

**Rethinking Environmental Education Curriculum: Will an
Age Appropriate Environmental Education Unit have a
Positive Impact on Students' Receptivity to Science?**

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Introduction

“In the end, we conserve only what we love. We will love only what we understand. We will understand only what we are taught.”

It is in these simple words, spoken by the Senegalese poet Baba Diuom, where the argument for the continuation and expanse of environmental education can be found. Internationally, environmental education has been helping individuals and groups come to understand and ameliorate environmental degradation such as habitat destruction, air and water pollution, desertification, biodiversity loss, sedimentation, and over-fishing. In the United States, while environmental education is nevertheless seen as an imperative element in the crusade to protect and conserve the environment, it is still an entirely insufficient, inconsistent, and scattered presence in the traditional school atmosphere (Hungerford, 2003). In other words, environmental education has been without a distinct niche, where it can be most effective and efficient in educating citizens to understand, appreciate and attend to the environment and its associated problems.

With kindergarten through twelve grade school curriculums already overloaded (Chen, 1997), a move to incorporate environmental education into formal school subjects has received varying resistance. This has been especially difficult, due to the argument that the complex nature of the subject requires it to be taught throughout the entire schooling career, along a continuum from early childhood to the adult years, to develop a proficient ‘environmental literacy.’ However, providing adequate funding and making specific space for a new formal class in environmental education at every level of schooling seems practically impossible considering the current challenges stressing educational institutions in the United States today.

Presently, the most notable stressor upon schools is the national 'No Child Left Behind' Act. Now in the act's second year, schools face the predicament of insuring math and reading skills of all students from every race are up to the acceptable levels, decided by the government's assessment exam. In addition, under the act, schools must report to surrounding communities, the 'quality' level of their teachers; while the term 'quality' is mostly measured by certification, thus forcing schools to recruit only educators with this qualification.

After the first year of national assessments under 'No Child Left Behind,' schools on average are facing bleak results. Locally, one third of all Providence schools are of the category 'in need of improvement,' (Macris, 2003). The nation's schools have until the school year 2013/14 to achieve a 'proficient' level of achievement in reading and math, but if the schools fail to reach this goal, they will face nationally mandated solutions to their educational 'problems.' With this increasing pressure, schools feel the necessity to teach for the national assessment exams (Rado and Little, 2003). Thus, attempting to encourage educators and school administrators to adopt sweeping environmental education into their schools, presents serious difficulties.

If environmental education is to flourish in future educational domains, it is essential that it be infused within the traditional academic subjects, ensuring educators that it will aid in student's receptivity to learning and not take more time away from the already overloaded curricula. In consideration of the present stressors on the nation's school systems, and the challenges facing teachers, it is the ultimate goal of this research to investigate the feasibility of integrating an experimental environmental education unit into the niche of a traditional elementary level science curriculum.

The Roots of Environmental Education and Literacy

While the particular niche for environmental education has always been debated, the fundamental goal of environmental education has remained relatively the same: to produce a global citizenry with the knowledge, concern, motivation and skills to tackle existing environmental problems and to aid in the prevention of further environmental degradation. In other words, a citizenry that is, 'environmentally literate.'

Since Charles Roth first conceived the term in 1968, 'environmental literacy' has received national and international attention within the fields of environmental policy and especially, environmental education. Due to the extensive interest in this idea, many researchers and policy makers have determined their own definitions of environmental literacy but still, there is not a single distinct definition. With that understood, for the purposes of this research I have broadly defined environmental literacy as: the knowledge and understanding of earth systems, effects of man's influence on the earth, how an individual's or groups actions can either harm or help the environment, and the ability to grasp problems facing the environment which involve scientific concepts and uncertainty, in addition to political, economic and ethical considerations.

After his initial work in 1969, Charles Roth split his fundamental definition of environmental literacy into three categories. In doing so, he wished to provide an environmental literacy 'proficiency continuum,' which he hoped would allow educators and policy makers to more easily plan goals and objectives in environmental education.

Roth (qtd. in Moseley: 1) defines these categories, within which, the population progresses numerically towards a final environmental literacy, as (1991):

1. Nominal Environmental Literacy- the ability to recognize many of the basic terms used in communicating about the environment and to provide a rough working definition of their meanings.
2. Functional Environmental Literacy- the capacity to use fundamental environmental knowledge, concepts and thinking skills to formulate action positions on particular environmental issues and in daily behavior.
3. Operational Environmental Literacy- the capacity to regularly perceive environmental issues; gather and evaluate pertinent information; examine and choose among alternatives; take positions and actions that work to sustain and develop the foundation of environmental knowledge; and use elements of questioning, analytical and deductive reasoning, logical thought processes, and objective analysis.

The brief history of environmental education has been entwined with the concept of environmental literacy in the public sphere since President Richard Nixon first spoke on the topics in his Environmental Message to Congress in 1970. In his message Nixon stated, "It is vital that our entire society develop a new understanding and a new awareness of man's relation to his environment- what might be called 'environmental literacy.' This will require the development and teaching of environmental concepts at every point in the educational process."

In that same year, President Nixon signed into Public Law, the first National Environmental Education Act authorizing the creation of the office of Environmental Education and the National Advisory Council for Environmental Education. While this was an important first step in publicizing the importance of environmental education, the act said nothing to describe a suitable place for environmental education within this country's educational structure. In addition the goals of environmental education had not been defined explicitly, and a starting point for environmental education was nowhere to be found.

This began to change in 1972, when environmental education reached the international sphere during the United Nations Conference on the Human Environment in Stockholm, Sweden. At this meeting, Recommendation 96 described environmental education as a means to address worldwide environmental crises. Three years later, the Belgrade Charter was published by the United Nations Educational, Scientific and Cultural Organization (UNESCO), reflecting on Recommendation 96, and roughly began to outline the basic structure and goals of Environmental Education.

Environmental Education Lacks Clear Direction

The guiding principles and framework of environmental education were not delineated until the first intergovernmental conference on environmental education convened in Tbilisi, Georgia (USSR) in 1977, under the organization of UNESCO in cooperation with the U.N. Environment Program (UNEP). The Tbilisi Declaration organized three main goals of environmental education:

1. To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;
2. To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
3. To create new patterns of behavior of individuals, groups, and society as a whole towards the environment.

Tbilisi also endorsed twelve principles and divided the objectives of environmental education into five categories including: Awareness, Knowledge, Attitude, Skill and Participation (UNESCO, 1977). The declaration gave direction to the field of environmental education, where there had previously been little.

According to the North American Association for Environmental Education (NAAEE), the programs and activities subsequently created after the Belgrade Charter and the Tbilisi Declaration, “lacked a clear direction, were inconsistent or failed to achieve the goals set forth” by the international conferences. In an attempt to correct the failings of such environmental education programs, Harold Hungerford et al, published the paper, “Goals for Curriculum Development in Environmental Education,” in which he developed a four level framework as a guide for creating environmental education curricula compatible with the Tbilisi Declaration. The four levels included: 1. Ecological Foundations, 2. Conceptual Awareness, 3. Investigation and Evaluation, and 4. Environmental Action Skills. Hungerford’s levels finally established a practical structure to environmental education, making it easier for curricula planners and educators to improve upon the existing course of environmental education.

The Present State of Environmental Education in the United States

Since the first mention of environmental education and literacy in the late nineteen sixties, numerous organizations supporting the proliferation of environmental education have developed. The Council for Environmental Education, NAAEE, the Environmental Literacy Council and the National Environmental Education and Training Foundation are among the most notable and influential. Many of these organizations have developed environmental education curricula that have received acclaim around the country. To better understand the current state of environmental education, the strengths, weaknesses, and the ongoing problem of how to better integrate environmental education into the traditional school atmosphere, it is necessary to examine how and in what context

environmental education is being taught in this country, and to investigate some of the most-widely used environmental education curricula.

Teaching the Environment in the Classroom

In a 2001 study entitled, “Environmental Studies in the K- 12 Classroom: A Teacher’s View,” researchers from the NAAEE surveyed a random sample of all K-12 teachers in the United States. 1,505 teachers responded to 3,900 mailed surveys. Of this population, 61.2% responded that they include environmental topics in their classrooms. The teachers of K-4 grades were most likely to teach environmental topics and as the grade level being taught rose, less environmental education was included. Another important finding of this study was the range of materials the respondents used in their environmental teaching. 79.1% of surveyed educators stated that they used textbooks to supply their environmental education material. K-4 teachers were most likely to rely on libraries as a primary source to attain their environmental education materials, in contrast to teachers of higher grades who relied heavily on textbooks, newspapers and groups/agencies. The respondents stated that they used materials from many varying suppliers; however they reported that the most useful materials were supplied by educational groups, commercial suppliers and governmental natural resource/environmental management agencies.

Another finding reported that of the teachers who included environmental education into their classes, the vast majority (70%) spent less than 50 hours per year on environmental topics. The study also reported the subjects taught by each of the respondents. Of all teachers (not including those that teach the same students all day) 118

were science teachers, and of these, 108 incorporated environmental topics into their curriculum (McKrea et al, 2000). This finding was consistent with other research citing the relationships between environmental education and science education (Dillon et al, 2002). Despite limitations of this study, ranging from poor survey response numbers to bias within the actual responses, it is the first large-scale attempt at understanding the present state of environmental education in the U.S.

Weaknesses of Environmental Education Today

In 1997, a highly controversial report by the Independent Commission on Environmental Education (ICEE) was published by the George C. Marshall Institute. The study was conducted due to the increasing national concern over the state of science education in the U.S. The report stated that outdoor environmental education had consistently been an excellent approach in making science come alive for young students, and could possibly be an effective tool in elevating the achievements of science education (Salmon, 2000).

The study reviewed approximately 100 widely used and recommended environmental education materials, investigating whether or not they presented an accurate state of scientific knowledge. The ICEE issued ten findings in result of their study. Notably:

- Environmental education materials often fail to prepare students to deal with controversial environmental issues.
- Factual errors are common in many environmental education materials and textbooks.
- Environmental education materials often do not provide a framework for progressive building of knowledge.
- Teachers are the key to successful environmental education, but the materials often fail to give them the support they need.

In addition to the findings the ICEE stated nine recommendations necessary for the further implementation of environmental education. These recommendations call for more detailed reviews of environmental education materials and curricula in addition to these three classroom/school recommendations, (Salmon, 2000):

- Environmental educators should place primary emphasis on the acquisition of knowledge.
- Students in the lower elementary grades should begin the study of science with the study of the natural world.
- Schools should consider teaching environmental education as an upper-level multi disciplinary capstone course integrating what students have learned in science, social science and other upper-level courses.

The ICEE concluded the study in support of the infusion of environmental education into traditional curriculum by stating (1997),

The commissioners are aware that introducing environmental education into the curriculum can reduce the time available for teaching basic subjects. It believes, however, that teaching about the environment, if based on rigorous standards, can be an enhancement to, rather than a diversion from the basics.

Strengths of Existing Environmental Education Programs

The ICEE did not have completely negative results on all environmental education materials. Several very widely used and respected materials demonstrated the highest standard of excellence, covering topics with depth and precision, according to review of the ICEE (1997) and the *Guidelines for Excellence* (1993), by the NAAEE. Of these praised materials, I wish to highlight two, to provide examples of curriculum currently in extensive use: Project Learning Tree by the American Forest Foundation and

Project WILD by the Californian Department of Fish and Game. Both of these curriculum are conceptually based.

Project Learning Tree was first developed in 1976 and is an interdisciplinary environmental education curriculum focusing on the forest. The curriculum encourages the growth of environmental literacy and integrates science, language arts, social studies, art, music and physical education. The curriculum's strengths, as reviewed under the NAAEE guidelines, include:

- Activities promote a sense of personal stake in the environment and the effects of action
- Layout and format are excellent and easy to use. Objectives and concepts covered are easy to identify.
- Wide variety of concepts presented in various contexts and settings.

One of the barriers with PLT remains: to receive guides for the curriculum, you must attend a workshop. However, there are PLT state coordinators in almost every state and the workshops are relatively well distributed.

Project WILD focuses on wildlife and habitats, integrating Science, Social Studies, Language Arts, Math and Art. It is an interdisciplinary curriculum, drawing on and emphasizing skills from a variety of subject areas. This curriculum has also been reviewed by the NAAEE, which listed these strengths:

- Covers a lot of ground with regard to environmental and ecological concepts and issues.
- Encourages students to think about stewardship and personal ethics.
- Material is usually presented in an unbiased fashion
- Good hands on, physically active activities.

Like PLT, the main weakness of Project WILD is the necessity to attend a workshop to acquire the materials. Each of these curricula allows for much flexibility in

how it is used, increasing the likelihood that it will be utilized on a wide-scale basis by educators who wish to incorporate environmental information into their lesson plans.

The ICEE had been concerned with the state of science education in the U.S and viewed environmental education as a possible method for increasing learner receptivity and excitement towards science. With its *Guidelines for Excellence*, the NAAEE (1993) had explicit goals of providing an easy-to-use database of effective environmental education materials, thus spreading the teaching of environmental education. The two organizations have separate goals that can be summarized by: establishing education as the method to equip the nation's students with the knowledge, ability and interest in the utilization of science and technology to tackle complex international environmental problems. This is best stated by Project 2061(1993), in *Science for All Americans*:

Science education- meaning education in science, mathematics, and technology- should help students to develop the understandings and habits of mind they need to become compassionate human beings able to think for themselves and to face life head on. It should equip them also to participate thoughtfully with fellow citizens in building and protecting a society that is open, decent, and vital... There is more at stake however, than individual self-fulfillment and the immediate national interest of the United States. The most serious problems that humans now face are global: unchecked population growth in many parts of the world, acid rain, the shrinking of tropical rain forests and other great sources of species diversity, the pollution of the environment, disease... What the future holds in store for individual human beings, the nation and the world, depends largely on the wisdom with which humans use science and technology.

Goal of Research:

After review of the foundations of environmental education and literacy, it is apparent that the over-arching goal of environmental education is to produce a nation of 'environmentally literate' citizens, concerned with alleviating current environmental

problems and preventing further environmental degradation. Investigating the history of environmental education since 1970, demonstrates that the persistent problem within environmental education has been the lack of a specific niche within the formal academic framework (Chen, 1997). Therefore I studied these central questions: Can an age appropriate environmental education unit be effectively molded within the niche of a traditional science course to enhance the student's overall receptivity to science? And if it can, does this provide a strong argument for the infusion of environmental education into overall science education, thus giving it a place within our national academic agenda?

Methodology

Methodology Overview: To address the questions outlined above, I developed an age-appropriate environmental education unit based on concepts of biodiversity, habitats and food chains, to teach within 5th and 6th grade science class contexts. Infusing the environmental concepts within a broader frame of several scientific concepts, it was my goal to enhance the science curriculum, making the learning more effective and fun. The scientific concepts I worked towards were: “Scientific Method,” “What is a scientist?” and “Scientific Journals.” I used qualitative methodology for data collection consisting of: classroom observation and ethnography, focus groups, informal interviews, and baseline/follow-up surveys.

School and Class Selection:

My teaching and research were conducted at CVS Highlander Charter School in Providence, Rhode Island. The school is set in an urban residential setting and has 195 students between kindergarten and eighth grade. Highlander’s mission focuses on project-based learning in small scale environments, with emphasis on individualized learning. Each class has a maximum of fifteen students. 75% of the students are from the City of Providence, while the remaining 25% are from other areas within Rhode Island.

The 5th and 6th grades of Highlander School were my two study groups. Ms. Smith teaches 5th grade and Ms. Jones* teaches 6th grade. Several class demographics are as follows in tables 1 and 2.

	5 th Grade	6 th Grade	Totals
Females	7	8	15
Males	8	7	15

“Sex Demographic” Table 1

	5th Grade	6th Grade	Totals
Hispanic	6	6	12
Black	6	5	11
Caucasian	2	4	6
Asian	1	0	1

“Race/Ethnicity Demographic” Table 2

Curriculum Development:

The first step in the development of my curriculum consisted of researching local and national benchmarks for science and environmental literacy at the elementary level. In *Benchmarks for Science Literacy* (1993), Project 2061 outlines specific scientific, technological and mathematical concepts for mastery at each stage of learning. After careful review of the benchmarks for achievement after 5th grade and conversations with Ms. Smith and Ms. Jones about goals they had personally for their classes, I selected several scientific benchmarks/concepts to teach. These included (Rutherford, 1993):

- Scientific investigations may take many different forms, including observing, collecting specimens for analysis, and doing experiments
- Clear communication is an essential part of doing science
- Results of scientific investigation are seldom exactly the same, but if the differences are large, it is important to try to figure out why. One reason for following directions carefully and for keeping records of one's work is to provide information on what might have caused the differences

More specifically, I wanted to ensure a basic conceptual understanding of the scientific method, keeping a science journal, and what defines a scientist.

After selecting the scientific concepts for the framework of my curriculum I consulted the *Massachusetts Benchmarks for Environmental Knowledge*, which were developed as state sponsored benchmarks, based upon Project 2061, but placed into the realm of environmental education (www.state.mas.us/envir/elbk-4.htm). Massachusetts standards are relevant to this study, based on the proximity and similar population demographics between Massachusetts and Rhode Island. Because the ages of my study group overlapped both the Project 2061 and MA benchmarks, to the best of my ability and in conversation with Ms. Smith and Ms. Jones, I selected concepts/benchmarks that would be most suitable for my classes. These included:

* Names replaced with pseudonyms

- Learners can portray/explain the basic interactions between humans and their environment in their own culture.
- Learners can demonstrate knowledge of the basic concepts of an ecosystem

In addition to the concepts discussed, it was imperative to consider various researchers opinions on what an environmental curriculum should include. Hungerford et al (2003) outlined some components in curricula design, in which I found two, particularly useful for my own curriculum. These included,

1. Teaching environmentally significant ecological concepts and the environmental interrelationships that exist within and between these concepts.
2. Providing carefully designed and in-depth opportunities for learners to achieve some level of environmental sensitivity that will promote a desire to behave in responsible ways.

It was based on all of these factors that I chose to focus the environmental education unit on the concepts of biodiversity, habitat and food chains, concentrating in the marine sphere, where I have the most familiarity and personal teaching experience, but also allowing for terrestrial and local examples.

After narrowing my conceptual goals I began searching web based science and environmental education sites, to glean ideas about activities for my lesson plans. I looked at a range of sites from individual educator's sites, to large organizations, including the Smithsonian, and the World Wildlife Fund, to small science experiment clearinghouses (See Appendix A for list and curriculum details). I have concluded that there is vast array of already existing environmental education materials; however the effectiveness and appropriateness of the activities and resources available vary significantly. In searching for and selecting my curriculum I used personal prior knowledge of children's receptivity to such activities, as well as significant input from Ms. Smith and Ms. Jones. I also relied heavily on personal creativity to design and partially design some of the games used in class. Three final sources of material for my

curricula were the two IMAX films, *Coral Reef Adventures* and *The Living Sea*, in addition to, the Disney film, *The Lion King*.

Qualitative Methodology:

In evaluation of the effectiveness of my environmental education unit on the students' overall receptivity to science, the utilization of several methods of qualitative research is imperative. After conducting numerous informal interviews with both teachers, two 5 student focus groups (see Appendix B), a baseline/evaluative survey (see Appendix C) and countless hours of classroom observation and teaching, the most productive presentation of this data relies upon ethnography.

With the increased recognition that Environmental Education has received since the controversial ICEE report, there has also been increasing acceptance of and interest in qualitative research within the field (Marcinkowski, 2000).

In the context of the classroom, especially with young children, the argument for ethnography is strong. In a conversation with Ms. Smith, she described a varying English literacy among her students, "Some of the students speak only Spanish at home, and their parents do not understand English and cannot help with their homework, so consequently their writing skills fall way behind the others." Limiting the research to only surveys or written evaluations would be biased towards the English-only writing students, and would not accurately represent the full conceptual understandings of the bilingual students.

Giangreco and Taylor (2003) report, "qualitative methods are ideally suited to providing an understanding of context." An example of such an instance occurred in an informal interview with Ms. Jones. She described the students' inquisitiveness while taking the evaluative survey, "They knew so much... I was really impressed. But some of the questions on the survey confused them, especially the one related to habitat- now they

see water as a habitat, as in the ocean or a lake, not just as something to drink. So if you see many of the surveys that say water is an example of habitat, you'll know how they were thinking." Erickson and Gutierrez (2002) point out, "qualitative studies can provide explanations for the results or outcomes of quantitative research." Children's excitement and interest towards certain subjects is difficult to quantify. Simply relying on surveys and tests limits the quality of the data. A researcher administering a survey to 5th graders, only interested in what is written, will miss the potentially invaluable whispered comments between students during the survey. This idea is best stated by, Erickson and Gutierrez (2002):

Unlike human organs, plants or cells, human beings are social actors who exist in a complex and multifaceted social and cultural environment. People are not passive objects that can be understood in a sterile laboratory or controlled conditions. Anyone who has spent time in America's public schools is sure to tell you that the influences affecting particular outcomes of interest are numerous and complex.

Findings

Curriculum

To best present the outcome of my curriculum, in a manner that allows for utilization by other educators, I have created a flow chart with a code to represent an evaluation for the development of the scientific and environmental concepts among students, taught over ten weeks at CVS Highlander. You will notice that some concept codes appear in topic boxes, after they have already been introduced; this means that the particular concept is re-emphasized and further developed through the teaching of other concepts. For example, you will see the code for ‘Scientific Method: Observations’, **SM2**, appears in several Habitat and Food Chain introduction boxes. This means that with the activities and homework of this topic, I was developing and re-emphasizing the concept of observations, through learning environmental topics. The codes are as follows:

SJ1, SJ2, and SJ3: Concepts related to Science Journals

SM1, SM2, SM3 and SM4: Concepts related to Scientific Method

S1, S2, and S3: Concepts related to Scientists

H1, H2, and H3: Concepts related to Habitat

B1, B2, and B3: Concepts related to Biodiversity

F1, F2, and F3: Concepts related to Food Chains

The specific materials, activities and homework I developed and used to teach my curriculum will be described throughout the classroom ethnography section (see Appendix D for further examples.)

Curriculum Flow Chart

Base Unit: Science Concepts

Science Journal (SJ)	Scientific Method (SM)	What is a Scientist? (S)
SJ1. What is a science journal? - A place to record all observations, hypotheses, and results from experiments or other science activities.	SM1. What is the scientific method and why is it important? - a way to always conduct experiments correctly and safely - what scientists have used for centuries to make sure they can replicate results	S1. Previous conceptions of a scientist: - what do they look like? - what do they do? - what materials do they use? - discussion and drawing
SJ2. Format for a science journal log: - Name and Date always at top - Colorful, descriptive drawings - Label all drawings - Neat writing and complete sentences	SM2. 1 st Step: Observation - Smell, Touch, Taste, See, Hear - good words for observation: adjectives such as: rough, smooth, clear, noisy, soundless, etc	S2. Who can be a scientist? - all women and men - test tubes, lab coats, and glasses are not needed!
SJ3. What not to do in a science journal: - doodle on the pages or outside - rip out pages - remember we may need to look over our experiments, and see what we may have done differently from other people that gave us that cool result - examples: medicine discovery and co-emphasizing 'scientist' concept	SM3. 2 nd Step: Hypothesis - What you think or predict to happen in an experiment or other science activity based on all background knowledge and observations. - What does a great hypothesis look like: I hypothesize that.... with complete sentences! - Words not to use in a hypothesis: - thing and it	S3. What do scientists do and why are they important? - show examples from IMAX and myself in recent research with sea turtles
	SM4. 3 rd Step: Results - What makes a great results section: - lots of descriptive words, what happened in the experiment in the correct order it happened in - Important to ensure, if you need to look back, that you have done the experiment correctly	* <i>Bold letters stand for the particular concept that is being introduced in that block.</i>



Secondary Unit: Environmental Concepts

Habitat (H)	Biodiversity (B)	Food Chains (F)
H1. What is habitat? - The specific environments that animals, plants and humans live in - Identify our habitat as humans, what other animals and plants live here - Using SM1 , to observe school habitat, neighborhoods, streets and backyards - Recording using all SJ concepts - Discovering a marine habitat: Coral Reefs at the IMAX theater	B1. Diversity- what does it mean to you? Bio- all life - so...putting it all together what is it and when do we see it? - the diversity of life on the planet - coral reefs have lots of biodiversity - Nature Walk to find biodiversity of neighborhood - Using SM1, SJ2 and SJ3 to observe and record all of the species	F1. What is a Food Chain? - some animals eat other animals, and those animals eat others- in a cycle - animals depend on each other for food, shelter and protection - Coral Reef examples - Nature Walk - Using SM1, SM2 and SJ2 to observe animals & hypothesize about their food chain - B1, B2
H2. Why is habitat important? - What things do we need from our habitat? Shelter, food, clean water and air - Healthy coral reefs are habitat for millions of animals- some can be used for medicines and many for food - Exploring S2 and S3 with the IMAX film, Coral Reef Adventures. - B2, B3, F1, F2	B2. Why is biodiversity important? - Coral Reefs and Rainforests have potential for medicines in the diversity of species that live their - food: coral reefs have lots of animals that other animals depend on- if one fish leaves- maybe it will cause the tuna to leave- then what will we eat! - H1, H2, H3, F1, F2	F2. What happens when you disrupt a food chain? - Certain animals gain too much population, others lose population - African Savanna Game - The Lion King - SM2 & SM3 - hypothesizing about African Savanna Game, discussing results - H1, H2, H3, B1, B2, B3
H3. What happens when habitat is destroyed or polluted? - Using SM1 to observe pollution around us and S2 and S3 to record it - Coral reef damage- lose potential medicines and sources of food - SJ2 and SJ3 to record pollution around us - B2, B3, F1, F2	B3. What about losing biodiversity? - this can happen because of habitat destruction- like in the rainforest - if we lose biodiversity, we may lose important undiscovered medicines and sources of food and jobs for lots of people - S2 and S3 - scientists are important for discovering species	* <i>Bold letters stand for concepts that are receiving emphasis and re-emphasis in the blocks where they are appearing.</i>

Classroom Ethnography:

The following depiction is a collection of experiences during my ten weeks of teaching science at CVS/ Highlander School. The accounts are factual and based on log entries that I kept throughout my research, including: classroom observation, informal interviews with Ms. Jones and Ms. Smith, two focus groups and all homework and in-class work. It is my self report on the impact of the activities, in addition to an evaluation of the effectiveness of my experimental curriculum and an examination of the feasibility for infusion of environmental education into the traditional science curriculum.

1. Student Profiles: The following are brief profiles of each student in my two classes, under pseudonyms. I will be referring to the students from now on by name. The profiles are provided to allow the reader a basic understanding of some classroom dynamics and characteristics.

Sixth Grade

Inés: *Slyly smiling constantly and always wanting to hang on me, especially when we are outside on the nature walks. She has a difficulty understanding written English and needs help when doing any written work.*

Monica: *Extremely smart and confident. She is a classroom leader, and seems to enjoy and excel in science.*

Isabel: *Quiet and intelligent, she doubts herself sometimes, but always supplies a right answer if pressed*

Jon: *He excels at art and is very inquisitive. He gets easily distracted by other boys, but is intrigued by science and pays attention to his best effort*

Juan: *A charmer, he wants to be famous someday and is constantly talking about it. Unfortunately I couldn't interest him in science, and he supplies many a distraction to other students.*

Carlos: *Very smart, but wants to appear "cool" so he doesn't try very hard in class. However if I ask him questions independently, he seems very interested and engaged.*

Tamara: *She is quiet and has a difficult time paying attention, however going outside sparked her interest intensely and it was there that I realized she had been listening all along*

Bianca: *She has some behavioral problems, and fights often with other students. However she also has a sweet side, and when in a good mood seems very engaged.*

Daniel: *Very intelligent and most likely has very smart parents, because he can debate on just about every topic. He loves Harry Potter and wears the cape every day!*

Caroline: *Smart, mature, and quiet, she sits in the back and follows every rule perfectly. Occasionally complains, but I can depend on her to set an example.*

Maria: *Sweet and docile, she pays perfect attention and offers to answer questions often. She constantly has pictures of her family that she shows to me.*

Alex: *When sitting with Carlos and Tamara, he has a very hard time paying attention. But in all experiments, movies and nature walks he was entirely engaged.*

Luis: *Very pleasant to me, always shakes my hand when I come, but he has a tendency to get it minor fights consistently throughout the day, especially with Jon.*

Kevin: *Mature, fun and dependable. I find him talking to me about sea turtles and other animals often. He loves science, but falls behind in written comprehension.*

Natasha: *Bianca's friend, however she is a complete opposite. She is pretty quiet, but loses attention easily.*

Fifth Grade

Sasha: Always pays attention, and consistently puts in an extra 150% effort. She volunteers answers often, but always raises her hand first.

Mark: Easily influenced by his peers, but is a wonderful boy. He is constantly smiling and loves experiments.

Ana: Speaks only Spanish at home and her parents cannot speak English. I think this hinders her in school, yet she is very inquisitive and independent.

James: Always smiling and evident leader of the class. Pays attention and provides jokes for all.

Lamar: Independent. He is the class clown with James and loves to be outside.

Kate: Kind, intelligent and very warm to her peers. She is liked by all and tries hard in school.

Tanya: Unfortunately, she is made fun of by her classmates and misses a lot of school. She has a difficult time reading, but asks for help and tries hard.

Paul: Active little guy who talks a lot. When he is on task, he seems to get a lot out of science.

Melosa: Quiet, kind girl who always includes everyone. She likes science and puts a full effort in for homework and in class.

Cassie: Very intelligent, angelic girl. She is extremely interested in science and environmental issues. She takes time to talk to me about issues she has heard about on the news.

Enrico: Humorous boy, who, with the right people, is very good at experiments. But put him with the wrong person and he jokes around all class period.

Serena: Very shy and quiet. She does not like to participate in class. Missed a lot of school, but told me how much she loved the IMAX movie.

Jerome: Quiet, serious boy who is a hard worker and persistent.

Tom: Loud, funny guy who is always making up stories. His teacher makes him tell the truth and he cracks up. When working with him independently, he is very diligent.

Charlie: Entered the class mid-semester and started getting in fights with others. However, he came around and really started to like science.

Introductions

Goals: Earn initial respect from students, assess previous knowledge, and introduce the concept, What is a Scientist?
 Activities: Looking at photographs, class discussion
 Date: September 12, 2003

It was the first day of science class, September 12, on a muggy New England day. The classroom was hot, the type of hot that makes your legs stick to your seat when you try to rise. Around me the chatter of first week jitters and teachers attempting to keep attention filled the air. Despite constant summer construction, the building that houses CVS Highlander School was still not completed, so each grade from kindergarten

through eighth, squeezed into the tiny, poorly ventilated building. I was nervous about meeting my classes, and hoped that I would be a good teacher. As I looked around the room, my first thought was, ‘Oh no, where is the overhead projector...are there any plugs?’ The room was rectangular with tables, benches and mis-matched chairs. There were two pillars in the center of the room, providing a perfect block of any students that sat behind it.

How much do they already know?

After a chaotic combining of both the 5th and 6th grades, I started with my introduction to science class. I talked about who I was and what we would be doing over the next several weeks, mentioning briefly science journals, the scientific method, and the environment. After asking the classes, ‘What do you think the ‘environment’ means?’, a tiny-voiced, brunette in the middle, who I now know as Maria, replied, **“I think it is the world around us, like, the air and trees and all the animals.”** I asked the class if they thought a ‘healthy environment’ was necessary for humans to live happily. Daniel, a short, squeaky voiced blonde, said quickly, asking questions like firecrackers, **“Oh yeah...it’s really important. I live on Narragansett Bay and this summer there were dead fish every where. Do you know what that means? Why did they all die, is our environment bad?”**

I had wanted to make an assessment of their previous environmental knowledge, so I was sure not to be boring or unexciting, but I was not prepared for the discussion that ensued after Daniel’s comments. This was one of the first of many awakenings into the world of little kids. My common rule now: Never underestimate how much they know and learn from observing the world around them.

Initially, most of the students seemed to be interested in environmental issues and aware of some environmental problems. A couple students were more knowledgeable than the others, but overall the students did not seem to have had extensive environmental education in their past schooling.

What is a scientist?

The rest of the class time I wanted to devote to the concept: **What is a scientist?** This may seem like something very simple, but due to popular cartoons, like *Pinky and the Brain*, and other media images, young children develop the belief that scientists are males, dressed in white lab coats, with glasses and test tubes bubbling unknown substances. It is important to debunk this myth early on, insuring that females and students of all races are assured that they can be part of the field, and for all children to know that science does not only exist in laboratories and that it can be an effective tool in helping to improve the environment. According to Benchmarks for Science Literacy (1993), “Teachers should emphasize the diversity to be found in the scientific community: different kinds of people (in terms of race, sex, age and nationality) pursuing different sciences and working in different places (from isolated field sites to labs).”

I first wanted to discuss their initial conceptions of what a scientist looks like. As I had predicted, students presented the classic image. Juan, a confident male student blurted out, “A white guy who wears a white coat and plays with tubes all day.” Another student, Ines, said, “Yeah, he has glasses too.”

To clarify this scientist myth, I used the example of myself as a scientist/researcher. In doing so, I had a second goal as well: to gain initial respect as a teacher. I presented them with overheads, color pictures depicting past research that I

have been part of, including sea turtle rescue, rehabilitation, and conservation. All of the pictures I portrayed were taken outside, on beaches or in tanks at the rehabilitation center, with 300 pound sea turtles. In doing so, I demonstrated that science does not exist only in laboratories, by lab-coated men, with test tubes.

As I showed the pictures, the room was silent, and each student looked wide-eyed with curiosity. After class, Ms. Jones came to me and said, “I couldn’t believe how interested they were, they haven’t been that quiet all week!”

The sea turtle connection followed me throughout the next ten weeks, and some students began to confuse their own pet turtles, ‘AquaTurtles’ with sea turtles. “**Miss Helm, should I take my AquaTurtle to the ocean and let it go?**” It took a bit of work to clarify these issues with independent students during breaks or at the beginning and end of class.

How do we use our science journals? What is observation?

Goals: What is a science journal and how is it used?
 Observations
 Activities: Observing ocean objects, observing objects from home, Raisins experiment
 Dates: September 15 – October 2

The next few weeks were dedicated to discovering the concepts of science journals and the first concept of the scientific method, **Observations** (see curriculum flow chart).

Highlander provided marble-cover composition books for each student to use as a science journal. To explore how to use a science journal I introduced the scientific method somewhat simultaneously, except I concentrated on observations. I brought into class a squeaky orange dinosaur, an abalone shell, large Baja sand dollars, conch shells,

and smooth rocks. We discussed the five senses and how these are our source of observation. Passing the orange dinosaur around the room, I urged the students to describe what they heard, felt, smelled and saw. At first, no one thought to squeeze the dinosaur, but finally everyone heard the squeak and laughed.

The classes split into lab stations, each with an object to observe. I explained that a good observation was a complete sentence with lots of describing words. The students, not only between classes, but within classes, were each at different writing and reading levels. Many students in the fifth grade and some in the sixth grade are still struggling with spelling, and writing can be arduous for them. So to help develop this skill, I emphasized using complete sentences, and trying not to use ‘tired words’ such as: it and thing. Despite their difficulty expressing themselves in writing at the beginning of school, the objects captivated their interest. Bianca asked, **“Hey, where did you get all these cool things?”** The students were excellent at making verbal observations, but motivating them to write each observation in complete sentences was difficult. A observation from Carlos’s paper read, **“its white and had a star in the middle and its sandy.”** I had anticipated following a faster pace, but after consulting with the teachers , we determined to spend more time on developing these skills and concepts.

Voluntary Show and Tell

At this time, students started to bring their own objects to school to show me. One student, Luis, approached me one day, **“Miss Helm, I brought in my shell collection to show you! I have been all over, to Florida and Hawaii and Puerto Rico, see!”**

Another student, Kate, came to me, **“Miss Helm, look at this. These are some things from Cambodia. My dad brought them here and gave them to me.”** Situations like

these two presented evidence in my opinion that most students were engaged in science, and excited enough about it, to think of it at home.

Experiments in Observations using Science Journals

We started conducting experiments to further enhance observation and recording skills. The first experiment was entitled, “California Raisins,” where the students are given a few raisins and carbonated water. After placing the raisins in the carbonated water, the raisins initially sink, but then rise after a few minutes. Caroline described her observations in writing: **“I see an old grape that is very dry and shrivled up. It feels gushy, soft and smoth. It smells sweet like a grape. (Tamara) said it tastes like strawberries.”** The students enjoyed the experiment very much. **“I can’t believe it- I thought they were going to sink. I never thought I’d see that happen,”** exclaimed Kevin. Many students quickly realized that shaking the table would cause the experiment to fail, and screamed for everyone to hear, **“Hey guys, don’t shake the table. They won’t float if you do!”** After reading some of the science journal entries from that day, many of the students recorded the table shake finding. A few students grouped together had some mints, and they put them in the carbonated water as well, but evidently the mints caused the experiment to fail, because neither the raisins nor the mints rose. We used this as an example of contamination in an experiment- another reason why it is always important to follow directions and record what you do.

Impact of Experiments on Developing the Observation and Science Journal Concepts

The California Raisin Experiment was successful in providing an engaging activity where the students were able to use their observation and science journal skills.

The extent of writing down observations varied significantly, but it was apparent to the teachers and I that the students were beginning to fully grasp observations and the use of science journals.

What is a hypothesis?

Goals: What is a hypothesis, where does it belong in the scientific method? Re-emphasis on observation and science journal skills.
Activities: Experiments with floating vs. sinking
Dates: October 6- October 15

Teaching continued with experiments and record taking in the science journals. The ongoing experiments concentrated on developing the first two age-appropriate steps of the scientific method, including: observation and hypothesis. The experiments were simple floating/sinking experiments such as: the floating paperclip, where a paper clip is placed on a piece of paper towel on top of water- the towel sinks and the paper clip floats. I also created other experiments, using various objects from around the house with hard-to-predict floating characteristics such as: bottle caps, soap and q-tips. In one such class, I presented a bent bottle cap to the class. I asked them to make hypotheses about what would happen if I dropped the cap in water ridge-side up and ridge-side down. Daniel, unable to contain his excitement blurted out, **“Oh I know, I know! If it’s ridge side up, it will act like a boat and will float!”** To this another student said, **“No way, I think water will come over the side and it will sink!”** The enthusiasm that persisted each time we conducted a floating/sinking experiment was clear evidence of the students’ receptivity to learning science. As long as our activities were hands-on, the students were thrilled with the class periods. We practiced observations and hypotheses until the students had a firm grasp of each concept.

What are results?

Goals: Results and re-emphasis of observation, hypothesis and continued practice in science journals.

Activities: Sinking/floating experiments

Dates: October 17- October 21

The sinking/floating experiments were exciting and fun for the students, so to develop the concept of results, I continued using similar activities. In one such experiment, we discussed the results of placing an unknown substance (soap) in a bowl of water. In this experiment, the soap began to dissolve into the water, and Jon started saying, “**Miss Helm, Miss Helm, there is contamination!**” I was delighted that he had remembered this idea from weeks before during the raisin experiment. The class overwhelmingly agreed with Jon and forced me to get new water, so I wouldn’t contaminate any other experiments. I was thoroughly impressed with their development and decided that it was time for an assessment.

Assessing the Students’ Conceptual Understanding of the Scientific Method

CVS/Highlander does not issue grades to their students, so to formally evaluate whether the students had full comprehension of each of the science topic concepts (refer to curriculum flow chart for complete listing), I gave them a survey to fill out on the last day of experiments (see Appendix E), which included a segment where they could write their feelings on how they liked science, or possible suggestions for the future. The assessment was useful: nearly everyone made thoughtful, complete hypotheses and answered over 3 of 5 True/False correctly. The most wide-spread confusion was the correct order of the scientific method: students were half and half on knowing if

observation or hypothesis came first. An unusual case appeared in Kevin, who shows extreme interest and excitement in class, but was one of the only students who did not do well on the assessment. This was interesting to me, so I tried asking him questions in a casual conversational manner to see if, in fact he actually knew more than he had shown on the assessment. In our conversation, it was immediately apparent that he completely understood the scientific concepts. I talked to his teacher about this and she replied, "I'm not sure why Kevin didn't do as well. He is such a good student in class, but never does very well on assessments." Feeling more confident in him, and knowing that I needed to put more emphasis on the correct order of the scientific method, I was ready to continue into the environmental component of my curriculum. However, before progressing to the environmental unit, I also wanted explore what the general attitudes towards science had been so far. After reading the students' suggestions for future activities, it was clear that many of them wanted to be outside, doing things more hands on. One sixth grader wrote, **"I mean I love science but it's too easy and I think we should go outside or something. Example- go outside and make a boy dig in the dirt and see what you find and research on them"** A fifth grader wrote, **"Science is fun, but I want to do more experments and go outside."**

Introduction to the Environmental Concepts

Goals: Habitat and Re-emphasis on What is a Scientist? Activity: Imax movie, <i>The Living Sea</i> Date: October 24

Taking all comments for consideration, and being aware of the need for further emphasis on the correct order of the scientific method, I began to refocus- teaching about environmental topics that would re-enforce all of the previous work completed.

Due to the environmental topics I taught, it is fairly simple to discuss the concepts with regard to each of the others. Specifically, when teaching about biodiversity it is not too complicated to infuse concepts about food chains, habitats, and vice versa. The strong factor of my experimental environmental unit is its constant re-emphasis and attention on reiterating the scientific concepts. Without fully cementing the scientific concepts, using an environmental curriculum in this context has no argument.

We transitioned into the environmental component by watching a MacGillivray Freeman IMAX film, entitled, *The Living Sea*. Before pushing play, I asked about habitat. To the question, “What do you think habitat means,” hands shot up in the air. Over half of the students wanted to talk about it, so we had a five minute discussion about our human habitat. Monica replied, “**It is the area and environment around us, like, around here its buildings and streets and trees and barking dogs and trash.**” Daniel said, “**There is a dock in my habitat because I live on Narragansett Bay.**” After several other students chimed in, I told them they would be seeing other types of habitats in the movie: marine habitats.

While watching the film, the students were very attentive and interested. In one part, *The Living Sea* portrays a female marine biologist exploring a salt water lake filled with jelly fish. It backed up the conceptual learning about scientists, and provided an excellent example of a non-classical image of a scientist. The movie impacted the students strongly. At the end of the film, I heard Monica say to Cassie, “**I want to be marine biologist when I get older, that looked so cool!**”

Nature Walks

Goals: To display habitats and biodiversity in students' reality, re-emphasis on science journals.

Activity: Observations outside and at home

Date: October 28

To continue conceptual learning about habitat and biodiversity, we took a nature walk to a near-by over grown field. Observing my students in this context was one of the most rewarding experiences of the entire study. Ms. Smith said to me later that day, **“Did you see them out there? I mean, it seemed as though some of them have never done that type of thing before- it was great!”**

The students were so excited to be outside with their science journals, observing the local habitat, that it was difficult to herd everyone back inside. While in the classroom, the students wanted to compile a list of all the species they had seen, on the white board to get a better idea of how many animals and plants existed in just a small field. **“I can't believe that there was actually stuff to look at out there, it just looks like an old dumpy field,”** commented Tanya. We determined over 30 different species, from plants to animals and insects. After this experience, I was wishing I had the resources to bring my classes to other outdoor sites because of the significant impact it had on my students. This was the start of seeing my students really appreciate science in environmental concepts. Most diligently recorded their observations in their journals and enthusiastically shared information with each other. I heard Enrico's voice shout across the field, **“Hey Tom, come look at this, we can write this thing down- it's an earthworm and it just pooped on me!”**

Progress in Science Journals

I decided to take a look at some of the students' science journals, to see the progress they had made in recording observations. Upon opening several science journals I saw colorful pages with labeled drawings of insects and leaves; many with full sentences describing their objects in detail. In Melosa's journal, she wrote, **"I see a red berry. It is the color of an appel but it is smaller than an appel. I found it on the ground. It smells like dirt, but I shouldn't taste it because the berry might be poison."** Encouraged, I felt as though I was starting to make a difference in their lives. Some of the students had never been given the opportunity to explore their environment, and I could see their eyes fill with wonder every time someone found a snail shell, berry or salamander.

IMAX, Here we come!

Goals: Emphasize environmental concepts
 Activity: Field trip to Feinstein Imax Theater in Providence Place Mall
 Date: October 31, 2003

At about this time in the semester, the IMAX film, *Coral Reef Adventures*, was showing in Providence. After reviewing the topics covered in the movie, it seemed relevant to take the class to see the film. If effective, I thought the movie could emphasize each environmental concept I had been teaching, in addition to being an exciting fieldtrip to get everyone out of the classroom on Halloween. While walking out of *Coral Reef Adventures*, Serena, a student who usually made few comments about science class, approached me and said, **"Miss Helm, I've never been to one of those movies before... I can't believe that there are that many fish in the ocean."** It was rewarding to finally

find an aspect of my curriculum, that interested and excited Serena. However, after the classes completed a worksheet/homework based on the film, it seemed that a division in comprehension had appeared. The sixth graders had understood the movie easily and grasped the concepts presented, while the fifth graders had a much harder time. The fifth graders could discuss and recount things they saw in the movie, but they could not accurately answer many of the questions on the homework (Appendix D) asking for conceptual understanding of things talked about in movie.

Food Chains

Goals: Basic concept of food chains, importance of biodiversity
 Activity: African Savannah Game, Don't Go Fish Game, Lion King
 Date: November 4 -14, 2003

In following classes after the IMAX trip, I taught concepts of food chains, linking always to biodiversity, habitats and re-enforcing the scientific method. I created a game called "The African Savannah," designed to portray what happens in the small food chain connecting grass, antelope and lions. In this game I assign each person as antelope and lions and spread around pieces of green construction paper in the classroom as grass. After discussing the rules about how many antelopes the lions can consume, and how much grass the antelope can eat, the students run around trying to acquire their source of food. It was a little chaotic, but still entertaining. Allowing the students to make hypotheses about what happens with less grass or fewer lions and antelope was an effective way of helping them to understand that each element of a food chain affects the others. Monica stated, "**Okay, so when there are not enough antelope, the lions will not get enough food and starve. But then, it will be okay because there won't be as many lions to get food.**" It can also build on concepts of biodiversity, letting them

experience first hand when a species is taken away from a habitat, the consequences that ensue.

To provide further conceptual understanding of biodiversity, habitats and food chains, I found a game through the Smithsonian Institute's Ocean Planet educational resources. The game, entitled, "Don't Go Fish," is played like Go Fish, except with playing cards from five different marine habitats. The students are to collect cards from each habitat and place them in food chains. Also included in the game are cards displaying some human pressures on marine ecosystems, such as over fishing, and coral blasting. While the game was fun in class, I think I overestimated how much the students would learn from the game. They understood the different habitats and the importance of biodiversity in the habitats, but placing species that they were not familiar with in food chains was fairly difficult.

The Lion King

In consequence I decided to design a different activity, focused on the Disney movie, the Lion King, to further the students understanding of food chains. In this activity, we took two class periods to watch the Lion King, each with introductions instructing the students to pay specific attention to several scenes. These scenes included examples of the importance of food chains, biodiversity and what can happen to habitats when food chains are disrupted. A homework assignment and after-class discussions finally demonstrated that the students were grasping the concepts of food chains fairly well.

Wrap Up

Goals: Review science and environmental concepts Activity: Nature walk, with observation and hypothesis construction and assessment Date: November 17, 2003

As a final class, I found it would be appropriate to go on another nature walk, to bring the environmental concepts back to an area within which the students identify: their local environment. Despite the bitter cold, and frozen noses, we found more species than on any previous walks. I had the students find one animal or plant, observe it in their journals, hypothesize about what food it depended on within its food chain, and what other animals depended upon it. One student wrote, **“I found a salamandar with black and red stripes on his head and back. It looks cold so I am holding it in my gloves. He is slimy and has dirt on his back and belly. I hypothesize that the salamander eats little bugs and I hypothesize that birds eat salamanders. I hope he doesn’t get aten by one.”**

Wrapping up class, I gave another assessment survey (Appendix C), which I also gave at the beginning of the environmental unit, in hopes that it would be an accurate evaluation of their conceptual learning over the course of the unit. Unfortunately, this assessment did not turn out to be as effective as I had hoped. The way I phrased questions and sentences within the assessment confused the students, so many of them were simply guessing answers. However, the classroom observation and focus groups provided a much greater understanding of how well the students grasped the concepts taught.

The Focus Groups

Key Questions:

- How would you use the scientific method to find something out about the environment?
- Has your idea of a scientist changed during the past 10 weeks?
- What is your idea about habitat? What is it?
- Did you like learning about environmental topics during science class?
- How would you use a science journal in an experiment?

Key Findings:

- Students could accurately explain a way to use the scientific method in an aspect of environmental exploration
- Their ideas of scientists have broadened
- Students are most concerned with their own ‘habitats’ where they experience violence and pollution.
- The students enjoyed the activities in the environmental curriculum unit and overall enjoyed science class
- Students could accurately describe uses for science journals.

Within the focus groups (Appendix B), I not only wanted to see how accurately the students could communicate the scientific and environmental concepts, but also I wanted to hear how extensively they had enjoyed science class and whether or not it had been an engaging experience.

The students were very eager to communicate about all the topics we covered in science class. They could easily discuss the scientific method. One student stated, “**It’s important cause sometimes some people get all different results to the same experiment, like when that one group put mints in their raisin experiment. I guess if they hadn’t written that down then we wouldn’t have known why their experiment didn’t work.**” Another student stated, “**I liked the first part of the scientific method best, when we observed everything. I liked going outside and finding all that stuff in the grass.**” When asked how they would use the scientific method to explore an

environmental topic, Cassie responded, “ **Well, I would first find something to look at and observe, like umm, birds flying in a v-shape direction. I would make a hypothesis about why they do that, and then I guess I would try to do an experiment to find out why. But...hehehe...I don’t know what experiment I would do.**”

After asking about their conceptions of a scientist, a female student replied, “**Oh yeah, now I know that not all scientists sit inside all day. Like the two scientists in the coral reef movie that were married- they were out swimming in the ocean and on boats. I really want to do that when I get older.**”

When we started to discuss the environmental unit, some very interesting and unexpected results started to appear. While the students seemed to have a firm understanding of habitats and biodiversity, they began to talk about environmental and social problems within their own local “habitats.” Carlos stated, “**The environment around here is really bad. There is litter everywhere and no one cares to pick it up ever. And like at my house, I can’t go outside a lot cause there are gangs. Last night my dad had to call the police because there were two gangs fighting and had guns. Except the police don’t really do anything about it.**” After this statement, many of the other students began to discuss their neighborhoods, detailing the crime and pollution that was all around them. “**We keep my yard really neat, but all the neighbors have tons of trash in their yards and it always blows in ours. It makes my mom really mad that they don’t care,**” stated Sasha. The students’ perceptions about their environment had not become apparent before the focus group discussion, despite the homework exercises encouraging neighborhood habitat exploration. While the students showed appreciation for the different environmental topics we learned about, when asked what they were most concerned about regarding the environment, the students responded overwhelmingly that

they were most concerned about their local environment. Again, the Narragansett fish kills of the summer were brought up, in addition to the notions of litter, smoke from factories and the social problems in their neighborhoods.

When asked whether or not they enjoyed learning about environmental topics in science class, Kate responded, **“I really liked the experiments, going outside and the games. You know, um, hands-on stuff. It made it a lot of fun to learn about the scientific method which is kinda boring without going outside or doing experiments.”** Overall the students could demonstrate a good understanding of the scientific concepts and had a basic knowledge of the environmental concepts. They were able to communicate about the scientific method, science journals and what a scientist is with ease throughout the focus group. In addition, after review of their science journals, it appeared that almost all of the students have been using their science journals appropriately; including full sentences, labeled drawings, names and dates, and many details. The students’ most strongly comprehended the scientific concepts, but it was apparent to me and the other two teachers that the students had also expanded their appreciation for the environment and were eager to learn more, especially through experiments, nature walks and observations of natural phenomena.

Additional Issues in Teaching

Throughout the ten week period of teaching, there were several issues that had an effect on the students’ ability to grasp the scientific and environmental concepts. The sixth grade class had significant behavioral problems, creating a difficult teaching and learning environment. There were several students that continually made fun of one another, and engaged in arguments, sometimes becoming physical. A somewhat

significant part of the class time was devoted to keeping each student focused and breaking up disagreements within the classroom. I strongly believe that this behavioral element had a noteworthy affect on the sixth graders ability to grasp the environmental concepts. The fifth graders did not present nearly as many behavioral problems, but occasionally there were a few incidences interfering with student learning.

Another issue was the difference in male versus female class participation and receptivity. The females in both grades were more likely to write down explicit observations and record all details of experiments, nature walks and observation activities. While the males seemed equally excited about science class, they were less likely to fulfill the daily class requirements, including: writing in complete sentences, finishing homework and experiment worksheets.

Strengths and Limitations of My Curriculum

The main strength of my environmental curriculum is the ease that it can be infused into the broader goals of conceptual understanding of the scientific method, science journals and ideals of scientists. These are only three concepts taught over a ten week period, when the school year is at least thirty two weeks long, thus more research is needed to find out other scientific concepts that can be bolstered with environmental topics. Also, the small class sizes of my population created an easier atmosphere for ensuring each student had conceptual understandings. If I had been teaching 30 students per class, as is the case in many of the nation's schools, I am not sure of how easily I would have been able to gage their learning. Obviously this method would take much effort on the part of the educator to find aspects of the old curricula that could be substituted for the more engaging environmental curricula. Also, not all administrators and educators

believe in the importance of environmental education- this presents the strongest limitation. If environmental education were as controversial as math, we would probably see it in schools much more often.

What I would have done differently

Given the opportunity to do this research again, I would have better prepared myself in child psychology and classroom dynamics. While I have some teaching experience, I do not think I was ready for 6th graders, although I quickly learned. I also would have provided more opportunities to go outside, to other areas, perhaps streams, a lake or wetland. The more engaging, effective hands on activities, the more the students will learn.

Conclusions

In the current educational atmosphere, where 'No Child Left Behind', funding problems and teacher certification issues provide numerous sources of stress on the nation's schools, environmental education has usually taken the back seat. While numerous sources point to environmental education being the single most important force in creating an environmentally literate citizenry, it still does not hold a prominent place in present traditional curricula. One of the main arguments to integrate environmental education into the formal curricula calls for the infusion of environmental concepts and topics into the traditional school courses. However, many argue that there is no room for the addition of other topics. This research is evidence that environmental education can find a niche within the formal science curricula, to not only increase the receptivity of students to science in general, but to help students better understand challenging scientific concepts in a framework of environmental experiences, activities and topics.

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Appendix A

List of Major Environmental Education Curricula Materials Used

1. Windows on the Wild- WOW

- A conceptual framework based directly on biodiversity
- Produced by the World Wildlife Fund
- Can be found at: www.worldwildlife.org/windows

2. Ocean Planet Interdisciplinary Marine Science Activities

- Produced by the Smithsonian Institute's Education Department
- I specifically used the card game "Don't Go Fish"
- Can be found at:

http://www.smithsonianeducation.org/educators/lesson_plans/ocean/main.html

3. Reeko's Mad Scientist Lab

- Experiments
- Specifically I used, Happy Dancing Raisins
- Can be found at:

<http://www.spartechsoftware.com/reeko/Experiments/ExpDancingRaisins.htm>

4. Teaching Resources: Wildlife, Habitat and Endangered Species

- An individual's clearinghouse for activities related to these topics
- Can be found at: <http://www.raysweb.net/specialplaces/pages/species-teach.html>

5. Teaching the Scientific Method

- An E-book for educators
- Can be found at:

http://www.teacherebooks.com/ebooks/scientific_method_preview.pdf

6. 4th and 5th Grade Student Research Resources- General Science

- A clearinghouse for science experiments and activities
- Can be found at: <http://www.learning.caliberinc.com/gensci.html#a>

7. PBS Kids "Zoom Too" Activity Pages

- Specifically used Floating Paper Clip
- Can be found at: <http://pbskids.org/zoom/too/printable/>

8. FunScience: Science Experiments in Environmental Education and Biology

- an individual's activity page
- can be found at: www.funsci.com/fun3_en/

Appendix B

Focus Group Moderator's Guide

How did you like science overall?

What was your favorite day or activity?

What was one thing you would have changed? Kept the same?

Did you like learning about environmental topics during science class?

Tell me about the scientific method and science journals...? What did you use them for?
Can you tell me why you think they are important?

How would you use the scientific method to find something out about the environment?

Has your idea of what a scientist looks like and does changed at all? If so, how?

Do you think biodiversity loss is an important environmental issue?

What is your idea about habitat? What is it? What about your habitat?

Can you tell me what a food chain is, you can give me an example?

Appendix C

Environmental Unit Assessment

Instructions: Please circle whether you think the sentence on the left is true or false.

- | | | |
|---|-------------|--------------|
| 1. A healthy ocean needs only very few plants and animals. | True | False |
| 2. On land and in the ocean, the biggest animals are always the most important. | True | False |
| 3.

If I kill this fish, all of the other fish in this drawing will stay alive and be healthy. | True | False |
| 4. A species is invasive if it does not belong in the habitat. | True | False |
| 5. Sometimes, humans bring invasive species into habitats where the invasive species do not belong. | True | False |
| 6. Invasive species are good for a habitat. | True | False |
| 7. Taking away habitat, by cutting down forests for example, is good for the animals that live there. | True | False |
| 8. Humans are an important part of any habitat. | True | False |

Instructions: Questions 9 and 10 are multiple choice. Choose the answer that you think is best.

9. A habitat is healthy if it has: (please circle one)
- one type of plant and one type of animal
 - many different types of plants and animals
10. What is an example of a habitat? (please circle one)
- food** **water** **a forest** **pollution**

Appendix D

Sample Materials from my curriculum:

A.

Homework: Due Monday

ACTIVITY 1.

Instructions: This homework is all based on the IMAX film *Coral Reef Adventures*. Circle the answer you think is correct!

1. What is coral?

A Rock

A Plant

An Animal

A type of seaweed

2. Why are coral reefs important for humans?

They provide food

They are good for tourism

They contain medicines that may cure diseases

All of the Above

3. What is a big threat to coral reefs?

Global Warming

Overfishing

Cutting down rainforests

All of the Above

ACTIVITY 2

Instructions: Circle True or False!

1. A medicine found on a coral reef is now being used to extend the life of AIDS patients.

True False

2. The term coral bleaching, when the coral turns completely white and dies, is caused by increased water temperature caused by global warming.

True False

3. Diversity is bad for coral reefs.

True False

ACTIVITY 3

Instructions: Fill in the correct words from the top in the following sentences.

Potato cod

Observation

Sedimentation

Diversity

Overfishing

Algae

1. The first step in science is always _____.
2. A rainforest is cut down 10 miles away from a reef. The reef dies because of the _____ caused by the deforestation.
2. Species _____ strengthens coral reefs.

ACTIVITY 4

Instructions: This sentence appears in the movie. Please write a paragraph on what this sentence means to you and why you, as a young person, are so important to the planet.

“We do not inherit the earth from our ancestors. We borrow it from our children.”

B.
Habitat/Observation Homework

Homework: due on Friday

HINTS: Remember in class on Tuesday: we talked about species diversity. Species diversity means how many species are found in a habitat and how many different types of species are found in a habitat.

INSTRUCTIONS: For this assignment, go outside in your neighborhood or yard. This is your own habitat! Spend half an hour outside and observe your habitat. Write down everything you observe on the lines below and make sure you include all the animals, birds and plants that you see. What do the animals and plants look like? Draw some of the things that you see on the back of this sheet. How many different types of animals and plants do you see? Make sure to use lots of detail and complete sentences! We will be talking about this on Friday.

Example Observation: There is a gray squirrel in the biggest tree in my yard. He is eating some kind of nut and his tail shakes around a lot. There are 3 types of trees in my yard. One has big green leaves that are changing yellow. One has smaller leaves and they are all red now. The last has lost all of its leaves already, but the bark is dark brown.

Observations: _____

How many different types of animals did you see? _____

How many different types of plants did you see? _____

C.

Lesson Plans Week 3- Reinforcement of Scientific Method with Lab

Week 3, Tuesday:

Conceptual Goals: Students will be able to construct a good hypothesis after careful observation

Lesson Plan Goals: What is a hypothesis and what makes up a good hypothesis. Give examples: a bad hypothesis and a great hypothesis.

Bad Hypothesis: I think it will sink.

Great Hypothesis: I think the paperclip will sink because it is wire, and seems heavy enough to sink. The paperclip is also not shaped like a boat or anything that would float, even if it was heavy.

Lesson Plan:

Split into lab groups. Hand out a paper clip to each group. Take turns making great observations about the paper clip. Look at the observation examples on the wall from last week. (Shiny, heavy, metallic, curvy, cold, smooth, two rough ends, etc)

Record observations in science journal, with a drawing.

Hand out cups of water. Take turns making great observations about the water. Again, look at the observation examples on the wall. (Tasteless, clear, liquid, bubbles on the side, etc) Record observations in the science journal, with a drawing.

Make a hypothesis. Each group will make a hypothesis about whether the paperclip will float or sink. And they will each brainstorm about how to make the paperclip float. Each person will record their hypothesis in their science journals. Then one person from each group will present their hypothesis and brainstorm to the class.

Week 3, Friday

Conceptual Goals: Results

Lesson Plan Goals: Reinforce hypothesis concept by reviewing what we did last class. Establish what makes up well-thought out results and conclusions.


Results: simply more observations. Describe and draw everything that happens in an experiment. Show good results, show bad results.

Lesson Plan: Split into lab groups. At the front of the class, each teacher will have a cup of water, a paper clip, a piece of paper towel and a pencil. They will demonstrate the experiment for the class and say what and what not to do. Do not bend the paper clip, make sure the paper clip is dry. Try not to touch the paper towel or the water when dropping the paper clip on the paper towel. One person from each lab group will get to come up and make observations about what they see happening after the teacher puts the paper clip on top of the water. These observations are the results! Now each group will get to do the experiment on their own. After everyone has done the experiment and written results in their science journals, the teacher will ask about why this has happened.

D.
Nature Walk Activity



Neighborhood Habitat: Observation and Hypothesis!

1. Choose one living thing (plant, animal or insect) and observe it.
2. Draw your observation right here: 
3. What does it look like?

4. What does it smell like?

5. Where is it located? _____

Now for your hypothesis:



1. What do you think your living thing needs to live? (answer starting with, I hypothesize that...) _____

2. Make a hypothesis about what your living thing eats:

3. Make a hypothesis about what a human might do, that would harm your living thing's habitat?

Appendix E

Scientific Method Assessment

Part 1:

1. Please put the following words in the correct order on the lines below:

Results**Observation****Hypothesis**

Part 2: Circle true or false for the following statements.

When I write a hypothesis, I need to use complete sentences. **True** **False**

I need to use a lot of detail when I write observations. **True** **False**

A hypothesis is an educated guess. **True** **False**

When I write results I should write everything I see happen,
in the order I saw the experiment happen. **True** **False**

I need labels when I draw an observation. **True** **False**

Part 3: Make a Hypothesis!

1. You are given a piece of chalk, a piece of paper towel, and a bowl of water. The experiment is to put the paper towel on the water and then put the chalk on top of the paper towel that is on the water. Make a hypothesis about what you think will happen on the lines below. (HINT: there are many correct answers- be creative!)

Appendix E continued

Part 4: How you feel!

1. Right now, we have science 2 times a week. Would you like to have science (circle one)

less than 2 times a week

3 times a week

4 times a week

everyday

1. How do you feel when we are doing science? (please circle one)

Bored

Excited

Confused

2. If you could change one thing about our science time, what would it be? Please write your answers on the lines below.
