts when interactive classroom and field approaches are taken (e.g., Rix & McSorley 1999, Ferguson 1999, Wendling & Wuensch 1985). Yet, little of the literature available has provided realistic evidence of the outcomes of environmental education, much less the outcomes of outdoor education (Leeming, et. al., 1993). There have been few rigorous studies on the effectiveness of field education in a traditional classroom context (e.g., Leeming, Dwyer, Porter & Cobern 1993). Our study evaluated the effectiveness of interactive field education in the traditional classroom context. Through this study we hoped to test whether outdoor education was beneficial to the learning and retention of wetland ecology concepts, as well as creating positive attitudes toward the environment and science. It is important to discover which teaching method is the most effective at conveying wetland ecology concepts. By determining whether interactive teaching methods for wetland education are more effective than traditional teaching methods, teachers and administrators will be able to improve current teaching strategies and increase retention of material taught. If interactive teaching methods are proven more effective than traditional teaching methods at improving student understanding and retention of wetland ecology concepts, this could open the door to apply interactive teaching methods to other subjects. If interactive teaching strategies were found to help students develop a more positive attitude toward the environment than non-interactive teaching strategies, students would benefit from a change in current teaching trends. It is important for us to find out what are the best methods for teaching science to middle school age students, as all middle school students must take science courses. It is important to help the students develop positive attitudes toward the environment as they will someday be stewards over it.

CHAPTER 2

HYPOTHESES

To test the effectiveness of different interactive teaching methods on the acquisition of knowledge of wetland ecology concepts as well as attitudes toward the environment, this study implemented the following experimental design: Nineteen 6th grade classes were divided into four different treatment groups (see Table 1). Treatment one was a classroom-only non-interactive presentation, treatment two was a classroom-only interactive presentation, treatment three was a field-only presentation and treatment four included both the interactive classroom presentation and the interactive field presentation.

Table 1
Number of teachers, classes and students per Treatment

Numbers	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Teachers	1	1	1	1
Classes	4	5	5	5
Students	79	79	79	110

Table 1 depicts how many teachers, classes and students received each treatment. Each treatment was administered by one teacher where number of students represents the number of students who were present during each presentation. Treatment one represented the most basic presentation, while the other treatments served as experimental interactive teaching groups. We proposed that students exposed to a

combined interactive classroom and interactive field teaching strategy would understand and retain wetland ecology concepts better and develop a more positive attitude toward the environment than students exposed to only one interactive teaching method (class or field) or non-interactive classroom lecture. We expected to find that the more involved the student was in the presentation, the more they would understand and retain. Hence, our hypotheses for this study were as follows:

- Hypothesis 1: Interactive teaching methods are more effective for promoting learning about wetland ecology concepts than traditional teaching methods. Therefore:
 - a. Treatment 4 (interactive class and interactive field) learning will increase the most
 - b. Treatment 3 (interactive field only) learning will increase more than Treatment 2 and 1
 - c. Treatment 2 (interactive class) learning will increase more than Treatment 1 (non interactive classroom presentation)
- Hypothesis 2: Interactive teaching methods are more effective at producing positive attitudes toward the environment and science than traditional methods. Therefore:
 - a. Treatment 4 attitudes will improve most
 - b. Treatment 3 attitudes will improve more than Treatments 2 and 1
 - c. Treatment 2 attitudes will improve more than Treatment 1
 - d. Treatment 1 attitudes will improve the least

- Hypothesis 3: Interactive field teaching methods are more effective for promoting learning about wetland ecology concepts than a classroom visit (with or without interaction)
 - a. Learning will improve more in treatments 3 and 4 than treatments 1 and 2
- Hypothesis 4: Interactive field teaching methods are more effective at producing positive attitudes than a classroom visit (with or without interaction)
 - a. Attitudes will improve more in treatments 3 and 4 than in treatments 1 and 2

These hypotheses are based on the idea that the more engaged the student is in the learning process, the more information they will learn and retain.

Research has shown that interactive teaching strategies increase student learning of subject matter. Powell & Wells (2002) conducted a study looking at three different experiential (learning by doing) approaches to teaching science to 5th graders. They found that all three experiential approaches resulted in learning among students, even though no one method was better than the other two. They concluded that experiential lessons have a significant positive effect on student knowledge gain, regardless of method. The National Science Teachers Association (1995) states that interactive teaching (or hands-on activities) is successful at increasing knowledge and attitude because kids already know how to do it, this is how they learn. Whether there are hands-on activities in the classroom where students make observations about animals, plants etc. or whether it is hands-on activities outside the classroom, such as a field trip outside, these interactive methods work at increasing knowledge because this is how children learn. Children learn

by being actively involved in the learning process.

We felt that the best way to evaluate the effectiveness of interactive teaching, specifically outdoor education or field based instruction, on learning and retention was to compare it to other types of teaching methods. Disinger (1984) reported that students participating in field excursions outperformed (achievement) those students who received only classroom instruction. In a later study, Disinger (1987) found that outdoor education with classroom instruction is more effective than either approach alone. Using both the class and field environments to teach science interactively allows students the opportunity to take what has been learned inside the classroom and apply it to their surroundings. Landis (1996) proposes that teaching science in the field provides unique opportunities for students to investigate the natural world around them. Just as classroom hands-on activities allow for meaningful learning, the natural environment also provides a good medium for such learning to take place. We believe that students who participate in outdoor or field-based education with hands-on activities will learn and retain more because as Sharp (1952) states, “we know the best way to learn is to come in contact with the things we seek to know”(p. 19). It is through personal contact with the environment that the students who participate in outdoor or field based education will have a full sensory experience as well as be able to experience wetland ecology as it relates to them and their environment.

Several additional studies have found that outdoor education increases learning (Lisowski & Disinger, 1991, Wise & Oakey 1983). Lisowski & Disinger (1991) say that Paigetian theory promotes the idea that experiential experiences assist and enhance learning. In a meta-analysis done of the effects of various science teaching strategies on

achievement, Wise & Oakey (1983) reported that non-formal learning environments (such as outdoor education) were more effective for teaching and learning than traditional learning environments (i.e. classroom). Cwikla, Lasalle & Wilner (2009) reported that out-of-school learning programs also increased students in-school attendance, participation and their attitudes toward school. Landis (1996) reports that field-based instructional studies that focus on the promotion of learning are worthy of greater attention. This is the foundation for conducting our research on the effect of field-based instruction on learning.

We recognize that outdoor or field-based education should be a supplement to classroom curriculum. As Sharp (1952) suggests, outdoor education experiences should be an occasional departure from school, not a substitute for it. Howie (1974) states that outdoor environmental education programs should be an extension of the classroom, not a unique event. We hoped that this study would support the use of the outdoors as an extension to the classroom as being advantageous to both the learning of subject material and to the improvement of attitudes toward the outdoors.

In addition to outdoor education being an important interactive tool, we proposed that interactive means in the classroom, such as visual aids, interactive discussion and games would also be important approaches to increasing knowledge retention of science subjects as well as developing positive attitudes. Ferguson (1999) stated the importance of providing teachers with “active learning tools that both engage and educate students...” (p. 285). Again, teachers don’t have to leave the classroom in order to create an interactive environment. A switch from traditional teaching methods to a more interactive teaching approach can be done through various techniques, which allow

students to be more engaged in the learning process. For example, Papaevripidou, Constantinou & Zacharia (2007) compared a modeling-based approach to a ‘traditional’ worksheet approach. They found that those students who participated in the model-based approach outperformed the ‘traditional’ worksheet approach group.

The second major focus of this research was on attitudes toward the environment. In addition to expecting that students would learn more about a topic in a natural setting, we also believed that students who received a lesson outside of the classroom would develop a more positive attitude about the environment. Zacharia & Barton (2004) define attitude as a mental concept that depicts either favorable or unfavorable feeling toward an object or subject. Mittelstaedt et al. (1999) further define the term attitude as “a mental system of cognitive and affective components, combined with a behavior tendency, directed toward a person, object or idea” (p. 139). The affective domain involves an individual’s interests, attitudes, moral and ethical values, and social skills (Crompton & Sellar, 1981), where the cognitive domain involves knowledge about the subject. According to Mittelstaedt et al. (1999) it is the combination of knowledge and interests that creates or defines attitude. Shrigley et al. (1988) propose that attitudes are learned either directly (through personal experience) or indirectly (from others.) Perhaps these learned attitudes of students toward the environment and science stem from parent or teacher influence and/or a lack of positive experiences in either setting. We proposed that interactive teaching methods used inside and outside of the classroom would improve students’ attitudes and perceptions toward the environment and science by providing them with a fun method of learning.

We expected that students who received field-based instruction would develop more

positive attitudes about the environment than those students who remained in the classroom. Disinger (1984), in an article relating to field instruction in school settings, reports that students participating in field instruction have a better attitude than those not participating in such instruction. We also expected that those students who received only the interactive classroom presentation would develop more positive attitudes about science and the environment than those students who received a non-interactive presentation. These expectations were based on the hypothesis that positive experiences in nature produce positive attitudes about the environment. In a paper examining the effect of outdoor education on the development of positive attitudes, Crompton & Sellar (1981) found that research generally supports the claim that outdoor education experiences promote positive attitude development.

Our hypotheses were based on the idea that as the degree of interaction in the learning process increases (i.e. telling vs. showing vs. involving), attitudes about the subject become more positive and knowledge acquisition occurs. Figure 1, the interaction spectrum, is our visual representation of our hypotheses. While researching the topic of interactive teaching I created this figure as a visual representation of what I expected to find as student interaction increased in the presentation. In our study, the students who were at the wetland learning through hands-on activities represented the “involving” end of the interaction spectrum. These students were expected to learn and retain more wetland ecology concepts and develop a more positive attitude toward the environment than any group of students who received a classroom presentation. At the middle of the interaction spectrum, “showing”, we had the group that received the interactive classroom presentation. It was expected that this group through the use of visual aids

would learn and retain more wetland ecology concepts and develop a more positive attitude toward the environment than those students who received the non-interactive classroom presentation, which represented the “telling” end of the interaction spectrum.

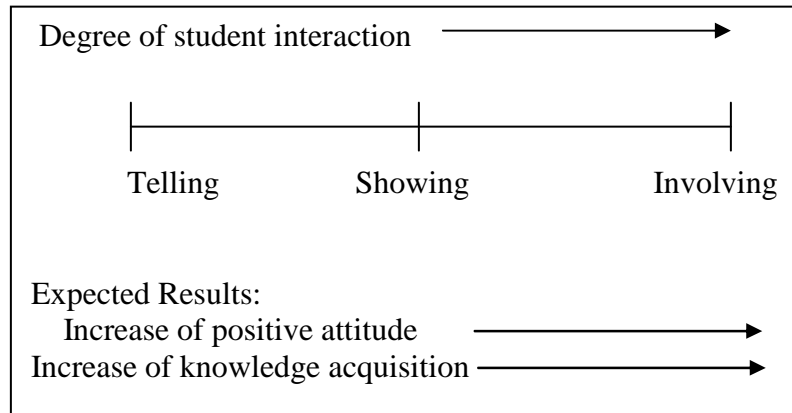


Figure 1. Interaction Spectrum

The promotion of positive attitudes about the environment is necessary if people are to understand the value of the natural environment and their stewardship of the environment (Mittelstaedt et al. 1999). If students are given the opportunity to take an active part in the learning process through interactive methods this could result in a better attitude toward the subject being taught.

As mentioned previously, interactive teaching methods are used in a variety of different settings. Rix & McSorley (1999) found that creating a “mini-classroom interactive center” could potentially help develop positive attitudes toward science. Interactive exploration where you can touch and play engages students in learning and leads toward positive experiences. Rix & McSorley continue by stating that interactive

centers can be very effective in developing positive attitudes in science, which could possibly lead to better science understanding in the future.

Several studies have been conducted on the impact of educational programs, but little has been done on the comparisons between different types of teaching methods. After conducting a critical review on outcome research in environmental education, Leeming et al. (1993) noted that most experiments in environmental education are designed with a simple experiment testing one intervention against a control group. Most of these simple experimental designs only showed how the intervention influenced attitudes or knowledge relative to the untreated control group. Leeming et al. suggest that future research design involve experiments that make comparisons between different types of interventions. For this purpose, we designed our research to test different instructional methods for teaching wetland ecology. It is important to determine whether different teaching methods yield different learning results and/or attitude development. We were interested in finding the best method for teaching wetland ecology not merely looking at one intervention compared to an untreated control group.

In attempting to develop a research design that incorporates different interventions (teaching methods), we were particularly interested in the comparisons between field and classroom interventions. Classroom interventions are generally limited to what materials are available in the class, which limits the student's interaction with the subject material. Students are generally restricted to learning about the subject through pictures and/or textbooks. This is a huge limitation if the subject material deals with the environment or any outdoor subject. Outdoor education on the other hand, appeals to and uses the senses—smell, touch, audio and visual (Priest, 1986). Taking the lesson outside of the classroom

allows students to be more engaged in the learning process by permitting the students to take a hands-on approach. Priest (1986) suggests that concepts that are best learned outdoors should be taught outdoors. The best place to teach about the environment is outside of the classroom. We believed that students would benefit from an experience outside of the typical classroom because of the hands-on opportunities given to them. Evaluation indicates that participants can gain greater knowledge of ecological systems using interactive programs (Mittelstaedt et. al, 1999).

Again, little research has been done to compare field instruction with other methods of instruction. After researching a 7-day field program, Lisowski & Disinger (1991) concluded that field-based programs are effective in aiding students understanding and retention of some ecology concepts. They suggest that further studies be conducted on the comparison between field instruction and other methods of instruction, as little research has been done “in the area of comparative effectiveness of various instructional strategies”. We were interested in comparing the outcomes of field instruction versus classroom instruction particularly on the learning of wetland ecology concepts and attitude development. We felt that the result of this comparison would be important to both teachers and students, because it would provide teachers with the most effective tools for teaching wetland ecology while at the same time allowing students the most effective means for learning.

We were also interested in researching the idea that interactive teaching can influence attitude development towards the environment. Interest in the natural environment can be in part attributable to positive experiences in nature (Mittelstaedt et al., 1999). Shepard & Speelman (1985) define an outdoor education program where a student has direct contact

with the environment. We hoped to see the improvement of attitudes toward the environment from the students who participated in an outdoor presentation because they had a positive and direct experience in nature. Several studies have been conducted to test the impact that outdoor education experiences have on a participant's attitude (Lisowski & Disinger 1991, Shepard & Speelman 1985, Wendling & Wuensch 1985). All of these studies focus on the impact a weeklong or more experience in an outdoor environmental education program has on participant's attitude. Simpson (1985) reported that further research regarding the change in environmental attitude that occurs through short-term outdoor education programs is needed. Our research design was developed so that the students who received the outdoor presentation were outdoors only one day. We designed our research this way so that we could see the effect that teaching a lesson outside of the classroom had on the development of positive attitudes compared to a lesson being taught inside of the classroom in relatively the same amount of time. We along with Simpson (1985) were interested on the impact that a short-term experience (one day) could have on developing positive attitudes about the environment. We hoped that our research would show that taking the lesson outside of the classroom improves student's attitudes about the subject and the environment.

CHAPTER 3

METHODS

We designed the experiment to compare knowledge acquisition and retention of wetland ecology concepts between several groups: (1) between students receiving a combined interactive classroom presentation and field visit and those students receiving only one treatment (either the classroom only or field only), (2) between students receiving a field visit (outside the classroom presentation) and those receiving a presentation in the classroom only, (3) between students receiving an interactive classroom presentation and those students receiving a non-interactive classroom presentation. In the experiment the independent variable is defined as the type of teaching method, while attitude and achievement are the dependent variables.

In order to conduct an experiment involving human subjects we first had to have our project reviewed and approved under the authority of the UNLV Institutional Review Board (IRB). We submitted a packet, which included the following: a study description (purpose, methods, procedures, risks, benefits etc.), informed consent documents (parent and child) (see Appendix E), descriptions of activities to be used, assessment tool, and completion certificates for Human Participant Protection Education for Research Teams. This packet was submitted to the IRB for consideration and approval on February 13, 2003. Final approval from the IRB was received April 3, 2003 by the UNLV Social Behavioral Sciences Institutional Review Board. We obtained IRB approval before conducting research. We also submitted a similar proposal to the Clark County School District Cooperative Research Committee to be reviewed and approved. Final approval from the Clark County Cooperative Research Committee was received April 9, 2003.

After receiving approval from both the IRB (see Appendix F) and the Clark County Cooperative Research Committee (see Appendix G) the next step was to find our research subjects: 6th grade science students. We determined that we would need a total of four 6th grade science teachers, each with at least four science classes in order to conduct our research. We felt that the best method for recruiting these teachers was to talk to Clark County School District Administrators, particularly the science curriculum coordinator. After advertising our study with the Clark County School District and on their website newsletter, we were contacted by teachers interested in our study. These 6th grade science teachers along with their classes of students were randomly assigned to one of the following four treatments (see Table 1):

Treatment 1: Non-interactive classroom lecture

A UNLV student presented a standardized lecture-based presentation to a Clark County School District (CCSD) classroom during one class period. The presentation included the use of pictures and text, delivered using PowerPoint (see Appendix A).

Treatment 2: Interactive classroom presentation (no field visit)

A UNLV student went to a CCSD classroom and facilitated a standardized interactive presentation during one class period. The interactive presentation consisted of games, wetland punch activity and Las Vegas watershed poster (these activities are described in detail in Appendix B).

Treatment 3: Interactive field activity (no class visit)

CCSD classes traveled to the Clark County Wetlands Park Nature Preserve for a 2-hour field trip led by UNLV students. This field trip included the following activities (described in detail in Appendix C):

A.) Wetland Characteristics

CCSD science students examined soil texture, vegetation and water at the wetlands.

B.) Water quality

CCSD students conducted measurements of water temperature and water depth to test water quality at the wetlands.

C.) Animals

CCSD students identified fish and mosquito species in their natural habitats.

D.) Las Vegas Watershed

CCSD students learned about the Las Vegas watershed by standing at the Las Vegas Wash overlook and comparing the Las Vegas Wash to the Clark County Wetland Park. Students also noted where the city of Las Vegas and Lake Mead are in relation to the Clark County Wetland Park.

Treatment 4: Combined interactive classroom and interactive field activity

CCSD students in this group received both the interactive classroom presentation and interactive field activity. The interactive field activity followed within 5 days of the interactive classroom presentation.

All four presentations included the same material covering the following topics:

1. Definition and components of a wetland
2. Functions of wetlands in general
3. Role of wetlands in Las Vegas
4. Introduction to wetland soils
5. Introduction to wetland plants

6. Introduction to water quality
7. Introduction to wetland animal life

Table 2
Experimental Design

Treatment Type	No or non-interactive classroom presentation	Interactive classroom presentation
No interactive field activity	Treatment 1 $n=79$ 1 Teacher 4 classes	Treatment 2 $n=79$ 1 Teacher 5 classes
Interactive field activity	Treatment 3 $n=79$ 1 Teacher 5 classes	Treatment 4 $n=110$ 1 Teacher 5 Classes

Table 2 represents the experimental design incorporated in this study. Columns are labeled with classroom interactive information; whether a class received a non-interactive classroom presentation (Treatment 1) or no classroom presentation (Treatment 3) or an interactive classroom presentation (Treatments 2 and 4). Rows are labeled with field interactive information; whether a class received (Treatments 3 and 4) or not an interactive field presentation (Treatments 1 and 2). Each treatment was administered by one teacher where n represents the number of student who were present during each presentation and the number of classes receiving each treatment is also included. 330 students participated in our study; however in later tables (chapter 4) only those students

whose assessment scores were used in our analysis are reported.

Each treatment had a minimum of 4 classes each, however not every class had the same number of students. Each teacher and his/her respective classes were randomly assigned to one of the above treatments. Each classroom presentation lasted one classroom period where the field visits lasted approximately 2 hours. A letter to the teacher and school administrators was sent prior to class and/or field visits. This letter informed the teacher and school administration about the research project: what would be involved, their responsibilities as well as the responsibilities of UNLV. They were also informed of what treatment they would be receiving and the date of the presentations. A second letter was given to those teachers receiving only classroom presentations informing them that they would receive a paid field trip to the Wetland Park (meaning paid transportation to the Clark County Wetland Park-2 buses) upon completion of their responsibilities (administering the consent forms and assessment tools in the designated time period, and returning the completed assessment tools and consent forms in the designated time period). This field trip would take place after the follow-up assessment tests were administered and returned.

To begin this study, each participating science teacher administered a pretest to all of his/her students. The pretest was given to establish each student's prior knowledge about general wetland ecology and the Las Vegas watershed. Typically the pretest was given the day before the scheduled presentation. After completion of the pretest, one of the four treatments was administered. Each class was assigned to a specific treatment prior to the actual day of the presentation.

All treatments ended with a posttest used to test immediate understanding. This

posttest was given immediately after the presentation. Approximately one month after the posttests had been completed, teachers gave their students a follow-up test to see how well the information they learned was retained. Those students who choose not to participate in this research study remained in class but their responses were not included in this research study. Only those students who had consent forms signed and returned by both their parents and themselves were included in this research study. Data was not used from students without signed consent forms. Although we had anticipated approximately 120 students per treatment (i.e. 4 classes with 30 students each), our numbers were much lower since only students who had both parental and student consent forms signed and who had completed pretest, posttest and follow-up assessments tests were included in our data analysis.

The instrument used in our study was a multiple choice wetland ecology assessment test with nine questions pertaining to wetland knowledge and five questions asking students their opinion about the environment (see Appendix D). Each of the nine questions testing wetland knowledge had four possible answers; one answer was the correct response while the other three were incorrect. Five of these questions were chosen to represent basic wetland ecology concepts, containing such information as location, function and benefits of wetlands (see Figure 2).

1. Wetlands are most likely to be found on:
 - a. The sides of mountains
 - b. Flat areas on the tops of mountains
 - c. Flat areas in the bottom of the valley
 - d. Rocky areas in the bottom of the valley
2. Which of the following is **NOT TRUE** about wetlands in general:
 - a. They are dominated by plants that require a lot of water
 - b. There is a lot of moisture in the soil
 - c. Water is at or near the surface most of the year
 - d. Very few animals live in the wetlands
3. Water quality is better after the water goes through the wetlands because:
 - a. Water moves through the wetlands very quickly
 - b. Wetland plants and organisms break down pollutants in the water
 - c. Wetland plants add nutrients to the water
 - d. The water picks up sediment as it moves through the wetland
4. Wetlands help prevent damage from floods by:
 - a. Directing the water away from the city
 - b. Soaking up the water permanently
 - c. Moving the water away from roads and houses quickly
 - d. Slowing down and spreading out the water
5. Which of the following is **NOT TRUE** about wetlands in general:
 - a. They help prevent damage from floods
 - b. They help improve water quality
 - c. They create disease problems
 - d. They provide habitat for animals

Figure 2. Wetland Ecology Knowledge Assessment Questions.

The remaining four questions asked about information specific to the Las Vegas watershed, particularly the Clark County Wetland Park. These questions were chosen in order to test student knowledge regarding the function, creation and usefulness of the Clark County Wetland Park (see Figure 3).

1. The Clark County Wetlands Park is located:
 - a. Between Lake Mead and Hoover Dam
 - b. Along the Colorado River
 - c. Between the city of Las Vegas and Lake Mead
 - d. Below Hoover Dam
2. Where does most of the water come from for the Clark County Wetlands Park?
 - a. The Colorado River
 - b. Wastewater from Las Vegas homes and streets
 - c. Rain and snow melt
 - d. Natural springs
3. After water leaves the Clark County Wetlands Park:
 - a. It does not leave the Clark County Wetlands Park
 - b. It all evaporates
 - c. It goes to Lake Mead and is not used again in Las Vegas
 - d. It goes to Lake Mead and is re-used for our water supply
4. The most important reason to protect the Clark County Wetlands Park is because:
 - a. It helps clean water that is eventually used for Las Vegas' water supply
 - b. It is a good place to build houses
 - c. It is a recreational area for swimming
 - d. It is like a zoo, where animals are kept so people can see them

Figure 3. Clark County Wetlands Park Knowledge Assessment Questions.

In addition to the knowledge assessment questions the instrument in this study also contained five questions asking students their opinion about the environment. These questions used a Likert scale (five options ranging from strongly agree to I don't know to strongly disagree), in order to determine attitude toward the environment (see Figure 4).

1. In general, do you like to spend time outdoors?
 - a. Yes, very much.
 - b. Only sometimes.
 - c. I don't know.
 - d. Not really.
 - e. No, definitely not.
2. Do you like learning about the environment?
 - a. Yes, very much.
 - b. Only sometimes.
 - c. I don't know.
 - d. Not really.
 - e. No, definitely not.
3. How much do you care about the environment?
 - a. Very much.
 - b. Only a little.
 - c. I don't know.
 - d. Not that much.
 - e. Not at all
4. How important is it to protect the environment?
 - a. It is extremely important.
 - b. It is somewhat important
 - c. I don't know.
 - d. It is not very important.
 - e. It is definitely not important at all.
5. Do you want to learn more about what you can do to take care of the environment?
 - a. Yes, very much.
 - b. Maybe.
 - c. I don't know.
 - d. Not really
 - e. No, definitely not.

Figure 4. Attitude Assessment Questions.

This instrument was used as the pretest, posttest and follow-up test. Questions were randomized and different form variations (A, B, C, D) were given in each class in order to limit copying.

A total of 330 6th grade students participated in this study. Five 6th grade classes received Treatment 1 (n=79). Four 6th classes received Treatment 2 (n=79). Five 6th grade classes received Treatment 3 (n=79). Five 6th grade classes received Treatment 4 (n=110). Researchers presented the material to each class separately as setup by the teachers' class schedule. As mentioned earlier, numbers in our analysis were lower than we had initially anticipated. Only those students who had consent forms signed and returned by both their parents and themselves and were present for pretest, posttest and follow-up tests were included in this research study. All other student data was not used. Pretest, posttest and follow-up test scores were analyzed using the Statistical Package for Social Science (SPSS). Tests were scored as number correct out of total possible correct. We compared treatment groups on attitude and knowledge using Oneway ANOVA analysis and Between Within ANOVA analysis.

CHAPTER 4

RESULTS

A total of 330 students participated in this study on the actual day of the presentations (see Table 1) however, only 323 students turned in signed parental and youth consent forms. A variation of this number was used in the analysis of the pretest, posttest and follow-up scores from the knowledge portion of the test, depending on if students were present for each test. Pretest, posttest and follow-up scores were calculated as total scores, where 9 would be a perfect score. We compared knowledge pretest scores between treatment groups using an Oneway ANOVA ($N=244$). We found a significant difference between the treatment groups ($p = .000$). According to this p-value our groups did not start out equal in their knowledge of wetland ecology concepts on the pretest, meaning some groups knew more than other groups. Treatment 1 had a mean of 3.21, treatment 2 had a mean of 3.31, treatment 3 had a mean of 5.97 and treatment 4 had a mean of 4.08 out of a total of 9 (see Table 3). That means that groups 3 and 4 started out with more knowledge about wetland ecology concepts than treatments 1 and 2. Due to these findings we felt it best to do further analysis using a Between Within ANOVA, which according to Lamb (2003) removes variance due to individual differences (i.e. individual test scores) and increases the likelihood that the differences are then due to treatment and not the participants, thus accounting for the initial un-equivalence in our treatment groups. We used a Between Within ANOVA between pretest and posttest knowledge scores. We found that all treatment groups learned from pretest to posttest ($p = .000$) but that there was no interaction between the treatments, all treatment groups gained the same amount of knowledge ($p = .235$) (see Figure 5).

Table 3
Knowledge acquisition between Pretest and Posttest

Time	Treatment	Mean	Standard deviation	N
Total score pretest	1	3.21	1.47	34
	2	3.31	1.51	64
	3	5.97	1.56	68
	4	4.08	1.92	78
Total score posttest	1	5.00	1.94	34
	2	5.05	2.24	64
	3	7.10	1.33	68
	4	5.35	2.40	78

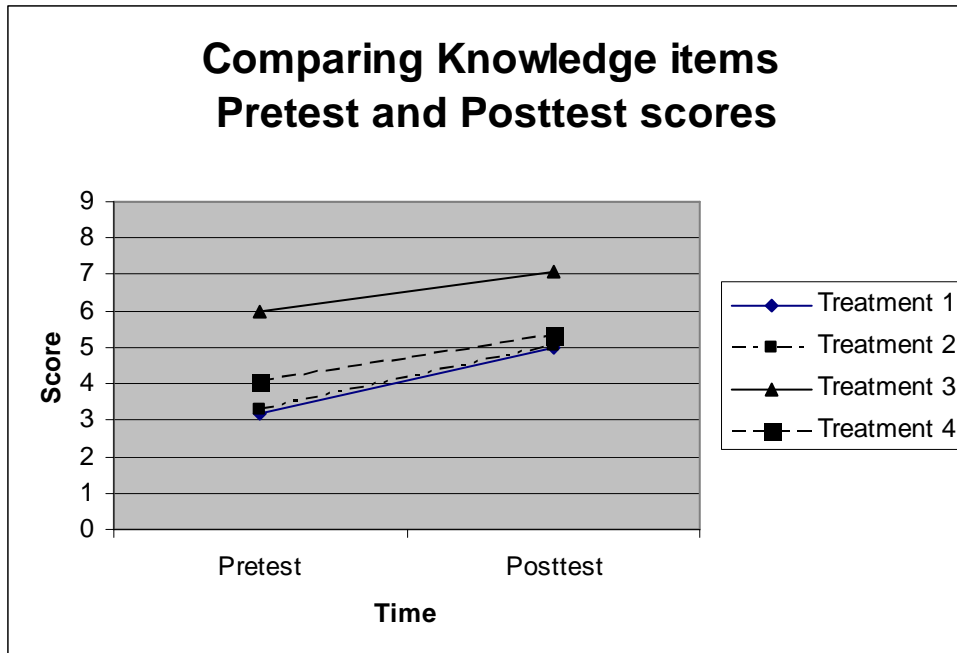


Figure 5. Comparing knowledge items pretest and posttest scores using a Between Within ANOVA

Figure 5 shows the mean of the total pretest and posttest scores both out of a possible 9 correct. Each group gained knowledge from pretest to posttest however the groups did not start out equivalent during the pretest.

After looking at pretest and posttest scores we then compared pretest and follow-up scores using a Between Within ANOVA (N=246). We found that all treatment groups had learned from pretest to follow-up test ($p = .000$) but there was no significant interaction between the treatments ($p = .085$), meaning that all treatment groups gained the same amount of knowledge from pretest to follow-up test regardless of treatment (see table 4, Figure 6).

Table 4
Knowledge acquisition between Pretest and Follow up test

Time	Treatment	Mean	Std. Deviation	N
Total score pretest	1	3.20	1.49	35
	2	3.31	1.49	64
	3	5.91	1.62	69
	4	4.19	1.91	78
Total score follow-up test	1	3.74	1.92	35
	2	4.83	1.96	64
	3	6.84	1.47	69
	4	5.55	2.24	78

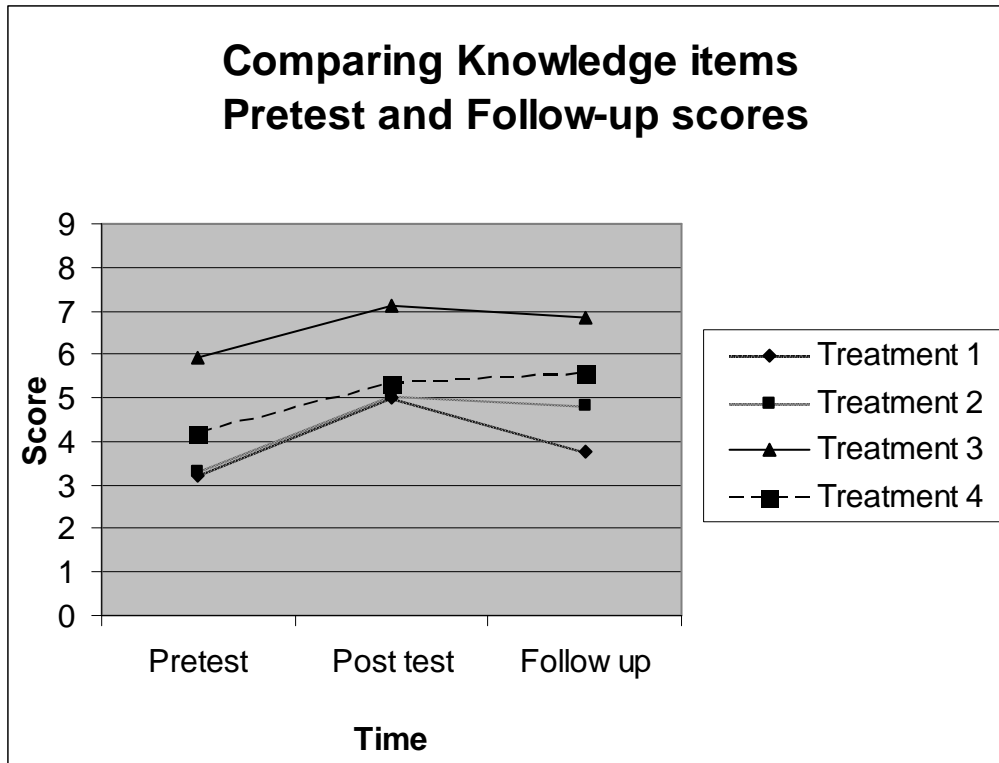


Figure 6. Knowledge Pretest and follow-up test scores compared using a Between within ANOVA

Figure 6 shows the mean total pretest score and a total follow-up test score both out of a possible 9 correct. Each group gained knowledge from pretest to follow-up test however the groups did not start out equivalent during the pretest.

This study also tested student attitudes toward the environment. Pretest, posttest and follow-up attitude scores were calculated as total scores, where 5 indicated the most positive attitude towards the environment, 3 indicated unknown attitude and 1 indicated the most negative attitude. We used a total of 308 student scores in the analysis of the pretest for the attitude portion of the test. Pretest scores were calculated as average total scores and compared between treatments using an Oneway ANOVA analysis. There was a significant difference in attitudes between treatment groups on the pretest ($p = .001$).

According to this p-value our groups did not start out equal in their attitude toward the environment on the pretest. Treatment 1 had a mean of 3.03, treatment 2 had a mean of 4.16, treatment 3 had a mean of 3.62 and treatment 4 had a mean of 3.93 out of a total of 5. (see table 5).

Table 5
Attitude means between pretest and posttest

Time	Treatment	Mean	Std. Deviation	N
Average scores on attitudes for pretest	1	3.03	2.04	47
	2	4.16	1.09	70
	3	3.62	1.74	96
	4	3.93	1.39	95
Average scores on attitudes for posttest	1	4.06	1.51	47
	2	4.26	1.10	70
	3	3.64	1.81	96
	4	3.88	1.68	95

Due to these findings we felt it best to do further analysis using a Between Within ANOVA in order to remove the variances we found due to individual differences. We used a Between Within ANOVA between pretest and posttest attitude scores and found there was a significant difference between pretest attitude scores and posttest attitude

scores ($p = .016$), but not as we expected. There was a significant interaction between the treatments ($p = .011$) where Treatment 1 gained the most with a pretest mean of 3.02 to a posttest mean of 4.05, while Treatment 4 means went down from pretest mean 3.93 to posttest mean 3.88 (see figure 7).

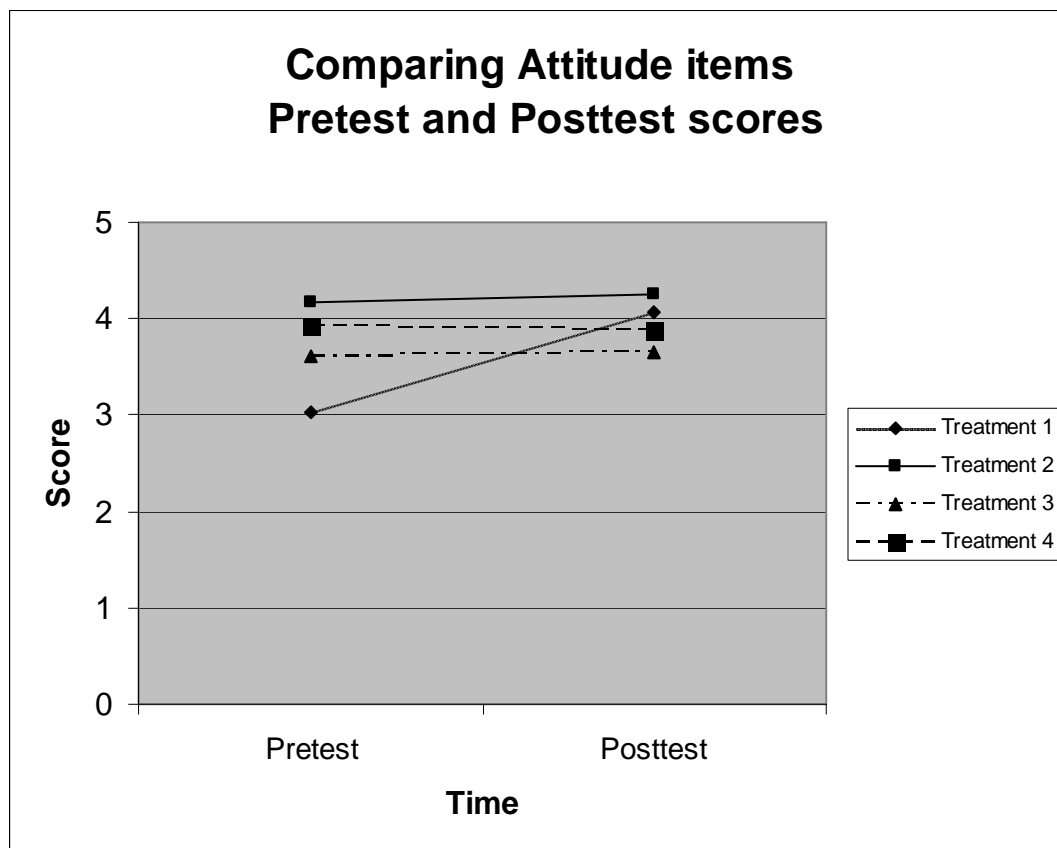


Figure 7. Comparing Attitude items Pretest and Posttest scores using Between within ANOVA.

Figure 7 shows attitude mean scores from pretest to posttest. Treatment 1, 2 and 3 all gained from pretest to posttest with Treatment 1 gaining the most, while Treatment 4 actually decreased.

After looking at pretest and posttest attitude scores we then compared pretest and follow-up scores using a Between Within ANOVA. We found that there was a significant difference between pretest attitude scores and posttest attitude scores ($p = .019$), but again, not as expected. There was a significant interaction between the treatments ($p = .015$) where Treatment 1 again gained/retained the most with a pretest mean of 3.02 to a follow-up mean of 4.08, while Treatment 4 means went slightly down from a pretest mean of 3.93 to a follow-up mean of 3.92 (see table 6, Figure 8).

Table 6
Attitude means between pretest and follow-test

Time	Treatment	Mean	Std. Deviation	N
Average scores on attitudes for pretest	1	3.03	2.04	47
	2	4.16	1.09	70
	3	3.62	1.74	96
	4	3.93	1.39	95
Average scores on attitudes for follow up test	1	4.08	1.38	47
	2	4.24	1.08	70
	3	3.62	1.64	96
	4	3.92	1.48	95

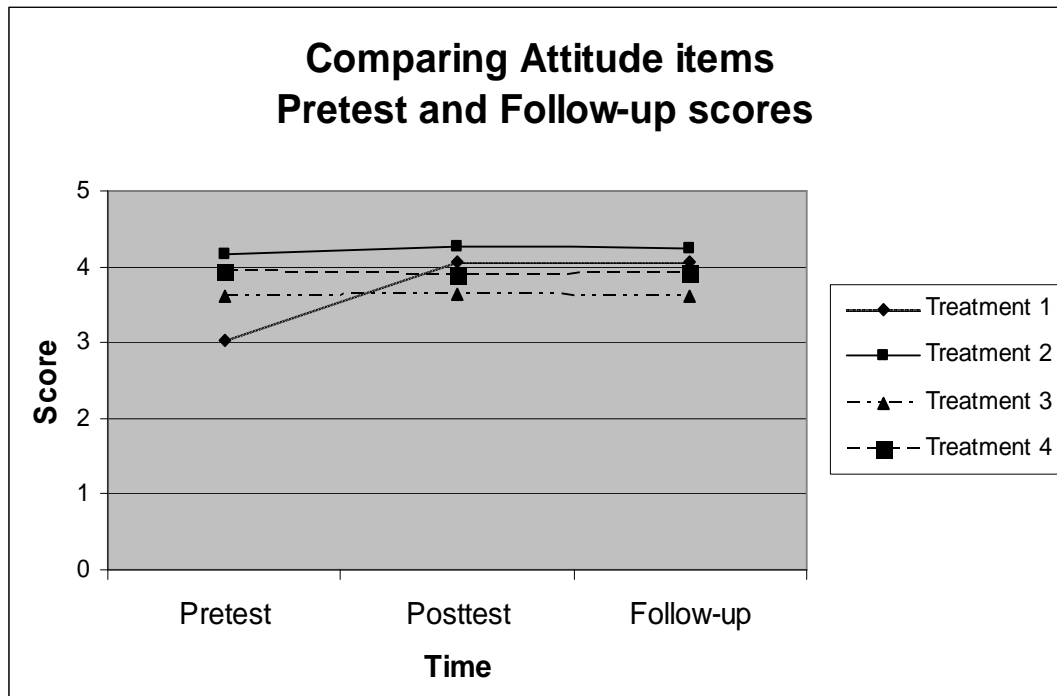


Figure 8. Comparing Attitude items Pretest and Follow-up scores using Between w/in ANOVA.

Figure 8 shows attitude mean scores from pretest to follow-up test. Treatments 1, 2 and 3 all gained/retained attitudes from pretest to follow-up test, with Treatment 1 gaining the most, while Treatment 4 means slightly decreased.

CHAPTER 5

DISCUSSION

After looking at our results it is apparent that we didn't start with equivalent treatment groups. Our treatment groups began unequal in their knowledge about wetland ecology concepts and their attitudes about the environment. Treatment 3 had the highest mean on the pretest (5.91 out of 9 possible), where Treatment 1 had the lowest mean (3.21 out of 9 possible). Since the groups were not similar before the treatment, we can not tell if the treatment had any effect on knowledge retention or attitude. Therefore, our results do not accurately reflect the research questions, and merit more attention. We compared knowledge pretest scores between treatment groups ($n=244$) using an Oneway ANOVA analysis. We found that there was a significant difference between the treatment groups ($p=.000$). These results indicated that our treatment groups began unequal in their knowledge about wetland concepts. Those groups that started out with more knowledge on the pretest were expected to have higher scores in subsequent tests. Based on the results from the One-way ANOVA we decided that we would use a Between Within ANOVA Repeated Measures to compare total knowledge pretest scores to total knowledge posttest and follow-up scores ($n=246$). We found that between total knowledge pretest and posttest scores that all groups regardless of treatment learned from pretest to posttest ($p=.000$) but, there was no interaction between the treatment groups ($p=.235$) meaning that all groups gained the same amount of knowledge regardless of treatment. We found that between total knowledge pretest and follow-up test scores, students still had gained knowledge (retention) from pretest to follow-up test ($p=.000$) although there was no significant interaction between the treatment groups ($p=.085$), all

treatment groups gained the same amount of knowledge regardless of treatment. Our results do not support hypothesis 1 that interactive teaching methods are more effective for promoting learning about wetland ecology concepts than traditional teaching methods. Our results also do not support the sub-hypothesis that interactive teaching, regardless of type, will promote better learning of wetland ecology concepts than traditional methods. These results also do not support hypothesis 3 that interactive field teaching methods are more effective for promoting learning about wetland ecology concepts than a classroom visit (with or without interaction). Although our hypotheses were not supported it is still encouraging to see that all groups gained knowledge from the pretest to the posttest and that knowledge was retained from pretest to follow-up test. This shows that wetland ecology concepts can be learned and retained by 6th grade students.

It is interesting to note that even though our results do not support our sub-hypothesis regarding interactive teaching promoting better learning of wetland ecology concepts than traditional methods, regardless of type (in the classroom or outdoors), that Treatment 2 (interactive classroom presentation) retained more information than Treatment 1 (non-interactive classroom presentation) according to follow-up test mean scores (treatment 2 follow-up mean 4.83 and treatment 1 follow-up mean 3.74). This is interesting because Treatment 1 and Treatment 2 started out having relatively the same wetland ecology knowledge (pretest means of 3.21 for treatment 1 and 3.31 for treatment 2) at the beginning of this study, and even gained about the same after the posttest (posttest means 5 for treatment 1 and 5.05 for treatment 2) (see figure 9). But by the follow-up test Treatment 2 appears to have gained/retained more when compared to Treatment 1 (see

figure 10). Perhaps if we had started out with groups more equivalent such as Treatment 1 and 2 appeared to be, we may have seen results more supportive of our hypotheses.

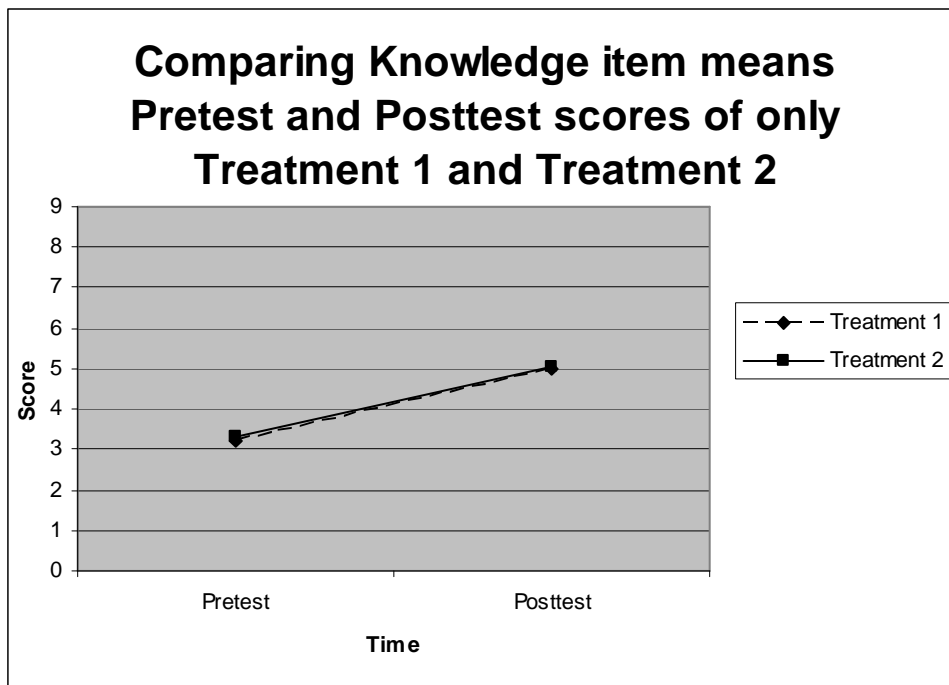


Figure 9. Comparing knowledge item means Pretest and Posttest scores of only Treatment 1 and Treatment 2.

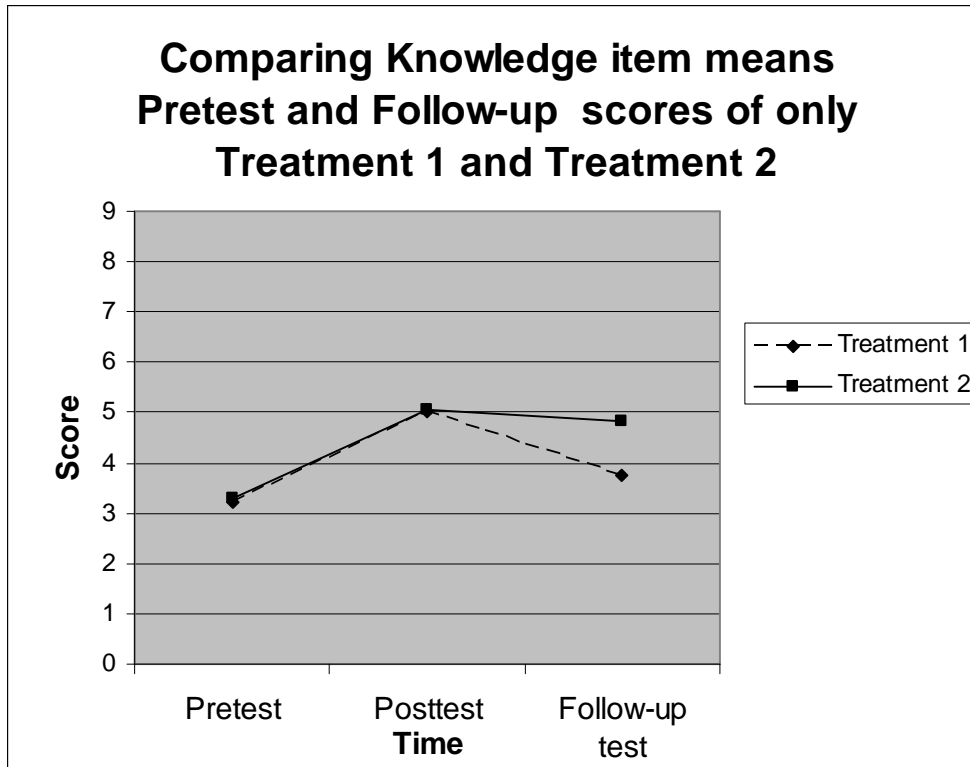


Figure 10. Comparing knowledge item means Pretest and Follow-up test scores of only Treatment 1 and Treatment 2.

In order to test the hypothesis that interactive teaching methods used inside and outside of the classroom would improve students' attitudes and perceptions toward the environment and science we ran a One-Way ANOVA. The One-Way ANOVA compared averaged attitude scores from the pretest across treatment groups ($n=308$). We found there was a significant difference in attitudes among treatment groups on the pretest ($p=.001$). Again, based on our pretest attitude scores we found that our treatment groups did not begin our study with similar attitudes about the environment. Due to these findings we decided to do further analysis using a Between Within ANOVA. We used a Between Within ANOVA between pretest and posttest attitude scores and found there was a significant difference between pretest attitude scores and posttest attitude scores (p

= .016), but not as we expected. Treatment 1 gained the most with a pretest mean of 3.02 to a posttest mean of 4.05, while Treatment 4 means went down from pretest mean 3.93 to posttest mean 3.88. After looking at pretest and posttest attitude scores we then compared pretest and follow-up scores using a Between Within ANOVA. We found that there was a significant difference between pretest attitude scores and posttest attitude scores ($p = .019$), but again, not as expected. Treatment 1 again gained/retained the most with a pretest mean of 3.02 to a follow-up mean of 4.08, while Treatment 4 means went slightly down from a pretest mean of 3.93 to a follow-up mean of 3.92. Therefore our results did not support hypothesis 2 that interactive teaching methods are more effective at producing positive attitudes toward the environment and science than traditional methods. These results also do not support hypothesis 4 that interactive teaching methods are more effective at producing positive attitudes than a classroom visit (with or without interaction). Students participating in treatment 1 (the non-interactive classroom presentation) had the least positive attitudes to begin with but who ended with very positive attitudes, in fact they gained the most (pretest mean 3.03 and a follow-up mean of 4.08). Maybe the novelty of a new subject sparked the interest of these 6th grade science students regardless of the fact that they received a non-interactive presentation. Those students in treatments 2 (interactive classroom visit) and 4 (interactive class and field) started with the most positive attitudes about the environment. It is important to note that both of these groups had the same teacher who at the time was also a graduate student working on water issues at the Clark County Nature Preserve. It is possible that these students because of their teacher's involvement with similar research were already aware of current local environmental issues and therefore started out with biased

opinions. Regardless of possible preconceived attitudes, if groups start out expressing very positive attitudes on the pretest, it is hard to see any improvement in their attitudes on subsequent tests (see figure 11).

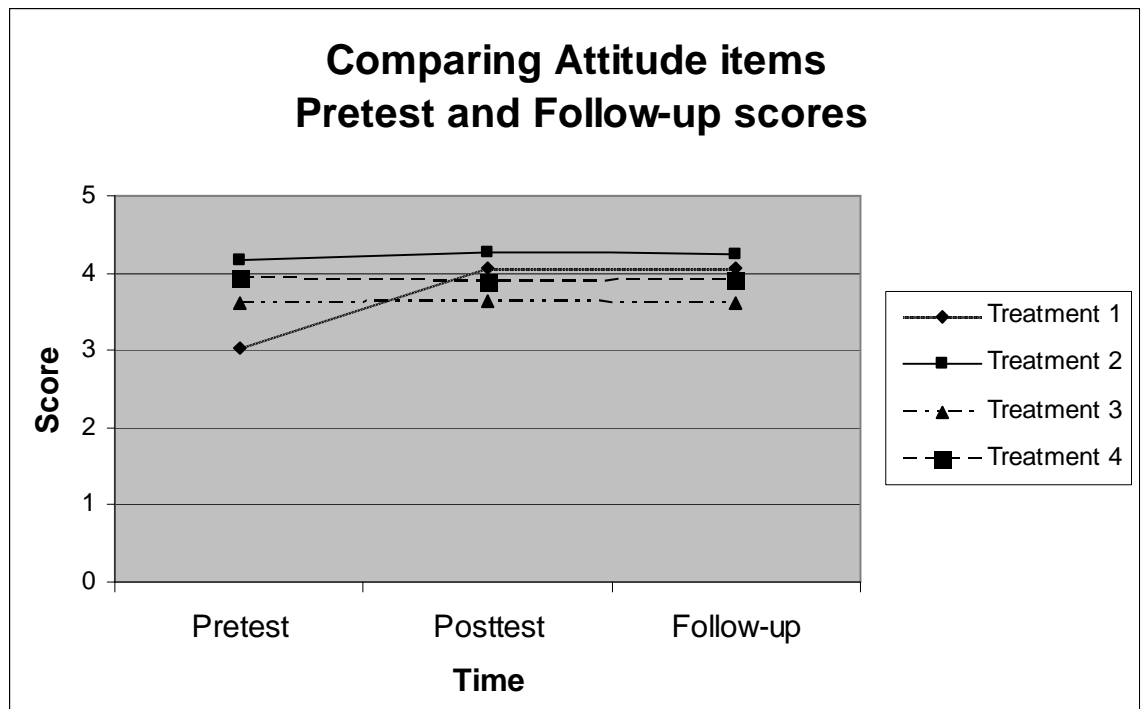


Figure 11. Comparing Attitude items Pretest and Follow-up scores using Between within ANOVA

Our research subjects were 6th grade science students from the Clark County School District in Las Vegas, Nevada. All of our research subjects were from public Schools. Powell & Wells (2002) suggest that education research done in public schools is subject to many problems, such as teacher variability, class and student differences etc. We attempted to limit these problems by randomizing the classes where each teacher and his/her classes in our study were randomly assigned a specific treatment. This was in

order to minimize these problems as well as get equivalent groups. According to our results we failed to get equivalent groups. We believe that this failure was in part due to the following reasons: (1) prior experience with wetland ecology concepts. The students in Treatment 4 and Treatment 2 had been instructed by their teacher about wetland ecology prior to our pretest and visit. This prior experience probably affected students' knowledge and attitude about the subject. (2) Teacher attitude toward a subject could possibly influence student attitude (Kyle et al., 1988). The teacher of the students receiving Treatment 3 was very enthusiastic about biology and wetland ecology even prior to our field visit to the Clark County Wetland Park. In comparison, the teacher of the students in Treatment 1 was not even present when the presentations were given in her classroom nor were her students informed of the presentation. (3) Different achievement levels within schools among the same grade. Class average achievement scores vary from class to class and from teacher to teacher. After concluding our study we were informed that students in the Clark County School District are placed in classes with students of their same achievement level. These placements are based on achievement tests that students are given during their elementary, middle and high school careers. This type of class arrangement, although beneficial for the students and teachers was disadvantageous to our study. Without equivalent groups at the beginning of our study, it is very difficult to come up with accurate results. We also feel that because each treatment was administered by only one teacher that our study may have suffered from teacher effects-results based on individual teacher effectiveness. Again, due to the voluntary nature of our study we were at the mercy of teachers who were willing to participate in our study.

The most effective way to get truly equivalent groups and reduce teacher effects would be to randomize the classes, where participating teachers receive all four treatments rather than just one specific treatment. This would remove any bias of personal teaching instruction from the results, making the groups more equivalent. This method, although ideal, is nearly impossible to accomplish when doing research with middle or high school students because some of the treatments require field trips, while other treatments stay completely in the class. It would be very difficult to have half of the teachers classes leave campus for a field trip while the other half of the classes stay back. Any teacher from middle school through high school would run into this problem as each teacher has more than one class. To separate the classes as mentioned above would prove very difficult for the teacher, maybe even costly (i.e. requiring a substitute).

Another suggestion to make the treatment groups equivalent would be to have a large sample taken from various schools. Even if we had continued with our method where one teacher receives one specific treatment, had we generated a large enough sample, our groups would most likely have been equivalent. The drawback to this option is teacher availability and cooperativeness. We worked with those teachers who were willing and available to participate in our study. With the current standards required by administrators, teachers have a lot to do in a little amount of time. Participation in a research study takes time that some teachers may not have.

There were other complications with our research study; one was regarding our measurement tool. Even though we felt that our measurement tool was age appropriate as far as language and content are concerned, there are a few things we would change. The first change would be the length of the knowledge portion of the test. While the questions

on the knowledge portion of the test addressed important concepts concerning wetland ecology, there were not enough questions to get an accurate measurement of student knowledge gain and retention. We had nine knowledge-based questions; a better measurement tool would have more. Perhaps the addition of some application type questions, such as, “While at the mall you notice oil spots throughout the parking lot. Based on your knowledge of the water system, where does this oil end up after it has been washed away by a rainstorm?”, or, “What would happen to the Las Vegas water supply if the Clark County Wetland Park were destroyed?”, would have given a better indication of student knowledge regarding wetland ecology concepts. The second change would be to the length of the attitude portion of the test. Again, the attitude questions we had on our measurement tool were age appropriate but lacked the quantity needed to measure change in student attitude. We had five attitude questions on our test; questions that are more specific are needed to accurately measure attitude gain. The attitude questions were very general, “Do you like to spend time outdoors?”, “Do you like learning about the environment?” etc. We would suggest adding more specific questions about attitude toward the environment such as “Do you think that we should protect the environment?”, “Do you think humans have the responsibility to take care of the environment?”, “Do you think it is okay to throw trash out into the street?” etc. The third change also has to do with the attitude portion of the test. Besides the number of questions to be used, we would also change the types of questions. The attitude portion of our test consisted of five questions with answer options using a Likert-type scale (five options ranging from strongly agree to I don’t know to strongly disagree). All of our questions were phrased in a positive direction (i.e. In general, do you like to spend time

outdoors?, yes a lot, yes sometimes, I don't know, not really, no I don't, Do you like learning about the environment? yes a lot, yes sometimes, I don't know, not really, no I don't). It is therefore difficult to see if the questions used really did measure attitude about the environment or if students just circled the first answer on each question. A better approach would be to include more questions and put at least one question as a "check" that goes the opposite direction, so that if that answer is inconsistent with the rest of the questions, that assessment test could be thrown out. Also, it would be nice to add a couple of free response questions to our measurement tool, such as "How do you protect the environment?". Evans et al. (2007) noted that there is a lot of research on measuring attitudes toward the environment for adults; the most prevalent being the New Ecological (formerly Environmental) Paradigm scale, however there is much less geared toward younger children. In an attempt to measure children's environmental attitudes Evans et al. (2007) developed games aimed at first and second grade students. Some of these games included picture options for evaluating environmental attitudes. Perhaps some simple pictures relating to the environment (i.e. one picture depicting a human as part of nature vs. one picture depicting a human as ruler of the nature), would be another option for our assessment test.

Another complication with our study was our control group. We attempted to do our research using a control group (traditional teaching) versus various experimental groups (interactive teaching). We wanted Treatment 1 to represent our traditional teaching control group, where students would receive a lecture. We decided that rather than subject the students to a guest lecturer standing in front of the class lecturing, that we would deliver the presentation using PowerPoint. We now recognize that PowerPoint

presentations, although common in most college classes and some High Schools, are not a good representative form of a traditional lecture experienced in Middle School. In fact, our PowerPoint presentation may have been too interactive, (i.e. with moving parts on the screen, pictures etc.) to represent the traditional method. A better more traditional lecture representative would be to have the students listen to a lecture on wetland ecology, using the chalkboard, followed by an assignment to read the corresponding chapter in the textbook. We feel that this would have revealed bigger differences in knowledge gain and retention between groups receiving the traditional and interactive methods. We propose that we would expect similar findings when comparing traditional and interactive methods on student attitude toward the environment.

Due to the aforementioned problems and complications with our study, we feel that our results should be interpreted with caution. A better study design incorporating the above-mentioned suggestions could lead to results that support our hypotheses regarding interactive teaching methods.

While our findings did not support our hypotheses, we did observe that all treatment groups gained knowledge from the pretest to the follow-up test. These multiple methods could help further help teachers match activities with students' different learning styles (Powell and Wells, 2002). As an educator, even though there was no significant difference between the treatment groups, all groups learned and that makes us happy. This demonstrates that teaching 6th grade students about local issues is a good thing. Dimopoulos & Pantis (2003) state the 6th graders are a good group to use in environmental education as they are open to new ideas. They also state that with 5th and 6th graders it is best to use local problems and real situations. It is also worth noting that

Treatment 1 started with the least positive attitude about the environment on the pretest, but had increased the most by the follow-up test. Again, these students received what we would term the least interactive of the presentations given and yet there was still an increase of attitude toward the environment. The students in Treatment 1 are normal urban schoolchildren. It is interesting to observe that receiving only a PowerPoint presentation their attitudes toward the environment increased and they retained knowledge. It is imperative that we teach middle school students about local issues so as to engage them in learning the material as well as improve their attitudes. It would be interesting to do this study again using similar students to those in Treatment 1, to see what affects if any these different presentations or teaching strategies would have on the learning and attitude of these students. Their knowledge and attitude increased using a simple PowerPoint presentation, it would be interesting to see what would happen if they had an even more interactive presentation.

Research dealing with interactive teaching methods, particularly outdoor education, merits more attention. With better-designed studies, it would be possible to find the best methods for teaching in 6th grade science. It is important for us as educators to find the most successful teaching methods so that we can give our students optimal learning environments.

After doing this research it is interesting to reflect on the things I have learned and what I would do differently. When I began this project I had no idea the difficulties that would arise when doing research with middle school aged children. It was quite difficult to arrange schedules and find interested participants. I think I would begin our study a little differently a second time around, by actually meeting with the teachers face to face

and explaining the importance of this study. Many of the teachers were contacted by telephone and letter only. I think had I met with each teacher prior to our visit and informed them of the scope of our research our results would have been different. For example, some of the teachers were so excited that we were coming that they prepped their students about wetlands before we even arrived, while other teachers barely remembered that we were coming. I believe that this difference among the teachers probably affected the results of this study.

After doing the final analysis there are more questions I would raise-Is there really a difference between interactive and traditional teaching or is it just a novel concept to have any new “presenter” come to your class? And how do we know that we are asking the right questions. When a traditional lecture is given there are definite concepts that we as educators expect our students to learn and understand, but with interactive teaching, more specifically outdoor education, are there definite concepts that they should learn? Maybe they just learn to appreciate the smell of nature or the process of a wetland, but is that really a knowledge concept? And if it is how do we measure those types of gains? I would be interested to find more information on how to actually measure knowledge gain based on outdoor education.

Although the results did not come out as we had hoped or expected I did enjoy seeing students enjoy all of the presentations. Most of the schools that participated in our study were low-income schools and it was interesting to me to see how much some of the students enjoyed learning about wetlands. It was neat to see them ask questions and get involved in the presentations, especially those students whose presentation took place at the Clark County Wetlands Park. How exciting to see them test the pH of the water or

look at the fish species found in a trap set at the Clark County Wetlands Park. Seeing the students get excited, regardless of the treatment they received was exciting for me. I believe that with the above mentioned suggestions an improved study design could possibly yield our expected results.

APPENDIX A

THE NON-INTERACTIVE (POWERPOINT) CLASSROOM PRESENTATION

WETLAND ECOLOGY AND THE LAS VEGAS WATERSHED

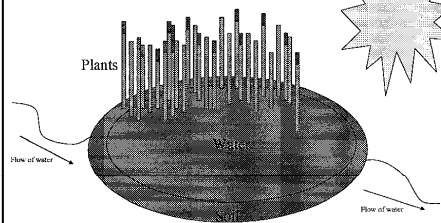
SPRING 2003
UNLV ENVIRONMENTAL STUDIES DEPARTMENT
Dr. Krystyna Stave and April Perry

What are the main components of
a Wetland?

General Wetland Characteristics

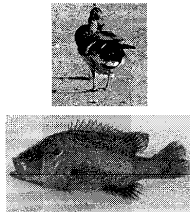
- Presence of water at or near the surface most if not all of the year
- Moist soil
- Plants adapted to wet conditions
- Land is low-lying and flat

General Wetland Characteristics



Functions of Wetlands

- Provide habitat for many animals
- 4 components of habitat: food, water, shelter, and space



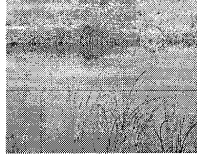
Functions of Wetlands

- Provides a rest-stop for migratory birds



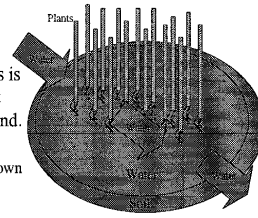
Functions of Wetlands

- Wetlands help prevent flooding
 - Wetland plants slow down and spread out water



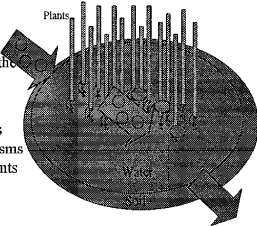
Functions of Wetlands

- Wetlands improve water quality. This is the most important function of a wetland.
 - Water is slowed down by plants



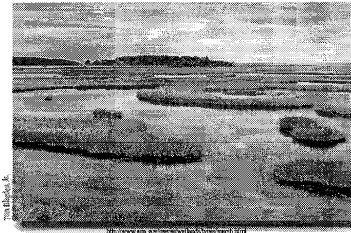
Functions of Wetlands

- Contaminants and pollutants settle in the soil
- Wetland plant roots and wetland organisms break down pollutants in the water



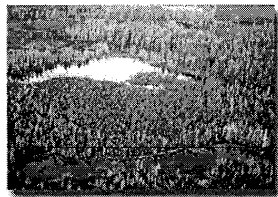
Other types of Wetlands

- Marsh



Other types of Wetlands

- Bog



Other types of Wetlands

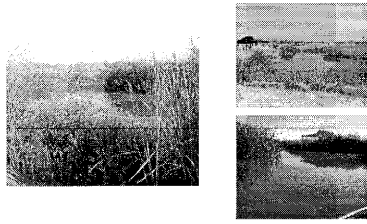
- Swamp



- Forested Swamp



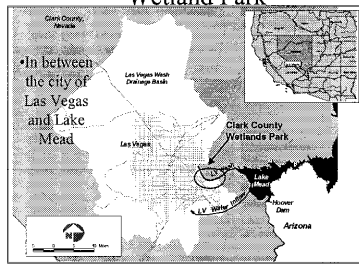
Our Desert Wetland



History of wetlands in Las Vegas

- Began as natural springs
- People moved into the valley
- Increase of waste water from Las Vegas residents
- Water gathers in a low-lying flat area

Location of the Clark County Wetland Park



Where does the water in the Clark County Wetland Park come from?

Water in the Clark County Wetland Park

- Waste water from Las Vegas homes
- Outside water wasted by Las Vegas residents (urban runoff)
 - Washing cars
 - Sprinklers
 - Watering Lawns
- Small amount from rain and snow melt

How does the water get to the Clark County Wetland Park?

Flow of water

- The Las Vegas valley
 - Surrounded by mountains
- Water flows from the highest point to the lowest point
- Water gathers at the lowest point of the valley
 - The Clark County Wetland Park



Why is the Clark County Wetland Park important to the Las Vegas watershed?

Importance of Clark County Wetland Park

- Urban runoff (water wasted outside of the home) flows down the streets to the lowest part of the valley
- Eventually this water enters the Clark County Wetland Park
- Urban runoff picks up contaminants and pollutants
 - Oil
 - Gas
 - Animal waste
 - Trash
 - Fertilizer

Importance of Clark County Wetland Park



- Wetland plants slow water down
- Wetland plant roots and wetland organisms break down pollutants in the water

Importance of Clark County Wetland Park

- The Clark County Wetland Park helps to clean the water
- Water leaving the Clark County Wetland Park eventually enters Lake Mead
- Lake Mead is the main water source for Las Vegas Residents

Why is the Clark County Wetland Park important to Las Vegas residents?

Importance of the Clark County Wetland Park

- Waste water carries pollutants and contaminants
- The Clark County Wetland Park helps clean the water
- Water leaving the Wetland Park enters Lake Mead
- Lake Mead is the main source of water for Las Vegas residents

Importance of the Clark County Wetland Park

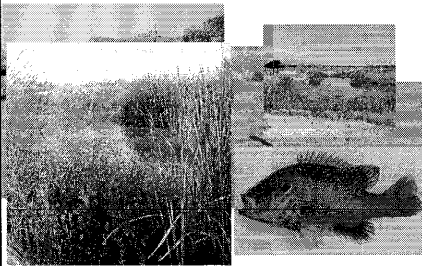
- Lake Mead is a recreational area
- Lake Mead creates habitat for many animals
- The Clark County Wetland Park is a unique ecosystem
- It helps naturally clean our water source

How can we help the Clark County Wetland Park?

Doing our part!

- Limit water usage outside
- Throwing our trash in a trashcan
- Properly disposing of oil and chemicals
- Cleaning up our streets
- Visiting the Clark County Wetland Park and learning more about wetlands

The Clark County Wetland Park



Thank you!

Questions?

APPENDIX B

THE INTERACTIVE CLASSROOM PRESENTATION

CCSD students receiving the interactive classroom presentation will learn about wetland ecology concepts and the Las Vegas watershed through the following activities:

1. Food Chain Game:

Objective: The object of this game is for participants to identify what species of wetland organism card they are holding and then place themselves along a simulated food chain. By the end of this activity, participants will have a general knowledge of how each organism affects those above and below them in the chain.

Preparing and playing the game:

1. Make sure that the players understand the objectives of the game.
2. Hand out one card to each participant (make sure that all organisms are included: cattails to detritivores to hawks etc.)
3. Assuming that participants are familiar with food chains, have them arrange themselves in a line across the room according to their perceived place in the chain.
4. Once the chain has been formed have each student, starting at the bottom of the chain, explain what card they are holding and what role that organism plays in the food chain.
5. After each participant has explained their organism's role in the food chain, start removing different organisms from the chain. Have the participants identify how these missing organisms might affect them or other parts of the chain. Doing this a few times with different sections of the chain will help participants learn that every organism in the chain has a vital role in the ecosystem, and that the removal of any one of them will have an effect on the entire system.

Note: Be sure you have retrieved a full set of cards before moving on to the next activity.

2. Wetland Punch: By Michelle Gresham @ The Atlantis Aquarium

Objective: To review the complexity of a wetland system

<i>Materials:</i> Large bowl	Stamp of sun
Fake plants	Large glass beads
Small plastic beads	Fake wetland animals (birds, fish, bugs, ducks etc.)
Container of water	Towels

Procedures:

- Ask students to help create a wetland out of the materials
- Encourage students to think about the main components of a wetland (water, soil, vegetation, animals, energy etc.) by asking them the following questions :

1. What is the primary energy source for a wetland or any habitat?

SUN

(Place the stamp of the sun into the “soil” around the edge of the bowl. Talk about how the sun provides energy for all life and that energy is required for all things to grow.)

2. What happens first in the formation of a wetland?

WATER collects in a low-lying area

(Pour water into the bowl)

3. What does the water bring with it?

NUTRIENTS, SOIL, ORGANIC MATERIAL

(Pour large glass beads into the bowl. Organic material is living material. **Detritus** is decaying material that was once living; it is made up decaying organic material and minerals.)

4. When nutrients, soil and water collects, what can begin to grow?

AQUATIC PLANTS, TERRESTRIAL PLANTS

(Place plants around the rim of the bowl, and inside the water)

5. What happens to plants in the fall? What happens to their leaves?

The leaves fall into the water and begin to decay creating **Detritus**.

6. What does Detritus attract?

DETRITIVORES.

(Pour small plastic beads in the water. Detritivores are microscopic organisms that eat detritus, cycle nutrients in the water and remove pollutants.)

7. Plants create shelter, and food sources. What begins to move into the wetland?

ANIMALS, NESTING BIRDS, SMALL MAMMALS

(Place fake animals in and around the wetland)

SHOW STUDENTS THE COMPLETED WETLAND AND REMIND THEM OF ALL THE COMPONENTS THAT GO INTO THIS DIVERSE HABITAT.

3. Las Vegas Watershed Poster:

Objective: To understand the Las Vegas Watershed by using an interactive poster to explore the flow of water through the Las Vegas valley.

Materials: Large poster board

Laminated cut outs of Las Vegas Watershed components:

- | | |
|-----------------|-----------------------------------|
| -Houses/Schools | -Water waste treatment facilities |
| -The Strip | -Cars |
| -Mountains | -Contaminants (oil, gas etc.) |
| -Wetland Park | -Las Vegas Wash |
| -Lake Mead | -Pipes |
| -Trash | -Droplets of water |
| -Plants | -Animals |
| -Adhesive | |

Procedures:

- Trace the path of several water droplets as they flow through the Las Vegas watershed.
- Begin with an empty poster board.
- Encourage students to think about the main components of the Las Vegas watershed (water usage, treatment plants, vegetation, Lake Mead, wetlands etc.) by asking them the following questions:

1. What does the Las Vegas Valley look like?
Add objects like mountains, houses, strip etc. to blank poster board
2. Where is the Las Vegas Wash located?
Add the Las Vegas Wash to poster
3. Where is Lake Mead located?
Add Lake Mead to poster
4. Where does water go after it is used inside your home?
To a water treatment facility.
Add water treatment facilities to poster
Add pipes leading from houses to water treatment facility
5. Where does water go after it is used outside your home?
To the Clark County Wetland Park
Add Wetlands to poster
6. Let's follow a raindrop as it travels from the mountains, down the street to the wetland. What might the raindrop pick up?
Trash, oil, pet waste etc.
Add trash, oil etc onto raindrop
7. How does a wetland help clean the water (rain droplet)?
Through the plants
Leave oil, trash etc in the wetland plants

8. Where does the water droplet go after leaving the wetland?
Enters Las Vegas Wash and then enters Lake Mead
9. Where do Las Vegas Residents get their drinking water?
Lake Mead
Add pipe coming out of Lake Mead (~6 miles downstream)
Water cleaned again
10. What would happen if the Clark County Park did not exist?
Contaminants in runoff would not be cleaned before entering the Las Vegas wash and eventually Lake Mead
Take off wetland
Show flow of raindrop without wetland (picks up contaminants in the street, enters Las Vegas Wash and enters Lake Mead)

The Clark County Wetland Park acts as a natural filter cleaning the water through the plants and small microorganisms. Without the Clark County Wetland Park many more contaminants would enter Lake Mead, which is the source of water for Las Vegas residents, as well as a recreation site. Lake Mead is also the home of many animals. Water for Las Vegas residents is pulled out of Lake Mead 6 miles downstream of where the wash enters Lake Mead.

11. Why is the Clark County Wetland Park important?
Answer: Urban runoff (wastewater full of contaminants) is cleaned before entering Lake Mead. Without the wetlands, more contaminants would enter the lake (think about the animals that live there, how it is a recreation site etc.)

Picture of Las Vegas Watershed Poster:



APPENDIX C

THE INTERACTIVE FIELD ACTIVITY

CCSD students receiving the interactive field activity will learn about wetland ecology concepts and the Las Vegas watershed through the following activities which will take place at the Clark County Nature Preserve:

1. Soils:

Objective: To determine differences between wetland soil and desert soil properties.

Materials: Shovels/Trowels Water
Desert Soil Wetland Soil
Gloves Anti-bacterial hand sanitizer
Dixie Cups

Procedure:

- CCSD students will examine soil texture at the wetlands
- Each student will:
 - A. Place a small amount of wetland soil in the palm of their hand
 - B. Add small amount of water to soil
 - C. Knead soil in hand
 - D. Determine type of soil by texture of sample in their hand
 - E. Steps will be repeated with desert soil
- After both wetland and desert soil have been tested, use the following questions to encourage students to make assumptions based on observations during the activity:

1. What are some of the differences that you noticed between wetland soil and desert soil?
2. What effect would these differences have on the ability to hold water?
3. What about the vegetation that each type of soil can support?

2. Water quality:

Objective: To understand the role that wetlands play in cleaning water. To understand the importance of clean water for Las Vegas residents and for animals found in this unique ecosystem.

Materials: pH strips Thermometers

Yard sticks
Gloves

Wetland Soil
Anti-bacterial hand sanitizer

Procedure:

- CCSD students will break up into small groups and conduct measurements of pH, temperature and water depth to test water quality at the wetlands
- After students have completed water quality testing, ask them the following questions:

1. What effect can pH, temperature and depth have on wetland animals?
2. How do wetlands clean the water? Why is this wetland function important?
3. Where does this water go after leaving the Wetland Park? Why is that important?

3. Animals:

Objective: To recognize that the Clark County Wetland Park is a unique ecosystem in which many animals depend upon. To understand the importance the Clark County Wetland Park as a refuge or resting area for migrating animals.

Materials: Fish traps Mosquito traps
Gloves Antibacterial hand sanitizer
Binoculars (optional)

Procedure:

- The UNLV crew will set fish traps and mosquito traps the night before the field visit. CCSD students will be able to observe different fish and mosquito populations in the Wetland Park.
- CCSD students will also identify potential animal habitat as well as animal tracks.
- Ask the students the following questions:

1. How can the fish in the wetland act as an indicator of water quality?
2. What is a habitat? (Food, water, shelter, space) Give an example of an animal's habitat.
3. How does the Wetland Park act as a refuge? What kind of animals would you

expect to see at the Wetland Park?

4. Vegetation and Las Vegas Wash overlook:

Objective: To recognize that the Clark County Wetland Park is a unique system separated from the Las Vegas Wash. Water that enters the Clark County Wetland Park is water that has not been treated by a wastewater treatment facility.

Materials: Binoculars (optional)

Procedure:

- CCSD students will stand at the Las Vegas Wash overlook and compare the Las Vegas Wash to the Clark County Wetland Park.
 - Students will also identify different wetland plant species.
 - Ask the students have the following questions:
1. Where does the water in the Las Vegas Wash come from? How is it treated?
 2. Where does the water in the Clark County Wetland Park come from? How is it treated?
 3. What do you notice about wetland plant species compared to plants you might see at Redrock or Mt. Charleston?
 4. How do plants help clean the water at the Wetland Park?



Field Visit at the Clark County Wetland Park (Wetland Outreach Crew Information Sheet)

Remember to use the Coyote sign (stop, look, and listen) anytime you want to get the “scientists” attention.

Shoot to be back to the pavilion by 11:15am

Area 1: General Ecology Information

Main Points:

- Presence of **water** at or near the surface for all or part of the year
- **Soil** that is moist or wet
- Living **plants** adapted to wet conditions
- Land is **low-lying** and flat

Activity:

- Identify the main points (physically)
 - ♦ Point at the water
 - ♦ Have the groups’ spread out and dig holes in different areas (i.e. close to the pond, farther away etc.) (Note color, texture, wet, dry...what’s in it? Does it form a ball?)
 - ♦ Have students touch the plants (touch the reeds, cattails, salt bush etc.)
 - ♦ Take air temperature
- Have the groups fill out data sheets and record observations.

Area 2: Functions of Wetlands: Habitat and Rest-stop

Main Points:

- Wetlands provide **habitat (FOOD, WATER, SHELTER and SPACE)** for many animals
- Desert animals and migrating animals use a wetland as a **resting area**. It is a place where they can get water, food and rest. It is a large source of water in the middle of the desert.

Activity:

- Locate fish traps in your area. Pull fish traps with students watching.
 - ◆ Have students note the species and number of fish caught.
 - ◆ Have groups make observations about the habitat of fish (water, shelter in plants, food-depends on what species they are, available space)
- (*Optional depending on time*) Have small groups search out evidence of animal life (tracks, feathers, nest etc.)
 - ◆ Have students hypothesize as to habitat of the animal from the evidence
 - ◆ Have students make observations
- Have small groups
 - ◆ Dig hole (note color, texture, wet, dry...what's in it? Does it form a ball?)
 - ◆ Take air temperature
- Fill out data sheet and make observations

Area 3: Functions of Wetlands: Natural Water Filtering System

Main Points:

- Water at the Wetland Park is naturally cleaned by the wetland plants and organisms
- Plants slow water down
- When water is slowed down, contaminants, pollutants, nutrients, minerals and silt settle in the soil
- Plant roots take up contaminants and pollutants in the soil and transform them into a usable form. This helps the plants but more importantly it cleans the water
- Detritivores (small organisms in water, soil and on plants...i.e. earth worms) also help process contaminants, pollutants and bacteria which again helps clean the water
- Water is slowed down by the plants and spread out. Helps in flood control

Activity:

- Each small group will test water quality, using the following:
 - ◆ Take air temperature
 - ◆ Take water temperature
 - ◆ Observe and note water clarity
 - ◆ Take water depth
- Have small groups:
 - ◆ Dig hole (note color, texture, wet, dry...what's in it? Does it form a ball?)
 - ◆ Take air temperature

- Fill out data sheet and make observations

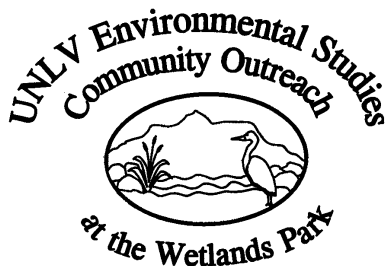
Area 4: Las Vegas Wetlands: Where it comes from and why it is important!

Main Points:

- Water in the Clark County Nature Preserve comes from **urban runoff** (water used by people outside).
 - ♦ History- Las Vegas wetland was originally natural springs. As the population of the Las Vegas valley increased water usage outside of homes increased
 - ♦ The Clark County Wetlands Park includes the Nature Preserve and the Las Vegas Wash. **The water in the Clark County Wetlands Park comes from wastewater from Las Vegas homes and streets.**
 - ♦ **Water in the Las Vegas Wash comes from wastewater treatment facilities (the water that is in your home, i.e. the sink, tub, toilet etc. goes to wastewater treatment facilities where it is manually cleaned)**
 - ♦ The water in the Wash continues to be cleaned by the plants and organisms in and along the Las Vegas Wash as it is also part of the Wetlands Park
 - ♦ Water flows from the highest point of the valley to the lowest point of the valley
 - ♦ Water gathers in the lowest part of the valley
 - ♦ Urban runoff is water used by people outside. Water flows down the streets and is diverted to the Wetland Park
 - ♦ Water flowing down the streets can pick up:
 - Trash
 - Glass
 - Oil
 - Bacteria
 - Dirt
 - Gas etc.
- Water in the Las Vegas wetland is cleaned naturally by plants and small organisms
- The Nature Preserve is important because after leaving the wetland the water enters the Las Vegas Wash, which eventually enters Lake Mead. We want the water to enter Lake Mead as clean as possible because Lake Mead is:
 - ♦ A water source for the Las Vegas Valley
 - ♦ A habitat for various plants and animals
 - ♦ A recreation area
- Las Vegas wetland is also important because it is a large water source in the middle of the desert. Many desert animals and migrating animals depend on it

Activity:

- Have students take note of the Las Vegas Wash and the Nature Preserve noting where the water for each comes from and how both are part of the Clark County Wetland Park.
- Explain that the wetland plants and organisms throughout the Clark County Wetland Park clean the water
- Explain the idea of living in a valley by pointing out the mountains surrounding them, the city of Las Vegas, the water flowing down from the city and towards Lake Mead
- Have small groups:
 - ◆ Dig hole (note color, texture, wet, dry...what's in it? Does it form a ball?)
 - ◆ Take air temperature
- Fill out data sheet and make observations



Field Visit at the Clark County Wetland Park

Date: _____

Arrival Time: _____

Leaving Time: _____

Field Personnel: _____

Description of Weather: _____

AREA 1: Wetland Ecology

Description of Activities

You may draw pictures or write descriptions.

1. Water Observations (water appearance, animals, odor etc.):

2. Plant Observations (leaf shape, trees, reeds, color etc.):

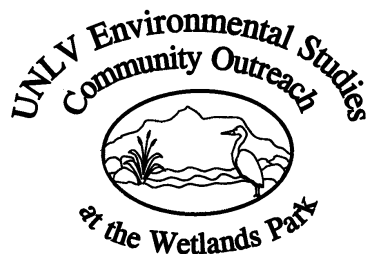
3. Soil Observation and Air Temperature:

Soils: Answer these questions. Share answers with group.

- ◆ How does it feel? Smooth, gritty, sandy etc.
- ◆ Is it dry, moist, wet or very wet?
- ◆ Can you roll it into a ball?
- ◆ What do you see in the soil? Sticks, rocks, animals...

SOIL OBSERVATIONS	AREA CLOSE TO WATER	AREA AWAY FROM WATER

AIR TEMPERATURE	SHADED AREA	SUNNY AREA
Use C or F degrees		



Field Visit at the Clark County Wetland Park

Date: _____
 Arrival Time: _____
 Leaving Time: _____

Field Personnel:

Description of Weather:

AREA 2: Functions of Wetlands: Habitat and Rest-stop

Description of Activities

You may draw pictures or write descriptions.

1. Fish Data:

___ Mosquito fish ___ Speckled Dace
 ___ Green Sunfish ___ Red Shiners
 ___ Desert Sucker

___ **Total Number of Fish Caught**

2. Fish Habitat:

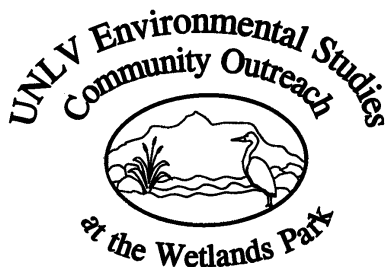
3. Plant Observations (leaf shape, trees, reeds, color etc.):

4. Soil Observation and Air Temperature:

◆ Soils: Answer the same questions found on data sheet from
 AREA 1

SOIL OBSERVATIONS	AREA CLOSE TO WATER	AREA AWAY FROM WATER

AIR TEMPERATURE	SHADED AREA	SUNNY AREA
Use C or F degrees		



Field Visit at the Clark County Wetland Park

Date: _____

Arrival Time: _____

Leaving Time: _____

Field Personnel: _____

Description of Weather: _____

AREA 3: Functions of Wetlands: Natural Water Filtering System

Description of Activities

You may draw pictures or write descriptions.

1. Water Quality

	OBSERVATIONS
Water Clarity	
Air Temperature (Degrees C or F)	
Water Temperature (Degrees C or F)	
Water Depth (mm, cm or m)	

2. Plant Observations (leaf shape, trees, reeds, color etc.):

3. Soil Observation and Air Temperature:

◆ Soils: Answer the same questions found on data sheet from AREA 1

SOIL OBSERVATIONS	AREA CLOSE TO WATER	AREA AWAY FROM WATER

AIR TEMPERATURE	SHADED AREA	SUNNY AREA
Use C or F degrees		



Field Visit at the Clark County Wetland Park

Date: _____

Arrival Time: _____

Leaving Time: _____

Field Personnel: _____

Description of Weather: _____

AREA 4: Las Vegas Wetlands: Where it comes from and why it is important!

Description of Activities

You may draw pictures or write descriptions.

1. Las Vegas Watershed Observations (including the Clark County Wetland Park- the Nature Preserve and the Las Vegas Wash):

2. Plant Observations (leaf shape, trees, reeds, color etc.):

3. Soil Observation and Air Temperature:

♦ Soils: Answer the same questions found on data sheet from AREA

1

SOIL OBSERVATIONS	AREA CLOSE TO WATER	AREA AWAY FROM WATER

AIR TEMPERATURE	SHADED AREA	SUNNY AREA
Use C or F degrees		

APPENDIX D

RESEARCH ASSESSMENT TEST

The research assessment test that follows was used as the pretest, posttest and follow-up test. Questions were randomized.

Wetland Ecology

Student Number: _____ Date: _____ A
Teachers Name: _____ Period: _____

The following questions will test your knowledge about wetland ecology concepts and the Las Vegas watershed. **Please circle the best answer.**

1. Wetlands are most likely to be found on:
 - a. The sides of mountains
 - b. Flat areas on the tops of mountains
 - c. Flat areas in the bottom of the valley
 - d. Rocky areas in the bottom of the valley
2. Which of the following is **NOT TRUE** about wetlands in general:
 - a. They are dominated by plants that require a lot of water
 - b. There is a lot of moisture in the soil
 - c. Water is at or near the surface most of the year
 - d. Very few animals live in the wetlands
3. The Clark County Wetlands Park is located:
 - a. Between Lake Mead and Hoover Dam
 - b. Along the Colorado River
 - c. Between the city of Las Vegas and Lake Mead
 - d. Below Hoover Dam
4. Water quality is better after the water goes through the wetlands because:
 - a. Water moves through the wetlands very quickly
 - b. Wetland plants and organisms break down pollutants in the water
 - c. Wetland plants add nutrients to the water
 - d. The water picks up sediment as it moves through the wetland
5. Wetlands help prevent damage from floods by:
 - a. Directing the water away from the city
 - b. Soaking up the water permanently
 - c. Moving the water away from roads and houses quickly
 - d. Slowing down and spreading out the water
6. Where does most of the water come from for the Clark County Wetlands Park?
 - a. The Colorado River
 - b. Wastewater from Las Vegas homes and streets
 - c. Rain and snow melt

- d. Natural springs
7. Which of the following is **NOT TRUE** about wetlands in general:
- a. They help prevent damage from floods
 - b. They help improve water quality
 - c. They create disease problems
 - d. They provide habitat for animals
8. After water leaves the Clark County Wetlands Park:
- a. It does not leave the Clark County Wetlands Park
 - b. It all evaporates
 - c. It goes to Lake Mead and is not used again in Las Vegas
 - d. It goes to Lake Mead and is re-used for our water supply
9. The most important reason to protect the Clark County Wetlands Park is because:
- a. It helps clean water that is eventually used for Las Vegas' water supply
 - b. It is a good place to build houses
 - c. It is a recreational area for swimming
 - d. It is like a zoo, where animals are kept so people can see them

Your Opinion about the Environment

Please tell us what you think. There is no right or wrong answer.

1. In general, do you like to spend time outdoors?
 - a. Yes, very much.
 - b. Only sometimes.
 - c. I don't know.
 - d. Not really.
 - e. No, definitely not.
2. Do you like learning about the environment?
 - a. Yes, very much.
 - b. Only sometimes.
 - c. I don't know.
 - d. Not really.
 - e. No, definitely not.
3. How much do you care about the environment?
 - a. Very much.
 - b. Only a little.
 - c. I don't know.
 - d. Not that much.
 - e. Not at all
4. How important is it to protect the environment?
 - a. It is extremely important.
 - b. It is somewhat important
 - c. I don't know.
 - d. It is not very important.
 - e. It is definitely not important at all.
5. Do you want to learn more about what you can do to take care of the environment?
 - a. Yes, very much.
 - b. Maybe.
 - c. I don't know.
 - d. Not really
 - e. No, definitely not.

APPENDIX E

INFORMED CONSENT

University of Nevada, Las Vegas
Department of Environmental Studies

INFORMED CONSENT

I am April Perry from the UNLV Department of Environmental Studies. I am the researcher on this project. You (and/or your child) are invited to participate in a research study. The study is to determine whether students exposed to a combined interactive classroom and interactive field teaching strategy understand and retain wetland ecology concepts better and develop a more positive attitude toward the environment than those students exposed to only one interactive teaching strategy or a non-interactive classroom lecture.

If you (and/or your child) volunteer to participate in this study, you (and/or your child) will be asked to do the following:

1. Sign and return this form to the researcher to be kept on file at the university.
2. Complete a knowledge pretest on general wetland ecology concepts and the Las Vegas watershed.
3. Participate in a lesson about wetland ecology and the Las Vegas watershed.
4. Complete a posttest and knowledge retention test after instruction takes place.

You (and/or your child) will participate in one of the four following presentations:

1. Non-interactive classroom lecture:

CCSD students in this group will receive a standardized lecture based presentation during one class period. The presentation will include the use of pictures and text, delivered using PowerPoint.

2. Interactive classroom presentation:

CCSD students in this group will receive a standardized interactive presentation during one class period. The presentation will include games and activities.

3. Interactive field activity:

CCSD students in this group will travel to the Clark County Nature Preserve for a 2-hour field trip lead by UNLV students.

4. Combined interactive classroom and interactive field activity:

CCSD students in this group will receive both the interactive classroom presentation and interactive field activity. The interactive field activity will follow within 5 days of

the interactive classroom presentation.

By participating in this study you (and/or your child) will be helping determine if the teaching methods currently being used in Jr. High School science classes are those which can maximize learning in students.

You (and/or your child) may experience a small risk of coming in contact with the water at the Clark County Nature Preserve. All precautions will be taken to ensure that you (and/or your child) will not come in contact with the water at the Clark County Nature Preserve. You (and/or your child) will be supervised by the teacher and the UNLV wetland park outreach crew. You (and/or your child) will also wear rubber gloves when near the water.

If you have any questions about the study or if you experience harmful effects as a result of participation in this study, you may contact me at 895-4771 or Dr. Krystyna Stave at 895-4833. For questions regarding the rights of research subjects, you may contact the UNLV Office for the Protection of Research Subjects at 895-2794.

Your (and/or your child) participation in this study is voluntary. You (and/or your child) may refuse to participate in this study or in any part of this study. You (and/or your child) may withdraw at any time without prejudice to your relations with the university. You (and/or your child) are encouraged to ask questions about this study at the beginning or any time during the research study. Those students who choose not to participate in this study will remain in class but their test scores will not be included in this research study.

All information gathered in this study will be kept completely confidential. No reference will be made in written or oral materials that could link you to this study. All records will be stored in a locked facility at UNLV for at least three years after completion of the study. After three years all information gathered in this study will be destroyed.

I have read the above information and agree to allow my child to participate in this study. I am at least 18 years of age. A copy of this form has been given to me.

Signature of Parent or Guardian if Student is under 18

Parent Name (Please Print)

Date

Name of Child (Please Print)

University of Nevada, Las Vegas

Department of Environmental Studies

YOUTH CONSENT FORM

I am April Perry from the Department of Environmental Studies at UNLV. I am the researcher of this project. You are invited to participate in my research study. This study will compare different ways of teaching the same lesson (on the same subject) to see which one works the best. Some classes will have a lecture style lesson (similar to a normal class period); others will have an interactive classroom presentation or an interactive field trip presentation, while some classes will have both the interactive classroom presentation and interactive field trip.

In order for me to know which one works the best, you will be given three different tests. The first test will be given to see how much you already know about the topic. After the lesson is taught to you, I will give you a second test. This one is to see how much you learned. Finally, the third test will be given one month later to see how much of the information you remembered from the lesson.

Those students who receive the interactive field trip presentation will have a small risk of coming in contact with the water at the Clark County Nature Preserve. All students will be supervised by the teacher and the UNLV wetland park outreach crew and wear rubber gloves when near the water for safety reasons

You do not have to participate in this study if you do not want to. Those students who choose not to participate in this study will remain in class but their test scores will not be included in this research study. If you do decide to participate, your name and your test scores will be kept confidential, that means no one but the researcher will see them. All records will be kept in a locked facility at UNLV for at least three years after the study is finished. After three years all information gathered in this study will be destroyed. By taking part in the study, you may help the way that wetland ecology is taught to students your age.

If you have read the information above and want to participate in this study, please sign and print your name below and return this form to your teacher. Thank you!

Signature of Student

Student Identification Number

Student's Name (Please Print)

Date

APPENDIX F

IRB APPROVAL NOTICE

UNLV

UNIVERSITY OF NEVADA LAS VEGAS

Social Behavioral Sciences Institutional Review Board Approval Notice

DATE: April 3, 2003

TO: April Perry, Environmental Studies
Krystyna Stave (Advisor)
M/S 4030

FROM: Dr. Fred Preston, Chair
UNLV Social Behavioral Sciences Institutional Review Board

RE: Status of Human Subject Protocol Entitled: ***"Comparing the Effectiveness of Interactive Field, Interactive Class and Non-Interactive Class Lecture Teaching Strategies to Teach Wetland Ecology Concepts to 6th and 7th Grade Science Students"***

OPRS# 826S0103-053

This memorandum is official notification that the UNLV Social Behavioral Sciences Institutional Review Board has **approved** the protocol for the project listed above and research on the project may proceed. This approval is effective from the date of this notification and will continue through April 3, 2004, a period of one year from the initial review.

Should the use of human subjects described in this protocol continue beyond a one-year period from the initial review, it will be necessary to request an extension. Should you initiate **ANY** changes to the protocol, it will be necessary to request additional approval for such change(s) in writing through the Office for the Protection of Research Subjects.

If you have questions or require any assistance, please contact the Office for the Protection of Research Subjects at 895-2794.

Cc: OPRS File

APPENDIX G

CLARK COUNTY SCHOOL DISTRICT APPROVAL

AN AFFIRMATIVE ACTION
EQUAL OPPORTUNITY EMPLOYER

CLARK COUNTY SCHOOL DISTRICT

2832 EAST FLAMINGO ROAD LAS VEGAS, NEVADA 89121 TELEPHONE (702) 799-5011



BOARD OF SCHOOL TRUSTEES

Mrs. Sheila R. Moulton, President
Mrs. Denise Brodsky, Vice President
Mrs. Susan C. Brager-Wellman, Clerk
Mr. Larry P. Mason, Member
Mrs. Shirley Barber, Member
Mrs. Ruth L. Johnson, Member
Mrs. Mary Beth Scow, Member
Mr. Carlos Arturo Garcia, Superintendent

April 10, 2003

April Perry Samson
4255 Tamarus Street, Apt. 423
Las Vegas, Nevada 89119

Dear Mrs. Samson:

The Clark County School District Committee to Review Cooperative Research Requests reviewed your proposal entitled: Comparing the Effectiveness of Interactive Field, Interactive Class and Non-Interactive Class Lecture Teaching Strategies to Teach Wetland Ecology Concepts to 6th and 7th Grade Science Students. The committee is pleased to inform you that your proposal has been approved with the proviso that you obtain the permission of the principal of each school you wish to include in your study.

Please provide a copy of your research findings to this office upon completion. We look forward to the results. If you have any questions or require assistance please do not hesitate to contact Cheryl King at 799-5195 or e-mail at cherylk@interact.ccsd.net.

Sincerely,

Karlene McCormick-Lee, Ph.D.

Assistant Superintendent
Research, Accountability, & Innovation Division
and
Committee to Review Cooperative Research Requests

KML/clk

Cc:

Lauren Kohut-Rost
Michael Robison
Craig Kadlub
Jhone Ebert
Shelly Channel

Andre Denson
Roger Gonzalez
Connie Kratky
John Carpenter
Tom Gifford

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VITA

Graduate College
University of Nevada, Las Vegas

April Marie Samson

Degrees:

Bachelor of Science, Zoology, 2000
Brigham Young University, Provo, Utah

Publications:

Kopp, O.R., Samson, A., Wilson-Ashworth, H. 2007. Lab Manual. College Biology I. Biology 1610. Pearson Custom Publishing.

Thesis Title: Comparing the Effectiveness of Interactive Field, Interactive Class and Non-Interactive Class Lecture Teaching Strategies to Teach Wetland Ecology Concepts to 6th Grade Science Students.

Thesis Examination Committee:

Chairperson, Krystyna Stave, Ph.D.
Committee Member, David Hassenzahl, Ph. D.
Committee Member, Kent Crippen, Ph. D.
Graduate Faculty Representative, Kimberly Barchard, Ph. D.