Technology Integration in Environmental Learning: A Photography Based Case Study

By
Samuel L. Northey
9/21/2009

A capstone submitted in partial fulfillment of the requirements for the degree of Master of Arts in Education.

Hamline University
Saint Paul, Minnesota
December 2009

Primary Advisor: Renee Wonser
Secondary Advisor: Tracy Fredin
Peer Reviewers: Marie Northey & Clara Roberts
Abstract

Northey, Samuel L. Technology Integration in Environmental Learning: A Photography Based Case Study (2010)

This case study explores the use of cameras in the classroom to aid in environmental education curriculum via firsthand experiences. The study utilizes the permanence and ease of technology to aid in retention and ownership of environmental concepts; allowing the three student groups to use the technology to study outdoor areas, over five instances. Included in the study are students of all abilities and over forty examples of student work. The study explores post trip examination of the photos and several examples of how to use the images in the classroom for further study, extending the learning opportunities.
To: All those who helped me through the process of creating and collecting these ideas, and the tribulations of its completion. I thank you.

I especially thank my wife Ellen for her patience and understanding, my children for their inspiration, my mother for her example, and my father for his insight.

Dedicated to the memories...
In wisdom gathered over time I have found that every experience is a form of exploration.

Ansel Adams
Table of Contents

Abstract ii
Dedication iii
Guiding Quote iv
Table of Contents v-vi
List of Figures vii

Chapter One

Introduction 1-8
  Reasoning 3
  Study Purpose 8

Chapter Two

Review of Literature 9-34
  Student Learning 9
  Learning Theory 12
    Place Based Education 12
    Interactive Learning 13
      Learning through Experience 16
    Visual Learner and Visual Literacy 19
  Digital Camera 23
  State of Environmental Learning 24
  Experiential Learning 26
  Study Basis 29
    Learning theory and Learning Engagement 29
    Current Challenges to Environmental Education 30

Chapter Three

Methodology 35-41
  Defining Terms 37
  Methodology of Study 38
  Study Variables 39

Chapter Four
Results 42-63

Case Study Group One 42

Description of Study Group 42

Visit One (Fall) 43

Pre Visit 43

Day in the Field One 45

Visit Two (Winter) 53

Pre Visit 53

Day in the Field Two 54

Post Trip 58

Visit Three (Spring) 58

Pre Visit 58

Day in the Field Three 58

Case Study Group Two 60

Case Study Group Three 61

Presentation Day 62

Chapter Five 64-69

Conclusion 64

Reflection 64

Literature Review 65

Implications 66

Limitations 67

Recommended Further Research 68

Communication 69

Closing Comments 69

Author’s Note viii

Appendix ix-xxxv

A-J xxxvi

References
Illustrations

Kolb Illustration .................................................. 17
Photography Graphic Organizer Illustration .................. 22
Student Demographic Table .................................. 36
Data table 1 ......................................................... 63
Photographic Evidence Chapter Four .........................

Figure 1-40 ......................................................... 42-63
CHAPTER ONE

Introduction

In the introduction, I will be explaining my point of view and the reasoning. I will preface the methodology to the study. I will be utilizing my personal thoughts and experiences as well as thoughts and experiences from many great people who preceded me to design this study to be helpful and meaningful for the future of education.

Personal History:

I can recall long, lazy days checking fence with my grandfather when I was very young. The joy, inspiration, and healing power of the natural world brought us closer together. Now all that remains of that world are my memories, a rusty fence, and my photographs. As with all things, people and places pass into history and are most often forgotten or lost. The only things I have to share with the next generation are my views of the past world through the lens and my stories. Oral and written stories are great tools for sharing, but nothing has the power of an image. This can be seen by looking through a child’s eyes when he or she sees a photo they took.

I was given my first camera, a simple 110, when I was eight years of age. I have captured the whole world on film from that day on. As I progressed through the stages of
life, my camera grew as I did. I moved from the 110, to an Argus range finder, to the cameras I own today. Photography might have been my way of proving to others the things I saw or the places I had been at the time. As my interest in photography grew and my eye as a photographer was honed, I purchased my next camera and the next. My camera became my outlet, even my escape into the wilds. I took a camera everywhere. Neither the time nor the weather was a boundary; it became part of what I carried. The camera let me explore worlds and places over and over once the light had faded, the flowers gone, or the faces had passed. I could bring the memories of that moment to the surface with photos. The photos I took so many years ago still have that power to recall the moment I snapped the photo.

Photography became a tool for me in school, in college, and in my professional career. Photography to this day is part of what I am, part of how I see the world, and how I interact with it. I use this tool to teach students skills and life lessons on daily basis.

In the following pages I will be illustrating and supporting how anyone can use digital photography to make a one day event into a lifetime of memories and lessons learned. Ansel Adams said “A picture is usually looked at - seldom looked into.” (Green, 1982, p. 162) It is my goal to have the students see beyond the whole image and see the intricate parts within, to let them have the power to recall that very moment in time when the photo was taken.
Reasoning:

Looking around the area and the world one needs only to glance to see that we as a species are generally visual beings. Every place we go, in every time period, humans have documented what they see and how they see it. From the Egyptian civilization to the present, visual images have been used to communicate ideas, thoughts and feelings. (Aucouturier, 2008 p. 1) Only in recent time has capturing a visual image been accessible to anybody via the camera. The dawn of consumer photography in 1900 by Eastman Kodak and Frank A Brownell made photography available to all. Everyone was allowed to capture an instant in time. Photography has progressed not only to immediate capture, but to instant feedback with the digital camera. (Bennett, 2004).

The camera has been used as an educational tool in the past, but generally it was not for the students’ use. Images were used as a tool for the educator to bring images to the classroom via pictures, movies, and annotated photos (the filmstrip) as a “special occasion”. In contrast, the students not only use the cameras, but they will also create teaching tools with them. The process allows the students to be a part of the learning process, not just a member of the audience.

Photos in education

As an educator, I have experienced that the power of a photo is often underestimated in the practice of teaching adults and students. Frequently, I have witnessed that educators don’t understand the value of visual learning and take photos or images for granted. They do not value the learning expressed through imagery.
Presentations may use the printed word, art work, and/or real images. The presentations with real images enable the audience to have a deeper understanding. When observing students, they are often more engaged when photos are present. An image instinctively catches their eye and draws the student into listening.

In a study done by Houts (2006), he and his associates tested this theory with patients. The patients were all given the same sets of written and oral instructions on how to take a medication, while the study group was showed photos that illustrated and supported the written instructions. The study group with the images had a marked improvement in comprehension and retention of the materials. It is found when any instruction or written material is linked to an image; images are processed differently in the brain. The images are linked to experiences. Images will evoke deep feelings of nostalgia, nature, and how humans relate to their environment. (Wulff, 2007) The same concept goes even further to aid in content acquisition when the individual is engaged in creating that image.

“The more you see, the more you know, and the more you know, the more you see” said John Hitchcock, anthropologist (Dragan, 2008, p. 5). The thoughts led the researcher to illustrate the concept of: What is known by each student on a fundamental level is what the student has seen or experienced firsthand, by enlarging his/her frame of reference. Each student arrives in the classroom with a set of values and prejudices from past experiences. It is the teachers’ role to place all students on a level playing field of knowledge, allowing the struggling students to catch up and the students who are
excelling to shine and progress. (Korkmaz, 2007) This delicate balance of learning can be achieved through visual imagery. The images that are shared by the students and staff make it possible to go miles in moments. The students will have the understanding of place. The students will then have idea of being there: what nature feels like; what nature smells like; what nature looks like; and what nature really is. This means the students will take themselves to the environmental site through imagery via stored memories to note the details of the scene. (Swaminathan, 2007) As Ansel Adams once said, ““There is a person in every one of my photographs, …” on Ansel Adams's starkest granite wall, in his emptiest desert landscape, a person is always present, and that person is Adams himself.” (Brower, 2002, p.1) The person wanted in the photo for this study is the student. Then the student can share that vision with peers and to share that understanding with others.

From my experiences and speaking to peers, not many schools have the opportunity to have a natural lab outside their door. Thus they are delegated to a single day field trip or looking at a small plot outside the school. The standard school district will have a unit of environmental awareness/ecology in its general biology/life science class, based on class offerings.

Few schools across the United States may be able offer an ecology class. Advanced Placement Environmental Science is one environmental class that is such a course. The AP program is not in every school. In the United States in 2007, there were only 2225 schools offering AP environmental, (13.9%) of the high schools of the 52,000 who participate in the AP exams.
At other levels it is hard to get definitive results, because environmental education has taken many names in communities. The cost of course development makes it cost prohibitive to take on without state mandated directives.

Another hurdle of environmental education is misconceptions by the community and businesses. The outrage of one can stir the discontent of many and cause the rest to question what they knew to be true in their heart.

“One of the major concerns by teachers and administrators about environmental education over the years involves the perception that students are given biased information that may lead to their becoming environmental activists. This would conflict with the value systems of a significant number of families, and in many cases the mission of schools. Here the common misconception that EE is composed of radical environmentalists can be found and in certain situations is magnified. Many believe this comes from the environmental movement having roots in the sixties, with liberal and what was characterized as radical agendas playing a major role in this. However, EE in its infancy in the late sixties and early seventies typically was not involved in direct environmental activism.” (Brown, 2007, p. 6)

Schools meet this challenge by making ecology a destination event such as a field trip to a nature center, a butterfly unit, or a trip to the zoo. It is typically a onetime event
that has a beginning and an end. It has been my experience that environmental education is currently not a complete integration of ideas and comments into the curriculum. Most of the educators I have witnessed with a successful environmental program have a distinct interest in the outdoors. Students are generally interested in nature and how it works. All one needs to do is think back to times of the past. Most people have a place where they interacted with nature from childhood. It could be a patch of grass, a vacant lot, or even fields and forests that excited their imagination to other worlds.

“For most of history, children spent their days surrounded by nature, where they were able to play, explore and interact with the natural world. With increasing urbanization, the lives of children today are much different and children today have fewer opportunities for regular contact with nature. With fewer opportunities for children to develop a connection with nature, future generations will have little desire to lead sustainable lives of become good stewards of the earth.” (Swayze, 2007 p. 2)

The educator needs to assure that students’ leave their class knowing about the world around them. Students should understand their part in that world; good or bad, and the affects of their actions. This fact is stated in What Teachers Should Know and Be Able to Do by the National Board for Professional Teaching Standards (p 21)

“The primary mission is to foster the development of skills, dispositions and understanding, while responding thoughtfully to a wide range of human needs and conditions. Teachers owe joint allegiance to the forms and standards of knowledge within and across disciplines and to the students they serve.”

**Study purpose**

This research study intends to help to define the student role in society further than the student’s current understanding, through detailed reflection on an environmental site. This study will allow through student reflection to think critically about implications of their actions, via environmental awareness. Imagery is the key that links the many concepts to one key curricular tool, the camera. Cameras have been used throughout history to document and record key moments. The time surrounding the Civil War to today have been documented through history through photography, each photo has a history, a time, a place, a mood, and even a story to tell. (Forresta, 2004).

This study will link cameras to the daily learning of kids to allowing them to express their thoughts and feelings in different ways to describe a situation. The study will achieve this goal through the process of letting the students create their own memories, their own links to vocabulary of nature and environmentalism by letting the students express themselves via photography.
CHAPTER TWO

Review of Literature

In this chapter, the research will illustrate learning theory and conceptual learning linking the ideas to student use of the camera and student learning. In these pages one will see that many of the educational tools and modes of environmental education can be linked to photography and the use of imagery to gain further understanding of complex concepts for students.

Student Learning

Student learning is defined in several ways, sometimes by outcomes sometimes by process, but over all educators goal is to expand or depend a student’s understanding of the concepts being taught. Students learn best by varied and diverse methods. These methods are highlighted in several articles. In 1991, Svinickio outlined six primary caveats for learning later (summarized by Garcia-Barbosa in 1998 p. 1). The researcher plans to show that varying the learning through the use of technology that environmental issues will be more attainable. This is done by demonstrating these tenants of learning. The students not only will observe via photography, but they will make it personal. They the learners created the image, they will internalize the image by capturing it in their minds’ eye, and they can through repetition use the image later to access the information within the photo.

1. The information must be deemed as important by the learner.
2. During learning learners act in ways that make the concepts more meaningful to them personally.

3. Items learned are shifted into long term memory by linking them to a pre-existing memory.

4. Learners will continuously check and recheck information with previous ideas shaping and changing them based on new and old information.

5. Transfer of information is not automated, it comes from repeated exposure.

6. Learners are more apt to learn if they are aware of how they learn best and have the ability to choose methods that work well for them. (Garcia-Barbosa, 1998 p. 1)

These items may seem fundamental to most teachers, but often in the chaos of the educational system, one or more of these items may be forgotten. “The goal of any educator is to offer a varied curriculum and meet the needs of all learners.” (Sutterback, 2009 p. 1) In the study, the research will use digital photography as a mechanism to meet the needs of students.

Needs of special education students

This can be further illustrated by Carnahan study of five teachers who used Photovoice as a tool to aid in student learning. Carnahan found that not only did the use of photos aid in increased learning and engagement, but their use also promoted student
success beyond what they had found with traditional learning strategies. She cited four primary barriers to learning of students with special needs.

1. General education classrooms' are passive. These environments do not promote active engagement in the learning processes. Teachers talk; students sit and listen.

2. General education classrooms focus on the teacher rather than on students' personal interests or learning style.

3. General education classrooms only engage one type of learner. Students must learn the way the teacher instructs instead of having the curriculum or teaching style adapted to fit the students' needs.

4. General education classrooms do not promote independence and learning. The environment promotes conformity and quiet learning rather than true learning. (p. 48)

Carnahan makes several claims regarding general education that illustrate the need for change to allow all students to learn through different modality. Carnahan (2006)

“Successful students will have: complex cognitive skills; ability to apply knowledge; the ability to discern and make decision for themselves; a integrates sense of self, integrity, and civic responsibility” (Kuhl, 1996, p. 1) Based on Kuhl’s report educators need to prepare students to meet these needs of a successful individual.
Learning theory

Place Based Education

“Place-based education offers a fundamentally different approach to reforming public education. By using the local ecological and socio-cultural setting as the organizing focus, place-based education aims to re-establish the connections among schools, youth and communities that have disintegrated in conventional schooling.” (Chin, 2001, p.8) Sobel (2004, p. i-iv) states “place based education is intrinsically linked to its location”, meaning the school should be in a place that has varied ecosystems and study areas. The location is what makes the place based education students experience rich and beneficial educational experiences.

Place based education does a great job of linking the natural world to curriculum, and integrating the two concepts seamlessly. One such school is Portage Charter School. This school involves the environment in every aspect of education; science math, via prairie planning and upkeep; social studies, by addressing state representatives via letters and in person, being part of the law making process; and physical education, life skills like canoeing, biking, hiking, fire fighting, logging, even yoga are all part of the integrated model. The staff has the opportunity to move the students to a myriad of local venues for educational enrichment purposes. There is an emphasis on career choices and goals for secondary education by job training in design, construction and management of personnel and supplies.
These tasks are done by letting the students be the leaders of task at hand. The staff utilizes environmental standards to shape all of the lessons. The charter school is a true environmental place based school. The faculty utilizes the gift of location and school-supported transportation to teach many of the conceptual aspects of environmental learning to seventh and eighth graders. (Rydbeg, 2007)

**Interactive learning**

Interactive learning illustrates several modalities at once.

“Interactive *learning* experiences may very well set the stage for an individual construction of knowledge. From a social constructionist point of view, these experiences help construct a workable reality by creating a dialogue of *learning*. In his book *Thinking in Education*, Matthew Lipman (1991) discusses the skills required for higher order thinking. He contends that teaching a child to think should be the most important goal of education.” (Mcgrath 2001, p. 613)

She further states

“children develop intellectually through direct experience. Psychologist Robert Glaser (1984) asserts that interactive inquiry methodology is extremely important in order to teach children to think within the context of the subject matter. The coupling of a realistic setting with the use of objects that belong in that setting and experienced in contextually relevant ways enhances a student's ability to store information within a contextual framework (Springer and Deutsch, 1981).” (Mcgrath 2001, p. 611)
Relating the experience to the study by involving the students in gathering said items of study makes the task real and meaningful. It allows the concrete examples of creative contextual clues for learning.

“Cognition depends on the kinds of experiences that come from having a body with particular perceptual and motor capabilities.” (Thelen, 2000, p. 5) Humans perceive things in a certain way based on their form and function. This study will utilize our view of the natural world from the eyes of the students to see the world as they see it. The human is a visual being who processes and assesses information from the greatest distance and by the most rapid survey of a large area with our eyes with little extra training; one only needs to look at all the images we are bombarded with daily. Aucouturier states

“We humans are visual creatures. Every day, we look at each other’s faces and bodies; we watch movies and advertisements; we appreciate the vision of a park or regret the dull visual environment of the commuter train. We all know that there is a difference between what the world is, and what we see of the world: we choose to look certain things and to ignore some others.” (Aucouturier et al, 2008 p 1)

It is this ability that makes this study of student learning with the camera so fundamentally interesting to the researcher at this point. Humans never before had such immediate means of capture and reflect on high quality images. Tunstall undertook a similar study with young students and play in natural settings. She used the camera to see and get feedback on their perspectives. She found that as the students examined the
places and compared one river areas to another the students returned with very adult perspectives on the environment and how it should be treated. “Comments recorded on site during the river visits indicate how the children thought the river sites could be made better places to visit or for play” (Tunstall, 2004, p.199) Each of the sites offered different aspect of play but most of the interaction for the children seemed to be the boundary between water and land. She proves this with the use of student taken photos offering them free play but seeing what they see.

“Uzzel (1976), and Maurer and Baxter (1972), have pointed out that there is a quality of intricacy and attention to detail in children’s conceptions of the environment not found in similar adult conceptions, which tend to concentrate on the broader picture. In this study, the children mainly chose to show specific components of the river environment, such as trees or plants, rather than the scene as a whole.” (Tunstall, 2000, p.188)

This attention to detail, this profound amount of information a photo holds, and the equally profound amount of information a student can take in at once make the photo such a valuable tool for educators. Education is the cornerstone of our civilization preparing the youth of today for the tasks and ideas of tomorrow.

“Children’s views grow into adult views. If, as researchers have argued, childhood experiences of the environment are particularly salient (Chawla, 1986), it may be that those who have had good experiences of rivers in childhood grow to have an appreciation of their special landscapes and features throughout their adult lives” (Tunstall 2004, p.200)
A similar study was undertaken in Berlin with adult Geography students (Latham, A., & McCormack, D. P., 2007). In a study conducted in Berlin in 2007, adult geography students were allowed to use cameras to document their urban surroundings. The geography students then reflected upon the observations later and produce measurable web based outputs as culminating project. Each student produced a website that could be assessed visually as well as detail information on what the student observed. The students noted what architectural details they observed. This information was used by the professor to see if the student had met the criteria for the course by the photographic proof they put within the website. This process was done with traditional cameras and this did not have the immediate feedback to the student that this study is utilizing with the digital camera. The investigation done by Latham et al shows that even the disinterested student can become interested with a methodology that allows for personal expression and freedom to take part in the learning process.

Learning through Experience: (The Kolb model)

According to Kolb (1984, p. 41), "learning is the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping experience and transforming it." He proposes that experiential learning has six main characteristic:

- Learning is best conceived as a process, not in terms of outcomes.
- Learning is a continuous process grounded in experience.
- Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world (learning is by its very nature full of tension).
- Learning is a holistic process of adaptation to the world.
- Learning involves transactions between the person and the environment.
- Learning is the process of creating knowledge that is the result of the transaction between social knowledge and personal knowledge.”

Kolb thinks of learning more as a continuum of experiences and learning as a process rather than a style. Meaning that a learner begins learning where they are most comfortable and through a varied approach to learning all learners will come out with similar experiences. And best

Illustration 1. Kolb’s learning model.
practice is allowing the learner to go through all the modes of learning to master a concept. (see Illustration 1)

Examples following Kolb’s Model:

Example One

Learning about insects:

- Reflective observation - Thinking about insects and watching another person catch and identify insects, Watch a movie about insects.
- Abstract conceptualization - Understanding the theory and having a clear grasp of what insects do in the environment, conceptualizing their role, inking what they really do in the big picture.
- Concrete experience - Receiving practical information and techniques from an insect expert.
- Active experimentation – Going into the field and learning by collecting and examining insects, allowing the learner to learn by doing.

Example Two

Learning to ride a bicycle:

- Reflective observation - Thinking about riding and watching another person ride a bike.
- Abstract conceptualization - Understanding the theory and having a clear grasp of the biking concept.
- Concrete experience - Receiving practical tips and techniques from a biking expert.
- Active experimentation - Leaping on the bike and have a go at it.

As you can see Kolb’s model can be applied to any concept and make learning at a higher level through experiences. Allowing the expertise to aid in the learning process, further illustrating that experience based photography is a sound learning practice.

**Visual learner and Visual Literacy**

A visual leaner as defined by Robbins.

“Visual Learning arises from the use of visual language, where linguistic meanings, information and sense are embedded in an image, rather than a text, and where the image is capable of being read, both in terms of the authors intent and in terms of the viewers own conditioned perceptions” (1993, p.1).

Furthermore he states, the visual learning is the first learning that takes place in our system of knowledge even before we acquire speech or language. The image being the universal language that universally able to read, and is not depended ant on the dialect of the individual viewing or creating the image. Visual learning occurs as an individual seeks to establish pattern and order in visual impressions of the world. It leads to the
personal ownership of a scheme of representations, which are classified and coded with meanings. These images become the imagination and are recalled to become the images—action enabling new learning to take place as correspondences are established and new internalized images synthesized, together with shifts in meaning. (Robbins, 1993)

The image in the student’s own reference bank to reference and to use as a basis for further learning opportunity. The photograph or literal meaning writing with light allows students to relay volumes of complex and literal information to others while not limiting by verbal or written ability making the information far more useful to students to draw on as they acquire the language tools need to explain the concepts. Plus the photo was taken by individuals has far greater meaning than that of the passive observation of others.

“It bypasses written language constraints and because the produced image may be subsequently reviews again and again, the information, visual stimuli, empathetic triggers and associations of meaning are all recoverable on demand.” (Robbins, 1993, p. 2)

The student then has the ability to further process the photograph. Each student then can use the photo not as a creative medium but as a factual representation of that time and place in history. This will forever link the photo in the memory of the student to that incident. As Abrahmov states, the student should

“instead of looking at photographs, which implies a passive act of recognition, we should insist on reading them. The act of reading involves
an active and complex comprehension of relationships and the assignation of meanings, as well as the exploration of the interaction between the reader and the image, in a similar fashion to our activity when reading text.

(Abrahmov, 2008, p. 4)

This act gives the photo greater value as a teaching tool since the student can now use the photo as a reverence point of context. It is just like looking back in a book to remember a detail. The student then has the ability to go back to the point where he/she took the image. Not only does the student have the ability to see his/her own photo, but he/she also has the ability to look at others and recall seeing him/her take the photo or place himself/herself in the scene since the student was present on site. Abrahmov also states “projects achieved the desired result of photographs that go beyond simple documentary photographs, that is, photographs with a developed interpretive level of meaning can develop his visual reading skills through a guided and focused set of activities, while learning from peer examples.”

(Abrahmov (2008) p 13)

He used photos to teach the class good and bad photo technique, while in this study we are using the photos to teach environmental concepts and ideas. A photo can be used as a vehicle to express content context and place. (see illustration 2)

When looking at a photo we must answer five questions:

1. What do I see?
2. What does it mean to me?
3. What in the photograph leads me to say this?
4. Why was this photograph created?

5. What does it mean?

(Abilock, 2008, p.1)

When students answer these questions, they have the ability to process each image more fully “and our learners will find this process transformational when they understand, evaluate, and use visual information for authentic reasons” (Abilock, 2008, p.7)

Just as the students use photos in this study, the students then have deeper understanding of the content and context of the study sight as well as extending that to further study bridging information for one site to generalize it to further study areas. “A photograph often reveals a great deal more information than its maker ever intended” (Goin, 2001, p.1). Students were able to see more details as they process the photos for later use. The students saw every small detail of the plant and animals they captured on film. Photo
projects will allow a certain level of professionalism as also shown by Shiller led to identifying new ways of thinking about children’s views as expressed through digital images and new ways of using the images taken by children to enhance their learning. “Digital photography provided young children with the opportunity to present their views ‘about things that matter’ in a medium taken seriously by adults and older children.” (Shiller, 2001, p. 214). The study group had the same result when the photos were placed on a bulletin board within the school.

**The Digital Camera**

Digital cameras are educational tools that support purposeful instruction with a clear vision on curriculum, instruction, assessment, and reflection. As classrooms continue to be infused with various forms of technology, teachers need to recognize the role digital cameras play in student performance and the multiple dimensions this instructional tool does to enrich learning. (Supun, 2006, p.154)

As stated by (Rivard 2004, p. 55) ”digital cameras have become the hottest tech trend in K-12 districts today.” The idea that the camera is a valued tool is prevalent in our society. Teachers need to adapt their instructional methods to enhance the visual literacy abilities of students while enabling learners to develop higher level thinking processes (Cooper, 2003; Wilhelm, 2005).

“Teachers’ responsibilities include: (a) providing the instructional tasks for the students' apply in the K- 12 classrooms. Digital camera
engagement, (b) providing an understanding for the use of digital cameras, (c) providing access and instructions to students for the handling and use of this technology, and (d) providing instruction and guidelines for using this technology to provide feedback.” (Rairigh and Kirby 2002 p. 36)

The digital camera is a powerful tool among our technology arsenal. In this study the digital camera will be used as tool to capture, document, and evaluate natural scenes and seasonal changes.

**State of Environmental Education**

Environmental issues may function as a unit or a mention in many schools, as mentioned earlier. National Science teachers have come forward as a champion of EE as seen in their position statement, although it does not have its own set of standards in most states. Wisconsin, Minnesota, and Kansas have become leaders in this area drafting separate EE standards for schools. The standards inter link through the curriculum, create their subset of standards that are endemic to EE learning.

NSTA strongly supports environmental education as a way to instill environmental literacy in our nation's pre-K–16 students. It should be a part of the school curriculum because student knowledge of environmental concepts establishes a foundation for their future understandings and actions as citizens. Central to environmental literacy is the ability of students to master critical-thinking skills that will prepare them to evaluate issues and make informed decisions regarding stewardship of the planet.
The environment also offers a relevant context for the learning and integration of core content knowledge, making it an essential component of a comprehensive science education program. (NSTA position statement 2009 [http://www.nsta.org/about/positions/environmental.aspx])

Currently in the USA, Environmental Education is included but not highlighted as part of the science curriculum. NSTA explores some of the reasoning and makes its suggestions through this letter. The letter from NSTA in support of the bill No Child Left Inside Act (H.R. 3036). Appendix B was accessed at [http://science.nsta.org/nstaexpress/NCLI-LetterOfSupport.pdf](http://science.nsta.org/nstaexpress/NCLI-LetterOfSupport.pdf), 10-2009) Stating that EE is under represented in our schools. And most of all in our struggling schools. It was drafted to urge all the law makers to take this initiative to heart and think of the future generations and their interaction with the world around them. The state of EE is precariously perched between education and law. All states at the time of the writing of the paper control the educational content of standards and content of the state based assessment. There has been a renewed vigor in the national awareness to environmental issue, as the presses lens shift once more educational health of the student. Mr. Obama has taken an interest in the No Child Left Behind inside campaign. This alone can shift American interest back to EE. Mr. Obama stated in his speech to the Department of the Interior,

“That’s a sacred trust the importance of which cannot be measured merely by the acres we protect…. It’s a child wandering amidst ancient redwoods, a love for science spurred as she looks skyward...a family
hiking along canyons carved by ancient floods or mountains shaped by shifting continents finding peace in the beauty of the natural world.”

(Obama, 2009)

**Experiential Learning**

"For the things we have to learn before we can do them, we learn by doing them."

Aristotle

The current literature is based on Kolb & Fry experiential learning model of four elements: concrete experience, observation and reflection, the formation of abstract concepts and testing in new situations. Kolb and Fry represented these in the famous experiential learning circle the graphic organizer involves concrete experience followed by observation and experience followed by forming abstract concepts followed by testing in new situations (Smith, 2001).

Experiential learning is based on the idea one can repeat the experience on a regular basis requiring reflection of the learner. Often this is not the case; in today’s fast paced high school environment educators are lucky to have one opportunity. Many educators leave the experience there. The study will integrate the experience into the aspects of further study in the classroom via the camera. The camera will allow the student to relive the experience, while allowing for further examination of details. It has been shown that the camera can be used for detailed study of many ideas. As Latham, A., & McCormack, (2007) did in Digital photography and web-based assignments in an urban field course: Snapshots from Berlin. Latham found that a problem with student
achievement was the engagement of the students in the process of field research looking at urban form and geography. Students often did not notice the details of the architecture and structures around them. The study allowed from student perspectives

“As one student put it, “it added more to our notes as using digital cameras enabled us to record images, which jogged our memory about a particular place”. In addition to working as a simple memory device, for many students the availability of the photographs in digital format on CD was central—or ‘vital’ as one student put it—to their experience of completing assignments. In part this was a matter of convenience. “In addition to the notes we made we had lots of visual material both for work in Berlin and when we got back.” But it was also because the excessive amount of images meant that details previously ignored might, after reviewing, take on renewed significance. One student described how the photographs from the fieldtrip allowed her to “look at things a lot more closely, look at things I may have otherwise have overlooked—this detail was useful later on when doing the coursework”. Indeed, many students not only found the volume of material they had generated useful but also appreciated how the availability of the digital photographs facilitated the setting of more visually orientated coursework assignments. As one student put it, “the use of digital photography made assignments different and creative and therefore fun to do. It also made assignments easier as we had primary data.” (Latham, 2007, p. 252)
Students in lower grades often are able to use photography to tell stories as well and explain complex events. Dragan uses photos across the curriculum to allow students measured success, with non-traditional assessment. She allows the students to take and use photos of them to dream what they may become; the photo allows them to visualize themselves in that situation, thus making it concrete. “One student Hector cared that actual image of him on a motorcycle that he drew under his image. That image is framed in his motorcycle shop 30 years later.” (Dragan, 2008, p. 8) “It is particularly noteworthy that when students take the photographs, ownership is promoted. When students see the photographs they took, concepts are clarified and attained.” (Supun, 2006, p. 155)

“Direct observation of students in comparison groups through different trips and judging the engagement level by the output projects produced and content knowledge of students. They found that all students had a higher level of engagement. The study documented the use and dissemination via the digital camera.” (Latham, 2007, p.255)

It may have been done originally to validate the grant money for the cameras, but as it is documented and studied it has greater scope. Latham has produced an exemplar of what happens when anyone holds a camera. Students suddenly looking for interesting details to document that if the camera was missing the average student would walk by in their own world not noting the item, as observed by Latham and during my study.
Study Basis

Learning Theory, and Learning Engagement

The basis of this study falls to learning theory, and learning engagement.

“Theories show that through varied stimulus students learn more detail and have a higher engagement. Visual studies literature reveals connections between image-based elicitation techniques and traditional literacy skills” (Hibbing & Rankin-Erickson, 2003 p. 768). My goal is to show with technology integration that can be achieved to higher levels than through standard look, see, and reflect approach.

This study is a documentation of how well students learn via digital imagery. The question suggests that with few guidelines and some technical training, students will interface to environment and environmental education in a more meaningful way; thus creating an exemplar for outdoor education. “Natural spaces and materials stimulate children’s limitless imaginations, and serve as the medium of inventiveness and creativity.” (Louv, Richard, 2007 p. 1) quoting Robin Moore, an international authority on the design of environments for children's play, learning, and education.

Initially, the study planned to have participating students go into the field, the students will document what they see, and how they see the environment via digital imagery to be used for later class projects and further analysis at a later date. The goal of the study is to illustrate that the use of technology will benefit the learning outcomes, and engage the students to a greater degree. Through the use of technology and excitement in the opportunities they can visualize
Current Challenges to Environmental Education

It is horrifying that we have to fight our own government to save the environment. - Ansel Adams

Environmental Education [EE] currently is facing a battle within the public educational system. The high stakes testing and constant pushing has tightened the curriculum. The push at the high school level is to include more items in the same amount of time. This follows the inch deep mile wide approach to learning. We are teaching student to know a small amount about many things. This prepared them for the standardized tests and the academic world, but does not give the student the depth and connectedness of the concepts. Each concept is intrinsically linked to the other, but the current educational model of seven to nine concepts in a day separated by minutes to pass does not facilitate deep conceptual learning, it is the antiquated factory model from the 1920’s when public education became compulsory. (Martina, 2009)

The idea of taking a moment to literally smell the flowers can be frowned upon, even stopped due to outstanding issues of liability. Teachers often fear taking a child outdoors due to liability, “Mr. Bambino suggested a policy under which a school board or superintendent must sign off on excursions that involve serious risks, such as a canoeing trip.” (Lenckus, 2007 p. 30) Along with injury issues there is the issue of lost time. The time spent for outdoor education is looked at as extracurricular, thus it takes away from other subjects educational time. This not only makes it harder for the staff but the student
as well, because the student has to make up missed time with other teachers to be in the field learning the current system of public schools. (Slingsby, 2006) Another issue is the comfort level of the educator. When staff members are asked if they want to bring their isolated class along, every time the researchers experience the staff members respectfully decline. One could conclude this to be more related to the staff member’s own feelings regarding the outdoors. These observations are mirrored by Perry and Clark’s study of Risk assessment and geography teachers: a survey (2004 p. 127)

“95% of respondents strongly agree/agreed that geography teachers are increasingly concerned about the threat of legal action arising from pupil injuries/complaints on field trips, 3% were undecided and 2% disagreed with the statement and Teachers are deterred from organizing trips because of the fear of legal action 62% of respondents strongly agreed that geography teachers are increasingly deterred from organizing field trips because of the threat of legal action, 21% were undecided and 15% disagreed with the statement. If any one of these items present themselves the trip to visit the natural areas are canceled.”

Ecophobia

To that end, one can look at today’s youth and see a generation that lock themselves in the home and fear the outdoors and what it may or may not hold for them. Ecophobia, coined by David Sobel, has become the norm instead of the exception in this day and age in most urban areas. In some areas the outside is
dangerous but as on health care worker stated “The mothers need to take back the streets…” (Marr, 2009)

McCarthey states that a generation seems to be lost to the screen. Many youngsters have more screen time that outdoor time. There are many factors that led to this, but opportunity and knowledge of the outdoors are deciding mechanisms.

Today, youngsters are not itching to go outside. They are stuck indoors, plugged in to cable TV, DVDs, high-speed Internet access, and electronic games. Even if a child wants to go out, the cars drive too fast and no one wants to let their kids out of their sight for safety sake. In many ways, our sense of community is confined to our homes, schools and places of worship. (McCarthy 2007, p. 1)

This very idea needs to be addressed by the public across the world; too many feel that nature is a place of danger. This trend needs to be stopped before we have alienated a generation or more of what nature truly is a place of beauty to be respected and treasured.

It is clear, that if we fail to get our children back outside and fail to have them reconnect with nature, our society as well as our children, will suffer. Show me a generation of adults that did not experience the wonders of nature firsthand when they were young, and I will show you taxpayers and voters who will not care about preserving open space, maintaining
biodiversity, keeping the air and water clean, maintaining our forest and parks, and keeping our land free from pollution. (McCarthy, 2007 p. 2-3)

One of the best ways to share nature is to show it to all students. Even those students that most teachers would leave behind for behavior other reasons benefit from being outdoors. It has been shown through various means that outdoor education aids in the self esteem and benefits special needs students in health and self awareness. (Luckner, 1987)

“Photos can capture children’s interests and passions and show these in ways even words cannot. These pictures help validate for kids what they see as important and help them become active, involved learners in our classroom. … Children construct meaning when they see their photographs. Their work is intensely personal and authentic.” (Dragan, 2008, p. 15)

This study will exploit that cognitive interest and passion to help students find their voice, their wisdom of place and time via the image. When students create images, they become theirs; it is their view of nature and the environment. In the classroom the study will utilize these photos for further study of the natural area. The student will utilize the camera documenting the world around them to spread the image and message of natural beauty. The student will be able to reflect on it through the future, and project what may happen in the future. The photos become their point of reference for their collective memory. Once an item becomes part of the collective memory system it can be discussed.
EE is not just something elite, mystical, or dangerous; it is what the public knows.

(Coser, 1992)
CHAPTER THREE

METHODOLOGY

Chapter three will define the parameters of the case study and the methodology comparing this study to the Svinickio outlined six primary caveats for learning later summarized by Garcia-Barbosa (1998 p. 1) in his model. This will be done by defining what a case study is and how it applies to in this instance; define the study group; and the chapter will further define terms involved in the study.

My thesis is that with technology integration i.e. cameras that student created images will aid in student learning objectives and allow the student a greater understanding through repeated exposure via the images.

The study will be done with a case study approach of three groups on five occasions. A case study as defined by Colorado State University is:

“A collection and presentation of detailed information about a particular participant or small group, frequently including the accounts of subjects themselves. A form of qualitative descriptive research, the case study looks intensely at an individual or small participant pool, drawing conclusions only about that participant or group and only in that specific context. Researchers do not focus on the discovery of a universal, generalizable truth, nor do they typically look for cause-effect relationships; instead, emphasis is placed on exploration and description.” (Bronwyn, 2010, p. 1)
The study groups follow as defined; they are small representative samples from mainstream public schools in two states over three years time. The participants of the study self reported their findings via the cameras.

Description of study groups:

<table>
<thead>
<tr>
<th>Date of Visit</th>
<th>Study Group</th>
<th>Location</th>
<th>Number of Students</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2006</td>
<td>Group One</td>
<td>DeForest, WI</td>
<td>17</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>January 2007</td>
<td>Group One</td>
<td>DeForest, WI</td>
<td>17</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>May 2007</td>
<td>Group One</td>
<td>Deforest, WI</td>
<td>17</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>July 2007</td>
<td>Group Two</td>
<td>Deforest, WI</td>
<td>12</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>May 2009</td>
<td>Group Three</td>
<td>Robbinsdale, MN</td>
<td>25</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 2: Description of study groups

The first group of students tested was of varied ability levels. A Survey Biology class, this is a specialized biology course for kids that need hands on experiences, it is co-taught with a special education teacher. Two thousand seven’s special education specialty was Speech and Language. Group one contains a mix of students with the following IEP labels: LD, CD, ADHD, argumentative disorders, hearing impaired, and sensory problems. The staff had unique challenges. This group was taken to the natural area a total of three separate times. This group of students historically had been left behind or not included with other trips to the area due to their academic and behavioral standing.
The second group was a summer school class that had on semester of biology in a compressed format (67 contact hours) to meet the needs of a remedial course. They too have a host of factors that led them to be in this class. Factors that may be present are poor performance, lack of attention to detail or personal conflict with the classroom teacher. They were a cross section of the lower academically performing students.

The third group observed, IB Biology was given free choice to use cameras or not for a self determined animal behavior project. Of the 20 students in the class 10 chose to make a camera an intrinsic part of the study by choice. The remainder when asked what would they have done is they were to redo the study would have used cameras to highlight behaviors.

Defining ideas for the study are the tools used for this study. The tools needed are based in technology and environmental learning. The criterion for use of these items is that students identify with the technology and it excites them about learning by using a tool that they are familiar with in some way.

**Defining Terms:**

**Digital camera:** a tool to document the surroundings with greater detail and more clarity than anecdotal observations.

**Natural area:** Is any wild, managed wild natural, or naturally designed area that is accessible by all students, it can be as simple as a park or as small as a flower bed.
**Field Research:** Is any research that occurs out of doors in a natural area.

**Pro Scope:** Is a hand held digital field microscope that when connected to a laptop computer will serve as a working digital outpost to record micro and macroscopic life forms and structures.

**Methodology**

1. "The information must be deemed as important by the learner". (Garcia-Barbosa, 1998 p. 1)
   - If the learner takes the photo they at some point and some level have found something that has sparked an interest and gain importance via the task.

2. "During learning learners act in ways that make the concepts more meaningful to them personally". (Garcia-Barbosa, 1998 p. 1)
   - If the learner captured the image, the image has ownership, and this the details catered in said image.

3. "Items learned are shifted in to long term memory by linking them to a pre existing memory". (Garcia-Barbosa, 1998 p. 1)
   - If the student makes the memory by taking the photo, when the student re-examines that same photo they will revisit that moment in their memory.
4. “Learners will continuously check and recheck information with previous ideas shaping and changing them based on new and old information.” (Garcia-Barbosa, 1998 p. 1)

- Then photo allows the educator to dispel any misinformation and allow the student to self guided research. Thus the student will be allowed to form their own knowledge base linked to the images they created.

5. *Transfer of information is not automated, it comes from repeated exposure.*

(Garcia-Barbosa, 1998 p. 1)

- The photo allows for the experience to be relived again and again for the student to comprehend it at the student's own pace.

6. *Learners are more apt to learn if they are aware of how they learn best and have the ability to choose methods that work well for them.* (Garcia-Barbosa, 1998 p. 1)

- The photo creation and documentation method allows the learner to access the information via imagery and textual information as well as aural learning through guided instruction based on the photo.

**Study variables:**

One variable of the study is the learning of EE concepts, and the depth of learning about the environment.

Other variables that may affect the learning process
• Pre existing knowledge (will be pre tested) of environmental concepts.

• How receptive student group is to learning about the environment.

• Student knowledge of technology, its uses, and the ability to use it to capture images for scientific purposes.

• Comfort with nature and natural areas. Self reported and observed by the student, and shown by their behavior while in the natural areas.

Field tools:

• Magnifying glass, grid Petri dish, ruler, 10x loop, notebook, pencil, bird, plant and insect keys, binoculars.

Cameras:

• Point and shoot digital camera with standard media, and a Pro-scope and laptop for collecting data on macro invertebrates.

Testing:

• Pre and post test on concepts and attitudes about the natural world and direct observable items that would be seen on site.

• On site activities, and photographic proof of those items. (see appendices C-J)

• Depth of learning to be determined by conceptual type questions based of the AP environmental test that are linked to the type of site visited

• Engagement to be measured like time on task study.
• Outcome based learning to be based on product based assignment to be completed by all students in the study group
CHAPTER FIVE

Conclusion

Reflection

I look back on the process of the study and find many of my original thoughts still hold true. The camera is a valuable tool to permit students to use multimodal skills to expand their learning and to lengthen the contact time with the outdoor classroom via imagery. Although I found very little literature that states how cameras can be used in the classroom by students, I know from antidotal experiences that most schools have cameras for various purposes. This fact alone can make one think that cameras are one of the most underutilized tools in the teacher’s arsenal of learning aids. Many times the teacher would like to record the work of the students for publication, but teachers do not have students in most classrooms become publishers.

The second premise of my study is to leave the site intact after students have used the site for educational purposes. The study site used has over 2000 students per year visit it from the local school system. If traditional (pick and pressing) gathering practices are used by all the students, the small site would be depleted of seed stock and its viability would be compromised. By utilizing photography, the pictures maintain the integrity of the site and teach greater commitment to the conservation efforts through modeling sound practices.
The study and the thesis helped students grasp and internalize concepts. When the students were asked to self report their understanding, they were able to describe in detail several environmental concepts. When the students were tested, the students gained greater understanding and appreciation for the natural world and were able to share that knowledge via objective testing. This was illustrated not only by their behaviors in the field but also by the way the students became engrossed in what the tasks during post trip assignments. The students left the continual peer testing and social hierarchy back at school and made the natural world their place, a place that the students can show and share with others via their photography without judgment or prejudices. A majority of the participants shared their photos with other classroom teachers and shared the experience to other classmates that in turn learned from them.

Literature review

As the literature states a student learns best with varied modality. My thesis, as proposed, illustrates several different mechanisms from simple observation, to evaluation reaching all learning modalities. Every student has strengths and every student has best practices that suit their learning style. Teachers are charged with the responsibility to seek out the best for the students. When one examines this paper, one can see it provides data supporting that via the camera, the experiential learner allowed for student guided research and repeated exposure to concepts via modification of the photos. A student will internalize the concepts and ideas showing greater understanding over other
presentation method that do not involve student lead and student centered instruction. More learning goals are able to be achieved by lengthening the field trip experience.

In this paper, the researcher discussed place based schooling at length. I think small community education should be the model that all should strive towards. School is only as strong as the community that supports it and makes the walls come to life with the dreams of the students. The school can be a warehouse. As long as the people within the school care and strive for the success of the student, learning will take place. The place base school has the benefit of location, but all schools can make this happen. They need only the will to make high level learning occur.

Implications:

The idea that the time afield can be used for further study is not new, but the means and the ease that digital camera allows us is. The student has immediate feedback and immediate results that they may use at a later date for a myriad of lessons. The leaders in the schools must take note that the pressures of the curriculum must be met in a multi-disciplinary approach. But to be valid for the student, it must be grounded in ideas the student knows and understands. The student understands the new technology. It is time we embraced it as an educational entity. Digital cameras are not just for the hands of the teacher but for the student too. Each student is bombarded with images all day long, i.e, advertisements, screen time, and educational screen time. Although this may add to
that time in front of a screen, we must remember it is the quality of the time not the quantity.

The photo as a means of communication is well established, the idea that students create the images is still not part of the norm. The budgetary responsibility for schools and organizations lie in the cost of the equipment, the cameras and computers to allow for manipulation. Most organizations already have computers in place. So that leaves the cameras. As with any technology, the cost for better equipment is reduced as the next generation becomes available. The cost is relative to the quality and quantity purchased. The decision makers for each organization need to make the decision to embrace the new technology that permeates the youth culture.

Limitations

The study group was limited to small groups of at risk students and a group of high achieving students. The researcher was not teaching 40 students alone in a classroom, nor was this their first time seeing a tree or a woods. The areas were primarily sprawling Midwestern suburbs, with a smattering of farms. The socio-economic class varied slightly, but not to the extreme ranges. The student population was diverse ethnically, but primarily Caucasian.

From studies done by students, the population in the area exploded in the 1980-90s. Old farm land was converted into neighborhoods. Some even spoke of losing “their woods” to homes. So these students were not afraid of lions in the grass or crocs in the river. They were aware of the dangers and prepped to be in the woods. Some of the
students had pre-existing outdoor experiences. Does this information negate the study? I think not, because real learning still took place. Even if they knew nothing in the woods or the grass would harm them, the students knew little prior to the trip about the dynamics and the endemic details that one can only find in a wild area. I believe the results could be duplicated in any school if the student to teacher ratio was correct for the group of learners, and the class had been prepped for being in the wild areas.

**Recommended future research**

The researcher would recommend further research to be performed on a larger scale. This study was limited in scale and scope to locations to areas where the researcher was an instructor. Although there were five trips and three locations, the study was by no means all inclusive and all reaching. The researcher did have the benefit of site. One would like to see the study performed in all areas of the country and all socioeconomic strata.

Minnesota Department of Natural Resources, Non-Game Division has developed a program, Digital Photography Bridge to Nature, that will loan out education camera kits for schools via a grant. Its development will allow for every school in Minnesota to re-create my study and weigh in with their findings. The trunks were developed during a parallel time of this study but unconnected and unrelated until this document was near publication when the researcher and the grant developer discussed implications for both parties. They found that the projects although unrelated fit together like a key and lock set, for further information on Digital Photography Bridge to Nature, contact
carrol.henderson@dnr.state.mn.us. At the time of publication of this document the DPBN was hiring a staff to manage the project.

Communication

The researcher plans to speak about the coordinators of Wet, Wild, PLT, and education coordinators for the state of Minnesota and share my findings with the hope that some of these activities may be added to future publications. He would also like to present these ideas at regional and state environmental conferences, NSTA, either in person or via a proxy once the document is published. The document in full will be available at the Hamline Library and at the CGEE offices. Further preparation and editing may occur if the demand is warranted to produce a marketable text of the same information.

Closing comments

The case study illustrates the need to apply student knowledge to environmental learning. The days of every student catching an insect collection, or picking and pressing rare plants are past. Often times the natural areas are limited, and visited so often by hundreds of students that if old techniques were followed, the site would be lost.

Technology is one opportunity the educational world can embrace to a greater extent to make learning authentic and original for each student. The images are proof of what the student saw and will aid in the learning process by taking the learning for the field in to the classroom for further study.
Authors note

I hope you have enjoyed the context of the previous pages. I am a teacher. Like any other teacher, I work every day to empower the next generation to make sound judgments through practical processes. My goal in doing this paper was originally simple, and via the writing process, was shown to be more complex. But, I do believe I stayed true to the premise: do no harm and have fun learning...

If you have any questions, please feel free to contact me. Via Northeyblog@gmail.com.

Both the grand and the intimate aspects of nature can be revealed in the expressive photograph.

Both can stir enduring affirmations and discoveries, and can surely help the spectator in his search for identification with the vast world of natural beauty and the wonder surrounding him.

– (Adams, 1960)
Appendix A

Pictures closely linked to written or spoken text can, when compared to text alone, markedly increase attention to and recall of health education information. Pictures can also improve comprehension when they show relationships among ideas or when they show spatial relationships. … Educators should: (1) ask “how can I use pictures to support key points?”, (2) minimize distracting details in pictures, (3) use simple language in conjunction with pictures, (4) closely link pictures to text and/or captions, (5) include people from the intended audience in designing pictures, (6) have health professionals plan the pictures, not artists, and (7) evaluate pictures’ effects by comparing response to materials with and without pictures.

(a) complex cognitive skills such as reflection and critical thinking; (b) an ability to apply knowledge to practical problems encountered in one's vocation, family, or other areas of life; an understanding and appreciation of human differences; (d) practical competence skills (e.g., decision making, conflict resolution); and (e) a coherent integrated sense of identity, self-esteem, confidence, integrity, aesthetic sensibilities, and civic responsibility. The Student Learning Project was initiated by ACPA President Charles Schroeder in the fall of 1993 by convening a small group of higher education leaders to examine how student affairs educators could enhance student learning and personal development. The group included Alexander Astin, Helen Astin, Paul Bloland, K. Patricia Cross, James Hurst, George Kuh, Theodore Marchese, Elizabeth Nuss, Ernest Pascarella, Anne Pruitt, Michael Rooney, and Charles Schroeder. Following a three day retreat in Colorado, a version of this document was submitted by George Kuh to spark discussion at the 1994 ACPA meeting in Indianapolis. This is a revised version of the original draft informed by comments and suggestions made at the Indianapolis meeting, and continuing dialogue since in various forms and forums.

© 1996 by the American College Personnel Association. All rights reserved.
Appendix B

September 8, 2008

The Honorable George Miller
2205 Rayburn House Office Building
Washington, DC 20515

The Honorable Buck McKeon
2351 Rayburn House Office Building
Washington, DC 20515

Dear Congressmen Miller and McKeon:

The undersigned education groups, representing millions of Americans, would like to express our support for the No Child Left Inside Act (H.R. 3036). We thank you for backing this important legislation to help states enhance the quality of their environmental education programs.

No Child Left Behind has produced many unintended consequences for students, parents and educators across the country. One of the most detrimental has been a narrowing of the curriculum, as schools are forced to spend more and more learning time preparing for high-stakes testing. This trend is most exaggerated in the schools of our poorest communities. At the same time, our country is facing a host of complicated environmental challenges, which are well documented in the media, which will require our citizenry to be more educated about our personal and civic choices than ever before. The No Child Left Inside Act is an important answer to both of these challenges.

Our groups strongly support providing rich, challenging, authentic environmental education experiences to all children. To reach this goal, teachers and schools systems must be provided with greater authority, flexibility, and support to incorporate environmental education into core subject areas.

It is important to note that the Act does not create any new mandates or requirements for states. To be eligible for new environmental education funding, states would be required to develop plans to ensure that all of their students are environmentally literate.

We strongly believe that educators must be given the training, the tools, and the time to incorporate environmental education meaningfully. Additionally, states in partnership with local school systems and other stakeholders must develop plans to ensure that all children are provided the learning experiences they need to become environmentally literate. The NCLI Act will help allow that to happen.
Again, we thank you for your leadership and look forward to continuing to work with you on these very important issues.

Sincerely,

American Association of University Women
American School Counselor Association
National Education Association
National Middle School Association
National Science Teachers Association

Appendix C

Subject and Grade Level: Biology

Overview: This mini-unit that will explore how plants, animals, and people cope with the harsh winter.

Purpose: To make students aware of the wonderful adaptations that plants and animals have for surviving the winter months.

Objectives:
- Same as purpose,
- Students will learn skills that will be useful to them when they are out of doors during the winter.

Resources/Materials: Internet, books, video evidence, firsthand experience

Activity and Procedures:
- **Activity#1:**
  - How to plants and animals deal with the cold?
  - Have students get in groups and brainstorm how different types of plants and animals deal with the winter here.
  - Have a class discussion on what the groups came up with.
  - Create a lesson to share with students (slides, notes, pictures, etc) on adaptations to snow and cold.
  - Migration vs. Hibernation vs. Resistance Different resistance strategies.
- **Activity #2:**
  1. Go outside and collect arthropods from under the bark.
  2. Bring back to class and classify as best we can.

Assessment: Students will give a brief presentation plus submit a 3 page paper for review after peer editing. One week from the assigned date.

Appendix D

Setting Up a Study Plot

**Purpose**

To set up a study plot and determine the coverage by native versus non-native (alien) species.

**Research Questions**

Are there plant invaders at the Big Hill? If so, how much area do they cover?

**Materials**

For the class (to share)

- 2 survey-type measuring tapes

For each team of two students

- one stake
- one ruler
- clipboard
- grid paper
- blank paper
Marking Off the Plot

1) Set up your plot area, 30 cm on each side.

2) Tell the teacher what number is on your stake, and be sure she marks her map to show where your plot is.

3) Have the teacher or the Photographer take a photo of your plot with your name in the picture.

"Map" the Plot (a.k.a. Collect the Data)

You have a paper with a graph or grid marked on it. Each square on the grid represents cm of the plot. Label each side of the graph with directional labels (north, south, east and west).

4) Select a plant to begin with. Count the number of plants that look exactly like it. Chart your plant on the next page.

7) Place a number inside the coverage area to identify this plant. On a separate piece of paper keep a list of the plant number, the name of the plant, and an accurate description of how the plant looks. If you do not know the name of the plant, just write a description of it using the characteristics we talked about in class (leaf shape, size, etc.), then you can review and compare data later in class.

8) This is very important. It will be used later to calculate the percent the of native plants versus the number by alien plants.

9) Repeat steps 4-8 until all the plants in the plot have been counted and identified.

Clean Up

10) All strings must be removed before we leave.

11) No trash of any kind may be left!" (-;
Appendix E

**Who Lives Here?**

**Aquatic or Terrestrial Wildlife Identification Activity**

**Grades:** Any

**Group Size:** Any

**Location:** Inside Classroom/ In the field

**Length:** 20-35 minutes, depending on number of stations

**Materials Needed**

Choose animals that are common to your area, examples of some animals may include: deer, musk rat, song birds, fish, ducks, herons, bats, snakes, turtles, and frogs.

Information for animals: 1) tracks sheet or poster, 2) feathers or study skins (furs) (photos of), 3) skulls, 4) pictures of nesting sites or deer yards, 5) food samples (plastic fish, acorns, wild rice, cat tails, plastic frogs etc.), 7) scat samples (photos), 8) related items such as a wood duck nesting box. For the discussion of habitat, assorted slides, pictures of aquatic wildlife species and life history information. (See your local, state, or federal wildlife biologists for some of these materials, or local sportsmen's groups)

**Description**

One of the reasons for keeping our area free of pollutants and available to others is to maintain habitat for important wildlife species. Students will collect photo clues about animals that live in habitats.

**Objective**

Students will identify and learn about various wildlife species through a hands-on, group exercise and subsequent slide presentation.

**The Activity**

1. Begin with a brief discussion on the importance of wild animal habitats. Then explain the activity they will be doing.

2. Set up 5 stations in the classroom or assign areas each representing a particular animal species. At each station include clues about each animal such as:

- a copy of the track the animal makes,
- a photo sample of its main food source,
- a clue as to where it lives (possibly a picture of its home or some of the building materials),
- a photo of skull, or other evidence
- a study skin (only partially exposed through a sealed envelope so only a portion of the back fur is visible) if available.
3. Have the students split up into groups and give each group a handout to record the clues and their determination as to what animal the clues represent. Have them rotate through the stations or habitats so that each group has an opportunity to identify each animal. Ten to 15 minutes per station should be adequate.

4. After the students have completed the rotation, ask each group to provide their answer for Station One. After they provide their answer and give their reasoning, show one or two slides of the animal the station represents and provide a few tidbits of life history information on the animal. If no group has come up with the correct answer, continue to give a few more hints until they identify the animal. Do this for all stations.

If you have time after this part of the activity is completed, show additional slides, and/or study skins, mounted specimens, etc. of other aquatic species, which were not part of the exercise. Have the older student share their experience preparing each station for the younger students.

Adapted from:

Bill LaFlamme
Bureau of Land and Water Quality
Maine Department of Environmental Protection
Station #17
Augusta, ME 04333

Author's note: Adapted from: In the activity that I did at the 1998 Southern Maine Children's Water Festival I used a beaver, a muskrat, an otter, a mink and a wood duck for the identification part of the activity. I was fortunate to have feathers and study skins to use. I cut a hole in a manila envelope; then placed each of the skins in the envelope so that a small portion of back fur protruded. This way, the animal could not be easily identified by the fur alone. I included track samples and/or food samples at each site. In addition to the slides identifying the animals in the slide show I included slides of a Canada Goose, a loon, a mallard, and a painted turtle. Each student also got to take home a copy of an animal tracks handout.

Northey notes: I have changed many of the real items to photos collected by students to use with younger students. This activity was redesigned to have my HS students pre teach to 4 grade students prior to going to the natural site they use their photos and each group of two students given one animal station. Photos are a more ecologically sound choice for the site due to limited size and number of students using the site.
Appendix F

Protist Lab

Background:

The Protist Kingdom is made up of a variety of unicellular organisms, which are sometimes referred to as protozoans or algae. Some of these one-celled organisms are capable of making their own food by photosynthesis. Others have developed methods of ingesting food by means of specialized organelles. (Some protists make their own food and eat other food.) Protists have a variety of appearances and methods of locomotion.

Materials:

Cultures of: Ameba, Paramecium, Euglena, and other assorted Protists, these culutes can be purchased or from a local source (pond); microscopes, slides, cover slips, droppers, and methyl cellulose

Special Note:

This lab is made up of Four Main Sections, which can be done in any order. In order to avoid extra waiting time, it is a good idea to not work on the same section of the lab that other groups near you are doing. You may begin with any of the four sections.

Section I:

The Ameba (large; colorless; no definite shape; move slowly by pseudopods)

a. Look up the word pseudopod, and define it in your own words:

1. Allow the teacher to place an ameba on a slide for you. (This may take a few minutes, so please be patient.)

2. Find the ameba under low power and observe it. Reduce the light by adjusting the diaphragm. (You may want to use medium power so that the ameba fills up a large portion of the field of view. This will depend on the size of the ameba that you are observing.) Watch the ameba for signs of movement.
3. Sketch the ameba in the first circle below. Wait about one minute, then sketch it again in the second circle. Wait again, then carefully draw the ameba in the third circle.

4. The ameba’s contractile vacuole appears as a clear circle. Look at your ameba and try to find what looks like a small bubble inside.

5. To eat, an ameba uses its pseudopods to trap and engulf food. When it has eaten, a food vacuole is formed. Look at the ameba in the microscope, and try to find a vacuole with material inside. (Do not confuse it with the nucleus, which is the largest dark object in the ameba.)

6. Return the slide with the ameba to your teacher.
Section II:

The Paramecium (medium size; clear; slipper-shaped; move quickly by cilia)

a. **Look up the word ciliation, and define it in your own words:**

1. Use the dropper in the paramecium culture to get a drop of “scum” out of the container, and place it on a microscope slide.

   Add one drop of methyl cellulose on top of the paramecium (this is a “syrup” to slow down the organisms). Place a cover slip on top of the mixture. *(may be done by teacher)*

2. Find a paramecium under low power and observe it.
   - Then, change to medium power to see the details of the paramecium better.
   - Reduce the light by adjusting the diaphragm. You may need to move the slide to keep the paramecium in the field of view.

3. Carefully draw the paramecium in the circle to the right.

b. **Look up contractile vacuole, and define it in your own words:**

4. The paramecium’s contractile vacuoles appears as star shaped structures at each end. Try to find the contractile vacuoles in your specimen. **Label them in your drawing**

5. To eat, a paramecium collects food in its oral groove. When it has eaten, a food vacuole is formed. Look at the paramecium in the microscope, and try to find a vacuole with material inside. *(Do not confuse it with the nucleus, which is the largest dark object in the paramecium.)*

d. **On your drawing of the paramecium, label the following: cilia, nucleus, cell membrane, cytoplasm, contractile vacuole and food vacuole.**

Section III:

The Euglena (small; green; oval; move quickly by flagellum)

a. **Look up the word flagellum and define it in your own words:**
1. Use the dropper in the euglena culture to get a drop out of the container, and place it on a microscope slide. Place a cover slip on top of the drop.

2. Find euglena under low power and observe them. Shift to high power, and get a closer look.

3. Carefully draw a few euglena in the circle to the right.

b. **Look up chloroplast, and define it in your own words:**

4. The euglenas’ chloroplasts appear as green objects inside the cells. Euglenas make their own food by photosynthesis, but may also eat if they choose to.

c. **On your drawing of the euglena, label: flagellum, nucleus, cell membrane, & cytoplasm.**

**Part IV Various Protists**

1. Use the dropper in the euglena culture to get a drop out of the container, and place it on a microscope slide. Place a cover slip on top of the drop.

2. Find organisms under low power and observe them. Shift to high power, and get a closer look.

3. Carefully draw one organism in each of the circle below. Label all structures you can identify.

Appendix G

Microscopic / Macroscopic Photo Illustration Cross Curricular Integration in Science

Name: Sam Northey

Unit Integration Title: Photo Illustration

Grade Level(s): 9 -12

Unit Integration Objectives:

- Students will have a clear understanding of visually presented materials.
- Students will clearly understand how to perform dissections.
- Students will clearly understand what to be visualizing through their microscopes.
- Students will create a photo essay, montage of macro/micro invertebrates.
- Students will inquire about the visual representation of the macro and microscopic world around them.
- Students will collect images of items while in the living laboratory then return the item to its native habitat, thus persevering and respecting the ecosystem. The students will become stewards of their eco areas.

Wisconsin Technological Academic Standard(s) Being Addressed:

Not all of these standards will be met on any one project, but through continued integration the standards will be met through time and effort. The standards may not be assessed in a formal matter for the “standard” but the end product will represent the completion of a skill or process. The student will realize the standard from continued manipulation of images and data for research, presentation, and peer review. The Pro scope will allow for greater depth of understanding in all of these areas.

A.12.2 Identify and use common media formats
- describe the common organizational patterns in different types of print media
- demonstrate how to import and export text, graphic, and sound files

A.12.3 Use a computer and productivity software to organize and create information
- use an integrated program or applications suite to complete a class assignment
- manipulate graphics objects in a word processing program (e.g., select, move, modify, delete, duplicate, arrange)
- use desktop publishing and graphics software to produce page layouts in different formats (e.g., brochure, tri-fold, newsletter)

A.12.5 Use media and technology to create and present information
- use draw, paint, graphics, or presentation software to visually communicate ideas or concepts
- produce a multimedia program using text, graphics, moving images, and sound

A.12.6 Evaluate the use of media and technology in a production or presentation
- assess the purpose and effectiveness of a production or presentation
- judge how well the production or presentation meets specified criteria
- specify ways to improve future productions or presentation

C.12.1 Pursue information related to various dimensions of personal well-being and academic success
- identify topics of interest and seek relevant information about them
- recognize that accurate and complete information is essential to sound decisions in personal, academic, and career pursuits

C.12.2 Appreciate and derive meaning from literature and other creative expressions of information

C.12.3 Develop competence and selectivity in reading, listening, and viewing
- choose materials at appropriate developmental levels
- identify and select materials that reflect diverse perspectives
• evaluate how words, images, sounds, and illustrations are constructed to convey specific messages, viewpoints, and values to shape attitudes and influence action

C.12.4 Demonstrate self-motivation and increasing responsibility for their learning
• make decisions about group and classroom projects and learning objectives
• identify topics for independent study to meet individual learning needs and interests
• develop and apply criteria for judging success of learning projects
• evaluate progress and quality of personal learning
• articulate personal goals in pursuit of individual interests, academic requirements, and career paths

D.12.1 Participate productively in workgroups or other collaborative learning environments
• collaborate with others to design and develop information products and solutions
• incorporate effective group processes and shared decision-making in project development
• complete specific projects within a timeline and budget
• critique completed projects and workgroup processes for future improvement

D.12.2 Use information, media, and technology in a responsible manner
• return all borrowed materials on time
• demonstrate use of the Internet and other resources consistent with acceptable use policies
• identify and define consequences of violations to the school's policies on media and technology use
• recognize the need for privacy of certain data files or documents

Activities:
• Student will collect and manipulate images within various applications; principally Power point, Word, and Logger Pro documents.
• Students will visualize items too small to see with the unaided eye.
• Students will be active participants in their learning, choosing and evaluating photographic evidence of their given project.
• Students will utilize instructional presentations done by the facilitator to complete labs and activities with more skill.

Resources:
• Vernier Pro Scope HR Biology Kit. Vernier software, Laptop computer, projector, microscope, dissecting scope, various biological samples, dissecting specimens, digital cameras, necessary cables, interfaces, and storage media.

Assessment:
• The assessments will be in the increased understanding of materials, instructions, and the world around them, via photographic enhancement. This will be measured by several curricular assessment methods in place, and new ones created to reflect the new opportunities offered through the equipment.
• A non-formal discussion on stewardship regarding the natural world and our role in preservation of that world for other students, and the future. Then while in the field, assign stewards to assure all living material is returned to its point of origin.
• Power Point presentations integrating the specialized equipment thus allowing the student to appreciate a greater understanding; via Power Point rubric, (a base rubric that is modified to meet the assignment needs, included below.)
Modifications/Enrichments:

- All material will be modified to meet the class needs per IEP, and/or add modifications not yet noted in the official file to protect the safety of students and equipment.
- All items can and will be adapted to meet the needs of the students specific to the class set that year, and activities as they present themselves, e.g. a student brings in an item to identify.

RUBRIC FOR POWERPOINT PRESENTATIONS

NAME: ______________________

KNOWLEDGE: 4 3 2 1 0
Shows an understanding of the material
Able to answer questions

PHOTOGRAPHIC CONTENT: 4 3 2 1 0
Photos are appropriate
Photos are properly credited
Photos are used in a way that enhances presentation

LENGTH: 4 3 2 1 0
Long enough to adequately cover assigned material

CONTENT: 4 3 2 1 0
Topic covered thoroughly
Enough information given to understand topic
Did not exclude any important information or include any unnecessary information

DESIGN: 4 3 2 1 0
Very creative
Easy to see and follow
Did not include any unnecessary graphics

HANDS-ON ACTIVITY: 4 3 2 1 0
Included class in the learning process
Did more than lecture to the class

TOTAL _______

23-24 A
21-22 B
18-20 C
16-17 D
0-15 F
Lab 2: Bio assessment

Problem:
What do stream organisms tell us about the water quality of a water source?
Are there more organisms found in riffle areas than in pools?

Overview: This activity allows students to monitor the water quality of Gravel Run using benthic macro-invertebrates (small animals) as indicators of the quality. Students will compare areas of the Crawfish / Menasha watershed and Rock Lake. They will be Identifying and counting organisms using traditional and on-line dichotomous key. They will use the data to both assess water quality and to compare riffle and pool areas of the stream. (above, below, and down river)

Background Information
The Structure of Streams
We all know that a stream has flowing water. As the water moves downhill, it winds its way through the land. In places it is deep; in others it can be very shallow. In areas where the water is either very shallow or the stream very narrow, the water moves very quickly. We call this the riffle area. This is like putting your thumb over a hose with flowing water. The slow-moving water will speed up to get out the smaller opening.
In other areas where the stream is wide or deep, the water moves very slowly. These pools provide a very different habitat for organisms. One of the things you are going to be asked to think about is how different these habitats are for the macro invertebrates

Macro invertebrates
In testing water quality by chemical and physical means; we see what the stream is like on a particular day. Even better indicators of water quality are the small bottom dwelling organisms that live in the stream. These are called benthic macro invertebrates (benthic = bottom dwelling; macro = large enough to see with the eye; invertebrates = animals without a backbone). They consist of the immature insects, crustaceans, worms, and mollusks that inhabit the moving waters of a stream. All breathe oxygen and feed from the water.
Much of what you see will be insect larvae, immature insects. As adults, many like the fly, mosquito, and dragonfly fly around, breathing air, but in their immature form, they are all aquatic organisms.
Some of the macro invertebrates are pollution tolerant; this means that they are hardy and can adapt to live in even polluted waters. A leech is an example. If
you found a stream with only leeches, you would know that the water was so polluted that only leeches could survive. Other organisms are pollution sensitive; this means that if the water changes even slightly due to pollution, these will not be able to survive. A stonefly is pollution sensitive; if we find one in our stream, we know that the stream is extremely healthy all year, not just the day we are observing it.

We are going to sample which macro invertebrates are found in our stream, and these will tell us a lot about the health of the stream. Coal miners years ago used to carry a small bird into the mine with them. If the bird became ill, the miner got out of the mine quickly. Smaller organisms will be affected by an environmental change sooner; so the canary was like an air pollution alarm. Macro invertebrates are thus our water pollution alarm system.

QUESTIONS:
1. Which area had the greatest diversity?
2. How would you explain these results based on your knowledge of a stream?
3. How would we rate the stream based on the Biotic Index?
4. Why are the macro invertebrates important to the stream ecosystem?
5. Was our experiment comparing the two areas a fair test? Why or why not?
6. Suggest another experiment that we might do to study macro invertebrates.

### BIOTIC INDEX CALCULATION WORKSHEET

\[
A \times B = C
\]

<table>
<thead>
<tr>
<th>Species</th>
<th>Pollution Tolerance Value</th>
<th>Number Found</th>
<th>Total Tolerance Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayfly</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dragonfly</td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Damselfly</td>
<td>7.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stonefly</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insect Type</td>
<td>Tolerance Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>True bug (boatman)</td>
<td>4.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dobsonfly/ Alderfly</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water beetle</td>
<td>4.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caddis fly</td>
<td>2.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>True fly</td>
<td>5.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midge</td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black fly</td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crane fly</td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planarian</td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earthworm</td>
<td>8.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leech</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snail</td>
<td>7.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopod (sow bug)</td>
<td>8.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amphipod (scud)</td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SUM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Biotic Index for Sample =** \( \frac{\text{Sum of Total Tolerance Values}}{\text{Sum of the Number Found}} \)
# Biotic Index Interpretation

<table>
<thead>
<tr>
<th>Biotic Index</th>
<th>Water Quality</th>
<th>Degree of Organic Pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3.75</td>
<td>Excellent</td>
<td>Organic pollution unlikely</td>
</tr>
<tr>
<td>3.76 - 5.0</td>
<td>Good</td>
<td>Some organic pollution</td>
</tr>
<tr>
<td>5.1 - 6.5</td>
<td>Fair</td>
<td>Substantial pollution likely</td>
</tr>
<tr>
<td>6.6 - 10.0</td>
<td>Poor</td>
<td>Severe organic pollution likely</td>
</tr>
</tbody>
</table>

Resources Needed:

<table>
<thead>
<tr>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereo scopes</td>
</tr>
<tr>
<td>magnifiers</td>
</tr>
<tr>
<td>Microscopes</td>
</tr>
<tr>
<td>ID guides</td>
</tr>
<tr>
<td>Micro pipette</td>
</tr>
<tr>
<td>Trays/ dishes</td>
</tr>
<tr>
<td>Internet Use Macro invertebrate Identification Key</td>
</tr>
<tr>
<td>Traditional Macro invertebrate key</td>
</tr>
</tbody>
</table>

xxviii
Lesson 2: Bio assessment

Overview: This activity allows students to monitor the water quality of Gravel Run using benthic macro invertebrates as indicators of the quality. Students will prepare bags of leaf litter, which will be immersed in several areas in Gravel Run. The bags will be collected and organisms identified using an online dichotomous key. They will use the data to both assess water quality and to compare riffle and pool areas of the stream.

Outcomes/Indicators:

**Life Science Outcome**

Students will use scientific skill and processes to explain the dynamic nature of living things, their interactions, and the results from the interactions that occur over time.

**Indicators:**

3.5 Explain that food, water, and air provide molecules that serve as building materials and supply energy for all organisms.

**Environmental Science Outcome**

Students will use scientific skills and processes to explain the interactions of environmental factors (living and non-living) and analyze their impact from a local to a global perspective.

**Indicators:** 6.1 Identify and explain the interdependency of organisms within the environment in a given ecosystem (i.e., producer/consumer, predator/prey, host/parasite).

6.2 Analyze how human activities can accelerate or magnify many naturally occurring changes (i.e., erosion, air and water quality, populations).

**Skills and Processes Outcome**

Students will demonstrate the thinking and acting inherent in the practice of science.

1.1. Scientific Inquiry
1.1.1 Access and process information from readings and investigations.

1.1.2 Formulate questions that lead to the development of a testable hypothesis.

1.1.3 Use observations, research, and select appropriate scientific information to form predictions and hypotheses.

1.1.4 Recognize well-designed procedures that identify the independent and dependent variables, the need for control when testing a factor, the importance of multiple trials, the selection of appropriate materials/equipment, and the development of clear, logical directions within an investigation.

1.1.6 Collect, organize, and display data in ways others can verify (i.e., numbers, statistics, tables, graphs, drawings, charts, diagrams) using appropriate instruments.

1.1.8 Interpret and communicate findings (i.e., writing and drawing) in a form suited to the purpose and audience, using developmentally appropriate methods including technology tools and telecommunications.

1.2. Critical Thinking

1.2.4 Provide supporting evidence when forming conclusions, devising a plan, or solving a practical problem.

1.2.5 Analyze and extend patterns.

1.4. Technology

1.4.2 Demonstrate and explain that tools are essential to scientific investigation for such purposes as to observe, estimate, measure, compute, collect, and communicate scientific data and information (i.e., size, distance, motion).

Performance Objective: Students will:

- inventory the benthic macro invertebrates in a stream and will evaluate the water quality of the stream based on the species collected.

- statistically compare the data collected from 2 different stream areas: riffle and pool.

- analyze the control of variables in an experiment.
Suggested Time: 2 hours

Resources Needed: leaf packs and bags, magnifiers, identification guides, trays/Petri dishes, strainers/sieves, kick seine, brushes, plastic spoons, stereomicroscope, Excel Spreadsheet
Appendix I
Activity Title: GET IN TOUCH WITH TREES! Activity Guide
Page #: 5

Objective(s): Students will:
1) become aware of how the bark of different trees varies in texture;
2) describe a variety of textures found in leaves and other tree parts.

Overview: In this activity students will explore their sense of touch and discover why touch is important to animals, including themselves.

Subject Area(s): Science, Language Arts, Visual Arts Grade Level(s): PreK-6

Standard
Performance Indicators
(by grade clusters)
Evidence of alignment (text from activity description)
Notes to ensure high alignment for every student
Science and Technology
K. Scientific Reasoning
Students will learn to formulate and justify ideas and to make informed decisions.
3. Make observations.

Part A #4
The blindfolded student should examine the tree’s bark, and if possible, its leaves and other features. Tell them to pay close attention to the differences and similarities between the two trees, and how they got there

Part B #1
Feel as many of the items as possible. Then have students search for “tree parts” that match those in the mystery box. Each student should participate as the guide and with the blindfold.

This was augmented by using ear plugs as well to reduce the amount of audio cues. Just like one of the students turning off their hearing aid.
Appendix J

Time Stands still for nothing:

Grade Level 9-12

Subjects Addressed: Biology, history, climatology, and mathematics

Concepts: plant growth and environmental factors, manmade or natural depending on the sample

Skills: Observation, Problem solving, self reflection, cause and effect, determination of cause, team building, working with and among others to a common goal

Materials: large tree slab(s), pins, internet access, access to history texts.

Time considerations: 2-4 45 min periods depending on depth of investigation.

Objective:

1. Students will research rainfall trends.
2. Students will analyze tree growth, and determine factors that may have affected the growth.
3. Students will gain an understanding of the life cycle length of a tree, and how it compares to that of a human.

Assessment Opportunities:

1. There are several that can be as simple topical incites ot as deep as linking historical evidence to greater evidence of ongoing change. It can be as light or details as you may like.

The lesson starts with a personal time line of the students’ life. The note their birth, important events, current time, while correlating it with recent history.

Next the student would go to the giant tree cookie (crosscut oak slab ~200 years old).

The students will mark in some fashion (pin) their birthday on the slab, noting the small portion of the trees life they occupy. Next the students will count the rings of the slab marking notable dates in history. Eventually, the students as a class will research a time line of the tree, noting events, wars, presidents, building of schools, and founding of the town.

I did this activity both in the classroom and in the field it has more power.
Part two of this lesson is denrochronology (the study of tree rings). The students will next access the internet to seek out rain fall trends for the area where the tree grew. The students will correlate years of drought or excess rain to the actual rings, determining patterns. The students will then discuss with in groups and compare results among groups to come to a consensus on the years and the resulting rings.

For the students that need a further challenge, have them determine there are trends or patterns in the lean or excess years, are they occurring more often? Less? Is the climate becoming dryer? What are some reasons for the changes?
REFERENCES


Basil the Great (329-380), Retrieved July 30, 2009
http://www.stthomas.edu/recycle/steward.htm


Brower, Kenneth, (2002). Ansel Adams at 100 The photographer would not have been pleased by this new retrospective The Atlantic Monthly | July/August


Green, Jonathan compiled by: (1982). Morrow's International Dictionary of Contemporary Quotations, Published by W. Morrow (New York)


Accessed:
http://ezproxy.hamline.edu:2374/ehost/detail?vid=29&hid=13&sid=52aabe10-1cfa-4396-881b-
ba8ce25a52cf%40sessionmgr14&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=buh&AN=25654804


http://www.orionmagazine.org/index.php/articles/article/240/


Marr, Janet. (2009). Interview Inner City attitudes with a head start nurse serving Minneapolis & St Paul Head Start Centers for the past 12 years. Conducted Nov 2009


Obama, Barak. (2009). Speech to Department of Interior Staff March 3, 2009 Retrieved on Dec 29 from:
http://www.leavenochildinside.com/news/detail/obama_emphasizes_connections_with_nature_in_speech


Rivard, N. (2004). Freeze frame affordable and easy to use, digital cameras are helping educators boost curriculum. District Administration, 40(3), 55-56 and 65.


http://www.themadisoninstitute.org/Education.htm


CHAPTER FOUR
RESULTS
A Case Study Approach

The following case studies highlight the trips to natural sites and the photographs taken at the respective sites. Each trip had its own dynamic interaction between the students and the natural world, as the reader will see. The students used the cameras to communicate their findings, and their queries by bringing them back to the classroom to process, and use for varied assignments.

Case Study One
Description of study group:
The first group of students tested were of varied ability levels. The title of the class is Survey Biology, a specialized biology course. It is designed for students that need hands on experiences, co-taught with a special education teacher. This year the special education specialist was speech and language. This group contains, but is not limited to students with the following special needs labels: CD, ADHD, argumentative disorders, hearing impaired, and/or sensory
problems. There were unique challenges.

The first study group was in Deforest, Wisconsin 2006, Figure 2. This group was taken to the natural area three separate times. The first was in the fall (October), the second was in the winter (Late January), and the last was in the early spring (Early May). Historically, this group of students had been left behind or not included with other trips to the area due to their academic and/or behavioral standing.

Visit One (Fall)

Pre Visit

The students had been prepped for the day in the field. We (the teaching staff, another teacher, a student teacher, and myself) had explained that this trip would be the first of three visits to the school forest site. The students were excited. The energy in the

Figure 3. This student was an avid outdoorsman and this trip was a moment of pride for him since he could act, (and look like) a wildlife guide to the rest of the class. He had little success in normal academic class work without a great deal of support.

Figure 4. This is just one of the many photos of fall prairie flowers that were keyed by the students later (an aster specie)
room was amazing. The student group was often under represented on field trips due to behavioral issues or other impediments, Figure 1 and 3. The students were allowed time to become familiar with the equipment. The students were taking in each of the packs. Each student pack contained a map of the site, one digital camera (Sony Mavica), 10 disks, a pair of binoculars, loops and magnifiers, small plastic bags, a net, an emergency rain poncho for each (garbage bag), a bird key, plant key, and in some packs a mammal key, and pond life keys. As for supplies, on site we have three pairs of waders and two of deep water tubes. The students pre-loaded the packs for their groups, and decided how they planned to

Figure 5. The students really began to see and observe the natural areas around them

Figure 6. Even the smallest of insects were found and recorded then returned back to the environment

Figure 7. We moved in to a scrub bush area and a student found the deer bone site, it became an hour long photo shoot. The students shot images of the site like they had seen on CSI. Then once the site was recorded they began to examine and photograph the items individually.
proceed through the site.

Day In The Field One

The field day came and the students met in the biology room with all the supplies. The students and staff boarded the bus, and were off to the site. Some students were playing with the cameras; some brought their own camera. All were excited.

We arrived in a few minutes later the students debussed, and went to the site’s shelter. The students began the day by becoming familiar with the tools of the day. Students were using the loops to look at their hand and dirt in the hand lens. Then a few students explored the equipment shed. We then reconnoitered the basic ideas and reiterated the rules of the day: One. Stay will you buddy. Two. Leave only tracks, take only pictures. We began our initial survey walk of the trail; this was the students’
first time on the site, so the students knew the limits of the site and the space. I pointed out the various landmarks and gave the students the boundaries. The students followed me out into the small prairie area and observing (Figures 4-7). As we progressed, these photos were taken. One individual in the group appointed herself historian. She later used the photos in a creative story for her history class. Each of the students soon fell into roles of a community, spotter (Figure 5), historian, leader, and the one person who hung back studying the situation. Each person took their role without incident. All had respect for the space, each other, and followed in the footsteps of the person in the lead. After getting the student acclimated, they were left to explore the trail and split into groups. Each group found different items; the students were very good about sharing the discoveries. The only direction I
gave them was to find evidence of life (Figure 6), scat, (Figure 10) feathers, tracks, and evidence of death, or a kill site. The students did a great job. The photos speak volumes regarding what they saw. One great item of interest was the deer kill site (Figures 7-9). The bones were bleached and clean of any debris. As the students picked up the bones, small decomposers fled. The students became enthralled. The group that discovered the site called the others to join, and they questioned how the deer died. Each group hypothe-

Figure 12. The fungus colony. With cameras even the smallest details can be looked at later and researched by the student.

Above: Figure 13. The bark chips yielded many organisms, pill bugs by the hundreds were found at this site.

Right: Figure 14. Earthworms also were of interest by the students as we had just dissected them in
sized theories based on the location, time, and broken bones. Each of the student groups defended their theory; after much discussion, it was determined that we could not definitively tell what happened.

Then the groups split up. Several went into the woods, and the remaining students went to the water (Figure 11). The groups each explored, paying attention to detail, and looking for another death site for investigation. The woods group began to take photos of scat, small insects, even tracks. The students dug in to dirt mounds, and piles of bark chips (Figures 12-14). Each instance, the student became engrossed in discovery. The students were seeing evidence of life all around them. The camera gave each student a voice of proof of

Figure 15. Maple seeds illustrated dispersion. This student thought they were the greatest thing as the helicopters fell around her.

Figure 16. The quest to see what lives in the mud.

Figure 17. The waders, getting there footing before walking around the pond.
items seen, a way to ask questions, and a method of reflection.

The groups each took turns exploring the two ponds on site, due to limited resources (waders). One set explored the deep pond while the other explored the muddy pond. The students had great fun donning the waders and stepping in a world they never would explore. The waders offered instant protection from “the sea weed and icky stuff” (DeForest study group female student, 2007). They worked collec-
tively dipping the nets, looking at the items in the nets, and photographing what was found. The students did take a small sample of aquatic invertebrates to place in a fish tank to monitor in class. The pond was an area the students enjoyed greatly. I was told later by one student that this was the first time he had been on water due to his fear (Figure 20). He did not know how to swim. This is the first time many had a chance to freely examine nature (Figure 15-16) without the built-in structures of formal education: worksheets and reading. This day of discovery gave them a chance to document individual interests. Some of the groups highlighted plant life, while others looked at light dappled through the woods.

Post Trip

The following week, we gathered as a group to examine the images. In the background, I downloaded them to a common drive that all students in my
class could access at school. The students went to the computer lab and began to look at the pictures as seen here (Figures 18-21). Each of the students found their disks and began to look at the views others. They saw and asked each other questions about the origins of the images (Figures 26-28). Their first assignment was to identify five images down to the specie of what they saw. The next assignment was to make a power point using the images to illustrate one of the areas of the school forest, prairie, oak savanna, northern hardwood forest, or wetlands area. The students worked a week on these two projects in the classroom. This repetition extended the experience for each of the stu-

Figure 28. A student using the reverse periscope. It is a tube designed to allow the student a close look at the bottom without swimming or disturbing it, while magnifying and illuminating the bottom if needed.

Figure 27. The tick, several students found them, for several this was a first time seeing them.
students, allowing them to share the ideas with others in the class. This aspect of peer to peer teaching alone made the investment worth while. The cameras allowed the students to more easily recall and explain details related to their observations without exaggeration. The students were able to speak to each other more accurately about the topic at hand. As the students utilized the photos, they began to see some simple trends, how different organisms are interdependent, how most animals made there way to the water source, and how many animals followed the same trails. The students saw the environment as a whole because the photos gave them time to process their perceptions. The process was similar to the process of putting a puzzle together, each photo being one piece.
Visit Two (Winter)

Pre Visit

The next visit was very similar. Only the season changed; the next experience was in January. The student were prepared by telling them to dress for the weather (Figure 22). Many of the students had to acquire some extra clothes to make this possible. The staff worked with the social workers and counseling staff to make sure all the members of the group had the right attire. In addition, a road kill deer was placed on the site by county workers. The road kill was placed 13 days prior to the field day. The same items were packed as the last trip. The preparation for the students in class was the similar. One extra tool was an ice borer to use for aquatic studies.

The students were asked to make predictions of what they would see, or how it would feel to be in

Figure 31-35 The images above depict the many taken that day showing how little of the animal was left after 13 days on the edge of a wooded area.

Figure 36 & 37 Although these signs recorded by students show the deer population is alive and well.
the woods in January. Many of the students believed that they would see nothing due to the chilly weather. They stated they would snow, ice, and no evidence of life.

Day In The Field Two

The bus came, and we loaded up. We debussed and arrived at the site. The students still had little hope, until one saw a hawk take flight off of a tree around the prairie and circle, looking for its next meal. The groups set off into the woods looking for the first deer bone site. We found it just as we left it, minus small changes in the bone where rodents had chewed. Then as we approached the trails in the woods, the students began to note tracks, scat (Figure 32 & 33) and even hair. The hair was identified as deer by one of the students, and confirmed by another, both of them deer hunters. (The expert status they took as deer hunters and outdoorsman was one of the dew times those students had academic success.) Then there was an in-depth discussion about whether or not hunting was allowed on the site. I responded with the hunting contingency agreement of the land donation to the school and city. The only people allowed to hunt are the
descendants of the donators. This information disappointed the deer hunters in the group, but they understood. The students dispersed. They were now familiar with the boundaries of the site. They were left to explore on their own, finding many signs and tracks of different animals.

We all met at the pond later to do aquatic study. In the winter this was done by drilling through the ice. (Figure 29 & 30) First the instructor (myself) went on the ice to assure the safety of the students. A sample hole was bored to show the student how the tool worked and to see how thick the ice was. Upon determining it to be six inches thick, the students were let on Figure 40. Remnants of a raccoon.

Figure 41. The students took to hear the ability walk they tried hard to determine how to navigate with out a sense of sight.

Figure 42. While walking one group found this and many other grass snakes emerging from their hibernation and out sunning on the warming prairie.
the ice to bore and explore the pond. They were to take water samples, temperatures at depth, and produce a depth map of the pond. The latter was done by boring several holes in rows at regular intervals creating a grid of the pond.

Then the students were to measure depth and look for signs of life in the water. Many thought life in the water was in vain due to the ice and cold, but became very excited as they found more and more invertebrates as the holes were drilled. The students seemed to enjoy the study because they were able to investigate the pond in winter (Figure 25).

I asked them all to meet at the deer road kill site at 11:00. We walked in on the trail looking for where the deer was placed after being on the roadside for two days in sub-zero weather (Figure 31-35). The deer had been placed by a survey pole as a reference site. The students
were to treat the area like a crime scene, not walking over existing tracks, accounting for all of their tracks. The goal was to determine the origin and type of the animals that visited the road kill site. The students became very interested and took several photos of the remains and how much was scavenged by predators and scavengers over the 13 day period. All that remained was some bone, skin and a small amount of flesh. They were amazed how far and wide the remains were spread by the animals that fed at the kill site. The site had been spread over one hundred and twenty feet from the...
dump site, and in three directions: to the water, to the woods, and into the corn along the fence line. The site was covered with evidence of many animals.

Post Trip

As before, we spent the next week in the computer lab looking at the photo evidence of what we found. The students used the photos to produce a crime scene report with their theories of what animal decimated the road kill deer. (figure 51) The presentations were on target for the student ability level. The biology learning goals addressed were: related to career exploration; the roles of decomposers; scavengers in the ecosystem; and using evidence to defend a scientific position were all met via this assignment and subsequent presentations. The students all embraced this assignment since it mirrored the popular TV dramas.

Visit Three (Spring)

Pre Visit

The spring visit was similar to the first two visits; the goal of the day was to

Figure 50. On the way back to school after an exhausting field day.

Figure 51 Students using the photos and the computers to identify what they took pictures of, and to complete the report on their study plot.
note the difference between the other two visits. In the meantime, there was a pre-
scribed burn on the prairie completed by the local fire department. The pre-trip was
much easier than the first two. By this time, the students were acclimated to all the
equipment and the tools to examine the world around them. On this trip, the students
were asked to focus on one area of the site looking for evidence of life (Figure 40) and
to look for things that may have changed in the area. The assignment goal was a Phre-
nology of the site. The students would return to document past areas, kill sites and to
note the differences.

Day In The Field Three

The students debussed and immediately began to move through the site as di-
rected. The groups split up. The teachers monitored the groups making sure they were
on task. The students were very focused. They found the rebirth aspect of spring to be
interesting and refreshing (Figure 44). Many of the students found evidence of new life
in the plant and animal signs of spring. They realized the growth and the rejuvenation
of spring, especially since the prescribed burn appeared to kill all the grass. The roots
pushed the blades forward. They noted new growth and bursting buds. The students
went back to both deer sites looking for evidence of further predation, and evidence of
any other road kill that made it into the school forest (US Highway 51 and US Highway
19 are both less than one mile from the school forest.)

With all the debris removed due to the prescribed burn, the students did a sen-
sory activity (Figure 41) where one or more senses were removed. The students were
given the choice to go blindfolded, and or use earplugs. They were given the choice to participate as much as their comfort level allowed. Most of the students blindfolded themselves and had their buddy lead them around. The students found that senses of touch and hearing became very important, as well as, trust in the guide. The students that chose to lose both explained that simple movements became difficult and nearly impossible without the guide, even if they stayed on the developed trails.

**Case Study Group Two**

The second group of students was a summer school class at De Forest, Wisconsin. They were remediating one semester of biology in a compressed format (67 contact hours) to meet the parameters of a biological science course. They had a host of factors that led them to this class, they represented a cross section of the lower academically performing students, each having distinct personalities and challenging needs. These students, due to the compressed curriculum, only had one visit to the school forest site. They were given the same pre-visit prep, and they had the same tools and packs.

The class was bussed to the site. The summer school administrator and myself were the staff. The summer session was the hottest (ninety degrees Fahrenheit) visit to the site. They found many of the early summer flowers in bloom. This group took the least amount of time on the site due to environmental factors (mosquitoes and heat), but they still found the camera a useful tool to capture the images and create documentation of the day. However, there was one slight change in the pack. Each stu-
dent was given a lanyard with a loop, and a ruler on the same lanyard gave the photos scale. (Figure 46 & 47) This worked out well, as previous classes had some trouble keying plant material. The ruler in the photo aided this task for the case study.

Two students found new death sites: a woodchuck and a raccoon. Although, the water was the area of greatest interest. (Figure 48) Many of the students suggested jumping in until leaches were found in the samples. The summer group also cataloged the most insect life, this was most likely due to the season. The students used plastic bags to temporarily hold the insects and display it while photographing it through the plastic. (Figure 49) The insect was netted, placed in a large plastic bag, then separated into a smaller bag and held in place by pulling the bag tight over the insect. Once the insect was immobilized in a position to be photographed, it was released unharmed. This method proved to be efficient and non-harmful for the insect allowing detailed study of each organism via the images and the direct observation.

The summer groups then returned to the classroom to identify all the plants in their study plots. (see appendix D) The students followed the guide to key and count the plants in their study plot, as guided by the worksheet. The activity allowed the students research and ask questions. The ability to reflect and use the information gathered in a short time over the following days.

**Case Study Group Three**

The students were International Baccalaureate Biology students from
Cooper High School in MN, a colleague’s class. The task was a self-determined animal behavior study to be done on their own time. They were to report the findings to the class and myself on a specified day. The students were given the directions and parameters of what was needed for the assignment. They were told they could use cameras if they’d like, or they could take notes and report their findings.

Presentation Day

Each of the groups stood up and presented as expected. Looking at the results in terms of grades and understanding, all found that they had under-estimated the amount of time it would take to observe natural behaviors among animals native to an urban/suburban landscape. When asked if they were to do another study like this, would they use photography, and how so? Most stated they would take more photos to help communicate their findings. Others said they would use photos to establish a behavior, and to identify individual subjects in their studies. I have included scanned documents in the appendix to explain, in their own words, their conclusions.

The students that were able to use photography had a better understanding of animal behavior and how the animals interacted with the environment due to the ability to reflect and compare their findings with standards used by professionals. The groups that used photos were able to recall ten facts for every photo. The students that used photography had contextual proof of what they saw and were not questioned by their peers about how or what they saw in the context of their research.

In contrast, students who did not use photography struggled to recall study data
for the behaviors they witnessed. The students without photos utilized notes, but had trouble recalling details of the site.

Data Table: Depicting student groups. 

The results on the surface may seem qualitative, but through repeated trials with different types of students in different situations, the results are definitive. Even though time had to be allocated to train students how to use the camera, the payoff in terms of scientific inquiry was tremendous. The students demonstrated a higher comfort level as seen by the table above.

Trials one through three were the same group of students on the same site as described above in the case studies. Trial four was a single visit by a summer school course that were told that they needed to complete various projects for the fast paced class. Trial five was the unguided group that were not told to, or not to take photos as stated previously. There was a notable frequency of photos used and a correlation of understanding as seen by the presentations as compared to students that were able to look back with photos.