Tuesday December 14, 2004

Mr. Francisco Dallmeier, Director
Mr. Alfonso Alonso, Assistant Director
Ms. Jennifer Sevin, Education and Training Coordinator
Monitoring and Assessment of Biodiversity
Smithsonian Institution
Washington, D.C. 20013-7012

Dear Mr. Dallmeier, Mr. Alonso, and Ms. Sevin,

Enclosed is our report entitled Biodiversity Education Initiative for Middle School Students. It was written at the Smithsonian Institution, Monitoring and Assessment of Biodiversity during the period of October 29 through December 14, 2004. Preliminary work was completed in Worcester, Massachusetts, prior to our arrival in Washington, D.C. Copies of this report are simultaneously being submitted to Professors Demetry and Petruccelli. Upon faculty review, the original copy of this report will be catalogued in the Gordon Library at Worcester Polytechnic Institute. We appreciate the time that you have devoted to us.

Sincerely,

Meryl Gray

Vincent Papia

Peter Vallieres

BIODIVERSITY EDUCATION INITIATIVE FOR MIDDLE SCHOOL STUDENTS

Report Submitted to:

James Demetry

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Worcester Polytechnic Institute

Washington Project Center

By

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In Cooperation With

Dr. Francisco Dallmeier, Director,
Dr. Alfonso Alonso, Assistant Director, and
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Smithsonian Institution Monitoring and Assessment of Biodiversity

December 14, 2004

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Advisor Signature

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Abstract

This report, prepared for the Smithsonian Institution's Monitoring and Assessment of Biodiversity Program, details the research done to determine the current world state of biodiversity education and the best possible methods and format for a biodiversity education program targeted at middle school students. Within the report is an explanation of the purpose, need, goals, methods, execution, results, and recommendations of this project.

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Meryl Gray, Vinny Papia, and Pete Vallieres

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1. Executive Summary

This report focuses on biodiversity education. Biodiversity is defined as the "biological diversity in an environment as indicated by numbers of different species of plants and animals" (Merriam-Webster, 2004). A loss of biodiversity is related to extinction rates and is caused by the disruption of ecosystems, whether by deforestation, urban or industrial expansion, or over hunting (National Zoo, 2004). The Monitoring and Assessment of Biodiversity (MAB) Program under the Smithsonian Institution's National Zoo is dedicated to measuring biodiversity around the world and stopping its loss. They accomplish this goal by using an integrated approach of research and education.

There were two goals we achieved in this project. First, in order to gain a better understanding of the current state of biodiversity education in the world for MAB, we created an inventory of major organizations conducting biodiversity education programs. Second, we conducted research using two methods to make recommendations to MAB for a biodiversity education program for middle school students.

To gather information for the inventory, we used web-based resources. We initially found a list of approximately 200 organizations which conducted some type of biodiversity education program. From this list we selected 31 organizations conducting programs that had been established for at least 2 years and were not available at universities for college credit. We gathered information about these organizations and wrote short summary sheets containing information about their main office location, sources of funding, website, mission, background or overview, education programs and audience of these programs. After collecting this information, we entered it into an Excel spreadsheet in order to develop visual representations of the data.

To gather information for the recommendations we conducted a survey of three middle schools, conducted web-based research of the state curriculum standards for Washington D.C., Virginia, and Maryland as well as the U.S. national curriculum standards, and researched studies on integrating our biodiversity education programs into schools. We created the questionnaires for the survey by asking questions about biodiversity, environment knowledge, and favorite learning styles. After receiving the completed questionnaires by students and teachers we collected the data and put it into an Excel spreadsheet to develop visual representations of it. We did content analysis on the open-ended questions in order to quantify the data.

We searched on the web for the curriculum standards named above. We compared the standards to each other and determined ways in which a biodiversity education program could be implemented in middle schools that would satisfy national and Washington D.C., Virginia, and Maryland state curriculum standards. We supported this information with studies done on biodiversity education in middle schools.

From our inventory we found that fieldwork and lecture are the most popular teaching methods used in biodiversity education programs, North America is the most widely targeted geographical area, and K-12 students, professionals, and K-12 teachers are the largest audiences. From our surveys we found that: environmental education is already implemented in middle schools; most students believe the environment is important to learn about but not all of those students find it interesting; students are not clear on the term biodiversity but some understand biodiversity-related concepts; students and teachers agree that experiments, hands-on activities, computer work, and group work are the most popular teaching methods; teachers have little to no funding for extra

resources; and the Smithsonian could help by providing lesson plans and activities for students. From our research of the middle school curriculum standards we found that: a biodiversity project could satisfy one English standard, three Mathematics standards, two Social Studies standards, and two Science standards; these standards are very similar across the three states and to the national standards; and social studies standards vary from state to state.

We have recommended to MAB that they should:

- continue with our survey process using our revised pair of questionnaires
- continue research of all state academic standards
- create a biodiversity education program that is interdisciplinary
- make lesson plans and activities unique for each grade (6, 7, 8)
- develop specific lesson plans and activities dealing with biodiversity
- keep these plans and activities simple
- use a variety of teaching methods for the program
- provide teachers with assistance in lessons and activities
- develop an effective way of evaluating the program

Through these recommendations, we believe MAB will be able to create an effective biodiversity education program.

2. Introduction

Biodiversity is defined as the "biological diversity in an environment as indicated by numbers of different species of plants and animals" (Merriam-Webster, 2004). A loss of biodiversity is related to extinction rates and caused by the disruption of ecosystems, whether by deforestation, urban or industrial expansion, or over hunting (National Zoo, 2004). The background rate of extinction, or extinctions of species that occur naturally, is generally between 10 and 100 species per year (Evolution: Library: The Current Mass Extinction, 2004). The current extinction rate is now approaching 1,000 times the background rate and has the possibility of climbing to 10,000 times the background rate if current trends continue (Human Impact Triggers Massive Extinctions, 1999). Based on the rate that tropical forests are being destroyed, we may be losing 27,000 species per year in those areas alone. This is due to the large numbers of species that exist in tropical forests (Evolution: Library: The Current Mass Extinction, 2004).

These numbers are indeed alarming. While history has shown that life will recover from mass extinctions, it is a very lengthy process: "And while the fossil record tells us that biodiversity has always recovered, it also tells us that the recovery will be unbearably slow in human terms -- 5 to 10 million years after the mass extinctions of the past" (Evolution: Library: The Current Mass Extinction, 2004) Since our reliance on biodiversity is so great, a loss in biodiversity this severe would have serious consequences for our race. While humanity is a resilient species (being called a "weedy" species because of our ability to adapt to unfavorable conditions), drastically altering the environment like we have been will affect the relative comfort we have been living in. While a significant loss in biodiversity will not likely be catastrophic, it will greatly

affect the quality of life to which we have become accustomed. We rely on biodiversity for medicines, food, fuel, and other necessities. A way to encourage people to be more careful when dealing with the environment is to make them knowledgeable about the importance of biodiversity and what they can do to help conserve biodiversity.

The National Zoo is a zoo and research facility affiliated with the Smithsonian Institution, an internationally-known museum complex and research organization devoted to science, history, and the arts. The National Zoo is home to endangered species such as the Giant Panda and Black Footed Ferret. The National Zoo also works to help restore endangered species in the wild. The Monitoring and Assessment of Biodiversity program (MAB), within the National Zoo, carries on a program of biodiversity education on a worldwide scale. Over the last ten years, MAB's Education and Training Initiative has conducted two successful training courses, aimed at educating resource managers, policy makers, and scientists about the loss of biodiversity arising from a number of factors, including the destruction of ecosystems through industrial pollution and urban expansion. People within MAB create the educational programs and implement them around the world. Ideally MAB would like to educate a majority of the population about the loss of biodiversity, and is seeking a new audience to target.

Middle school students are an excellent new audience on which to focus. They are impressionable and open to new ideas, like the importance of biodiversity. If made aware of this importance from an early age, they will be prepared to face current and future challenges posed to the environment.

There were two goals for this project. The first was to inventory major organizations that conduct biodiversity education programs around the world and the

second was to provide MAB with recommendations for a biodiversity education program for middle school students. The purpose of the first goal was to give MAB a better understanding of the current state of biodiversity education. The purpose of the second goal was to give MAB sufficient recommendations and supporting information so they could create a successful biodiversity education program for middle school students.

If the program is implemented in middle schools, our efforts will have helped future generations learn from the mistakes of the past. Biodiversity is very important to our quality of life and must be conserved. “In the end we will conserve only what we love. We will love only what we understand. We will understand only what we are taught.” (Baba Dioum)

3. Background

In this section we will be discussing the Monitoring and Assessment of Biodiversity program, Biodiversity, and Education

3.1 Monitoring and Assessment of Biodiversity Program (MAB)

The Monitoring and Assessment of Biodiversity program (MAB) within the National Zoo is an organization dedicated to the conservation of biodiversity, mainly focusing on tropical climates in Latin America, South America, and Africa.

3.1.1 MAB's Mission and Objectives

MAB's mission is the conservation of biological diversity. MAB works around the world with governments, industries, academic institutions, nongovernmental organizations, local communities, and others to do research on biodiversity in their respective areas. The program mainly focuses on the tropical and temperate forests of Latin America and the Caribbean, North America, Africa, and Asia.

MAB employs a number of methods in order to fulfill their mission of the monitoring and assessment of biodiversity around the world. These methods include the testing and implementation of techniques and protocols for long-term, technical mappings for monitoring of forests, the establishment of new biodiversity monitoring and assessment projects around the world, the provision of data management and analytical procedures to better allow for the analysis and dispersal of information, and the coordination of the International Biodiversity Monitoring Network (IBMN), a system for implementing globally standardized protocols. MAB has biodiversity monitoring and

assessment programs all over the world, from Gabon to Madagascar, Cameroon to Mexico. In addition to these activities, the MAB staff has published extensively on such topics as forest biodiversity, the need for monitoring biodiversity, and biodiversity database systems.

3.1.2 MAB Courses

Another method MAB employs to accomplish their mission is a set of two biodiversity courses. Both of these courses are typically held at The Smithsonian National Zoological Park's Conservation and Research Center. The first of these is designed to teach people how to monitor and assess biodiversity in their own area. More than 40 internationally recognized instructors and speakers teach the course. It is an intensive, 5-week, 300-hour course designed for resource managers, ecologists, biologists, environmental educators and consultants. The course is varied in its execution. Professionals learn through lecture as well as being subject to a very hands-on approach in which they do fieldwork, laboratory analyses and report preparation. This course is divided into eight modules:

> "**Module 1:** A framework for biodiversity assessment and monitoring. Background information on Geographical Information Systems (GIS), information management and statistics.
>
> **Modules 2-7:** How-to units on the assessing and monitoring of vegetation, aquatic systems, arthropods, amphibians and reptiles, birds, and small and large mammals.

Module 8: A how-to on integrating your biodiversity program, including developing site-based multi-taxa monitoring within an adaptive management framework" ("National Zoo | FONZ", 2004).

The second of these courses, again designed for professionals, focuses more on communication and leadership than on biodiversity. It is a two-week, 80-hour course dealing with issues very different from the first course. This course covers a number of topics, including:

"**Foundation Skills for the Environmental Leader**:

Learn how to enrich your personal leadership style and to recognize and understand the personal styles of others.

Negotiation and Conflict Resolution Strategies:

Learn how to better manage your projects.

Creating Compelling Futures

Impactful Environmental Communication:

Learn how to tell others clearly and powerfully about the important work you are doing and to better explain new and innovative ideas to others." ("National Zoo | FONZ", 2004)

3.2 Biodiversity

Biodiversity consists of three different levels of diversity: genetics, species and ecosystem (Alonso p 4-7, 2001). Direct products and ecosystem services are what make biodiversity important. Through these products and services, life on earth is maintained. The theory of natural selection, or the idea that only the best adaptations within a species result in that species' survival is what causes evolution and allows for the diversity of life.

3.2.1 Diversity

Genetic diversity accounts for variety within the same species and helps to insure that the genes needed for a species to survive, for instance, "disease resistance and physical features" are passed on (Alonso p 6, 2001). Genetic diversity allows for species to adapt and evolve when new circumstances arise in ecosystems (Haury p 1, 1998). Species diversity accounts for different species with their own distinctive characteristics within an ecosystem. Species survival is based on their ability to reproduce with a member of their species. Lastly, ecosystem diversity, the mixture of living and non-living environmental elements, is important because all parts of the earth interact to make one complex system (Alonso p 7, 2001). Ecosystems vary in climate from the rainforest, desert, arctic, mountains, and many more. The elements of the ecosystem have adapted over time to interact and coexist within the complex system. The three diversities together are what make biodiversity.

3.2.2 Direct Products

Biodiversity is important because of the many products it creates (Alonso p 8-9, 2001). Some products gained are foods: fruits, vegetables, grains, nuts, etc. Natural medicines are obtained from a variety of plants, in addition to painkillers which are derived from plants. Our homes are also filled with direct products; fuel, timber, and fiber are all natural resources.

3.2.3 Ecosystem Services

Ecosystem diversity helps to keep the earth inhabitable (Alonso p 10-13, 2001). Trees take the carbon dioxide we release and change it into oxygen. Water is purified through the organisms that live in the marshes and wetlands. The food we eat often comes from pollination of plants like blueberries. Plants help to hold the soil in place to prevent erosion when it rains. The soil holds thousands of organisms that transform waste into nutrients. The earth is distinctive because of the relationship between all the different ecosystems and the species that live in them.

3.3 Education

One of our goals is to provide recommendations to MAB so they can develop an education program for middle school students to learn about biodiversity. In order to develop an effective program, we must provide them with information about middle school students and what motivates students to learn.

3.3.1 Middle School Students

Before MAB can design an effective education program, we must gather information about the students being taught. Looking at middle school students we must realize that they are young people in a major transition phase of their life. They are intelligent and do not take everything adults present to them as the truth (Santrock p53, 2004) as with the case of elementary school students. Also, they are not quite at the abstract thinking level of high school students.

Not being children any longer, and not being quite young adults, middle school students are in a unique development period of their academic and social lives: adolescence. It is a time of major physical, emotional, mental, and social changes in a young person's life (Brinthaupt & Lipka p 4, 2002). These changes allow adolescents to start to discover self-consciousness, and shape the person they will become as adults. Adolescence results in a person who is "expected not only to be responsible for his or her actions, but to make big decisions, express preferences, and defend beliefs (Letendre p178, 2000)." Children become adults during adolescence.

Middle school students are adolescents. An education program for middle school students must take this into account. To successfully educate students at this level, an education program should motivate the students' interest in the subject, have a clearly defined set of objectives, include forms of active participation in a class setting, and use cooperative group work.

3.3.2 Motivation of Students

The first step in effectively educating middle school students is to find a way to motivate them. This is done by first making the education course authentic (K. Scopinich, personal communication, September 21, 2004). If the students realize that the course or program has no purpose or they do not see that it can help them gain knowledge, they are not going to be interested. Thus, it is important that the program or course has some kind of authenticity to it. Perhaps it has a real world application, or its goal is to achieve something that the middle school students can use later.

After establishing authenticity of the course or program, there must be something that grabs the students' interest (Pintrich & Schunk p127, 1996). The Audubon Society in Lincoln, Massachusetts for example, has an agreement with middle schools in the area where the students complete a community service activity with the Audubon Society. The Audubon Society tries to hook the students into participating in the program by allowing them to perform active community service work in the outdoors. The hope is that this will interest them in the program and while they are contributing in the program they will find other hooks that show them that biodiversity is important and interesting. The key to motivating students is to understand them and what they find interesting, and to know what they want to get out of the course.

3.3.3 Objectives

The next part of having an effective education program is to have a clear set of objectives for that program. Until objectives are "established the learner has little direction or guidance regarding what he should be able to learn, and the teacher has no

basis for either evaluating achievement or assisting that learner to that achievement" (Lancaster p 2, 1974). Objectives illustrate what to expect from the course and provide a way to assess the student. The first step in developing objectives is to efficiently communicate the expectations. Objectives must be simple statements that are clear for both the teacher and students. They need to communicate directly what the purpose of the course will be. Objectives are best understood when they are expressed as action verbs (Dunn & Dunn p 32, 1993). A few examples are "differentiate between, identify outcomes of, solve a problem for, and compare and contrast" (Borich p 112, 1992). The key action verbs here are differentiate, identify, solve, and compare and contrast. These action verbs combined with a simple, well-stated sentence will directly communicate the objectives. For example: "at the end of this lesson the student will be able to differentiate between deciduous and confiner trees by looking at pictures of both kinds of trees." This example tells the student and teacher what the student should learn, and is easily understood.

Objectives also give the teacher an opportunity to assess the student. The teacher needs to know if the student has achieved the desired knowledge, thus an assessment of that desired knowledge is necessary (Lancaster p76-83, 1974). Using the example above, the teacher will test the students' knowledge by giving the students pictures of different trees and asking them to differentiate between the two kinds of trees. How that assessment is done is up to the teacher. This gives the teacher an idea of whether or not the objective was achieved. Objectives are the first point in creating an effective educational course because they provide a clear idea of what knowledge should be gained, as well as a way to assess if that knowledge was actually gained.

3.3.4 Active Learning

Once the objectives are defined, one can begin to look at effective ways in which the knowledge is to be given. It is widely accepted that the best way to have students learn is to have "the students become active, overt participators in their education-not passive" (Lancaster p55, 1974). This type of learning is called programmed or active learning. The idea behind active learning is to have students always active in the educational setting; the more active students are, the more they tend to learn new knowledge and behaviors (Dill p 208, 1990). There are many ways to apply active learning, and all increase the effectiveness of an educational program. Meyers and Jones (1993), show in their book that active learning can be broken down into talking, listening, writing, reading, and reflecting. These teaching strategies combined with a lesson plan that engages students moves the class along steadily but quickly, and teaches in a way that recalls earlier topics, grabs the students' interest and allows them to become active learners (Harmin p 49, 1994).

This can be achieved by using different methods which include lecture, discussion, questioning strategies, and cooperative work. Lecture may be the least active of all because it is teacher-centered. However, if done properly, the student will understand why it is important to gain factual knowledge and then become interested and active in the topic (Lancaster p 57, 1974). Discussion is slower in getting ideas and knowledge across to students, but is one of the most active methods and allows the student to become part of the lesson (Borich p 68, 1993). Discussion allows students to evolve thoughts by seeing many points of view. Questioning strategies takes the best of lecture and discussion and combines them (Eble p 117, 1988). It is teacher-centered like

lecture, but requires students to be involved in the lesson and lets them see many points of view. Finally, the most active and important teaching style is cooperative work.

3.3.5 Cooperative Work

Cooperative work is an excellent tool that can be implemented into any education program because it provides a realistic task that the students can work on. Working in cooperative groups encourages the students to combine talking and listening, reading, writing, and reflecting (Meyers & Jones p 98, 1993). It also allows students with different learning styles to come together and use each other's strengths (Dunn & Dunn p 8, 1993). Students are faced with a common goal or objective to achieve, and by working together the students are actively learning. They are responsible for their own, and the members of the group's education, with only direction and guidance given by the teacher (Harmin p67, 1994). This is the best example of active learning. It also helps students develop socially by interacting within a group (Borich p 92, 1992). They learn appropriate social behavior, how to understand and consider alternative perspectives and viewpoints, and achieve a higher thought process (Hertz-Lazarowitz & Miller p 134, 1992). Cooperative learning provides the ingredients for higher thought processes to occur and sets them to work on realistic and mature tasks.

Motivation, active learning, objectives, and group work combine to create effective learning. Increasing student interest in subject matter will motivate them to learn. Objectives give students and teachers a clear idea of what should be gained as well as a means for assessment. Active learning involves everyone in the educational process. Group work combines with active learning and puts the students in charge of their

education. In summary, education is most effective when the students are motivated, objectives are clearly stated, the environment for learning is active, and they are given a chance to pursue their own education.

3.3.6 Science and Biodiversity Education

Today many students are deciding during the middle school years that they will not pursue a career in a science or mathematics related field. This is especially true for minorities and young women (Coyle, 2004). This poses a major problem for the field of biodiversity. By the time students reach high school they probably know very little about biodiversity, and already lack interest in the subject. This makes middle school students a critical target audience for science and biodiversity education. To educate middle school students about science and biodiversity it is necessary that their current beliefs and concepts be challenged and that new concepts are introduced to them. This is best done by applying an effective education program, getting them to ask questions about the subject, and using hands-on and interactive learning to get middle school students interested in science and biodiversity.

3.3.7 Importance of biodiversity education

The earth has been evolving since the beginning of time. With each volcano eruption or earthquake the species around the natural disaster have to adapt to a new environmental condition. According to David Haury, “it is sobering to realize that we seem to be in the midst of the sixth great period of extinction and, we seem to be causing it…caused by the rapid destruction of habitats, depletion of resources, and the ecological

mixing of incompatible species" (Haury p 1, 1998). This shows that education about biodiversity is important because humans are a cause of the loss of biodiversity and therefore need to be educated about how to stop the loss. The article goes on to talk about the services of biodiversity and the benefits of products like medicines for society. Biodiversity conservation is directly linked to the welfare of the human race through economic, ecological and environmental quality. The benefits of conservation of biodiversity are listed by Bryant (2002) as potential for:

- "Broadening our food supplies
- Increased use of biological control agents
- Potential sources of genes for hybridization and genetic engineering
- Increased use of natural products
- Recognition of environmental services performed by wild organisms
- Sources of warning signs to offset the lack of health screening test
- Provision of model systems for basic scientific research
- Aesthetic value of interesting wildlife and plant life
- Future benefits yet to be determined"

The potential benefits of biodiversity conservation are important to all species. Earth is in a constant state of evolution and species are constantly adapting to changes and without the adaptations the species becomes extinct. Especially now that people are causing many of the reasons for adaptations it is important to educate people about biodiversity. Middle school students are especially important because they are the future generation for the planet and the ones who will be the decision makers in the future.

4 Methodology

The goals of this project were 1) to inventory major organizations that conduct biodiversity education programs around the world and 2) to provide MAB with recommendations for a biodiversity education program for middle school students.

The project was organized and managed as three distinct but interrelated activities:

- To create an inventory of major organizations that conduct biodiversity education programs
- To survey students and teachers about biodiversity education, and conduct archival research about biodiversity education
- To research national and Maryland, Virginia, and Washington, D.C. curriculum standards for middle schools and find where biodiversity education meet the standards

Strategies for completion of each part of the project are explained in this methodology section.

4.1 Inventory of Organizations

For the first part of our project we created an inventory of organizations that conduct biodiversity education programs. The purpose of this inventory was to give MAB an idea of the current state of biodiversity education programs offered by various organizations. We considered only those organizations whose programs were established and ongoing, and were not offered at a school, university, or college for credit towards graduation. To complete this inventory we searched the World Wide Web using key

phrases such as “biodiversity education”, “biodiversity training programs”, “environmental education”, and so on. From our research we determined where these organizations were located, what audiences they were targeting, and what methods of education were being used.

We initially created a list of approximately 200 organizations. After further review, we narrowed the list down to the 23 which met our standards. When we reached this point we began to write short summary sheets for these 23 organizations (see Appendix C for the summary sheets). The purpose of making the summaries about the organizations was to have all the information provided by the websites in a form we can easily access and understand. For the summary sheets we used the format that a past intern, Mike Elion, used. We also combined our research with 8 organizations he found in his time with MAB bringing our total number of organizations to 31.

In the summary sheets we listed the homepage of each organization, a short overview or background, the mission of the organization, any education programs they provide, the audience of these programs, and the organization’s source of funding. Once these sheets were completed, we entered the information into an Excel spreadsheet. To organize this information, we determined a number of points of information we decided were important to know about each organization. These points of information were the organizations’ government affiliation, their geographic location, the area of the world their education programs target, the types of people the programs target, the organizations’ sources of funding, the first year a program was given by a certain organization, and the method of education the organizations used in their programs.

Using the spreadsheet we were able to make graphs and charts for a visual representation of the information collected.

4.2 Surveys on Biodiversity Education

Our project made recommendations for a biodiversity education program to be implemented in middle schools. This required that we know the status of biodiversity education at that level. This was accomplished by surveying middle school students and teachers.

4.2.1 Student and Teacher Surveys

We employed survey methods to gather information from students and teachers. We created one questionnaire for students, another for teachers. See Appendix B for full copies of the questionnaires. Our questions for the students' questionnaire were crafted to give us a better understanding of:

- Biodiversity education in middle schools
- Student knowledge of the Smithsonian Institution
- Environmental activities students have participated in
- The nature of the environmental activities
- Student interest in environmental education
- Effective teaching methods

We limited the student questionnaire to one page so that it would not be overwhelming for the students and so that they would be able to complete it in less than fifteen minutes. The student questionnaire contained both open-ended and closed questions. Also, it is important to note that we felt it would be necessary to ask the students about the

environment and environmental education and not just biodiversity and biodiversity education because 1) the students may not have heard of biodiversity before, and 2) biodiversity is a topic within the broader topic of environment education. The teacher questionnaire was kept to only two pages in length so that the teachers would be able to complete it in less than fifteen minutes. This questionnaire was created to give us a better understanding of:

- Teacher understanding of biodiversity
- Preferred and effective teaching methods
- Resources teachers would want/need to educate students about biodiversity
- Teacher knowledge of the Smithsonian Institution

These surveys helped to provide us with a better idea of the level of biodiversity education in the classroom.

Initially we wanted to present these surveys to seven counties around the Washington, D.C. area. These seven counties were Calvert, Caroline, Howard, and Montgomery in Maryland, Fairfax and Loudon in Virginia, and Washington, D.C. Due to the limited amount of time to complete the project we were going to survey one school from each county. We had hoped to get two classes from each school to take the survey. This would have given us fourteen teachers and about three hundred and fifty students if the class size averaged twenty five students per class. After making fifty-nine phone calls to schools in these counties, we had left twenty-three messages with teachers, e-mailed ten teachers, and personally spoke with four teachers. No teachers responded to our messages, and one teacher responded to our e-mails. The teacher that responded to our e-

mail said that he would take the survey, but could not give it to his students because we first needed permission from the county Board of Education. The four teachers we spoke to also told us that we could not conduct surveys until the county Board of Education had given us permission.

We then contacted the Board of Education for the counties of Howard, Montgomery, Caroline, and Fairfax to request permission to distribute the surveys. The Board of Education for Howard, Montgomery, and Fairfax each gave us an application to fill out to be able to conduct the surveys in the counties. There was a very strict application process, and it would have taken at least one month before we would even be approved. This wait was too long for us, considering our project timeline. Instead, we contacted our hometown teachers in Fitchburg, MA and in North Yarmouth/Cumberland, Maine, as well as teachers our liaison, Jennifer Sevin knew in Grayslake, Illinois and in Hendersonville, North Carolina. Since these were teachers who we knew, they were willing to take the teacher surveys and give the student surveys to their classes. These teachers provided us with gracious support, and helped to provide us with information necessary for the completion of our project.

4.2.2 Survey Organization

The information provided by the student survey was entered into an Excel spread sheet. A set of categories was established based on the questions asked in the surveys. These categories were:

- Biodiversity knowledge
- Smithsonian knowledge

- Environmental activities (in-school or outreach and type of activity)
- Types of environmental activities
- Environmental topics learned in school
- Environmental interest
- Environmental importance
- Preferred classroom activities

After the data were organized in a spread sheet, we were able to make visual representations of the data.

The teacher responses were not organized in a spread sheet as were the student responses. Instead, we analyzed the teacher information to determine whether or not the students and teachers were in agreement. We looked at each of the teacher questionnaires and compared the responses with those of the students.

4.3 Biodiversity Education and Curriculum Standards

If biodiversity education is to find a place in middle schools, it must be demonstrated that such materials and topics contribute to the current curriculum standards for this level. To accomplish this we first looked at the National Education Curriculum Standards for middle schools which we found on the web. We found ways in which a biodiversity education program will fit into the national standards for language arts, mathematics, social studies, and science. Next we looked at the education curriculum standards for Maryland, Virginia, and Washington, D.C. because of their proximity to the Smithsonian Institution in Washington, D.C. In addition, we compared

the three state education curricula to find which aspects of the national standards were most often used in order to create a program that could be implemented nation wide.

We also determined the ways in which biodiversity is already being integrated into middle school curricula. To supplement the research of standards, we searched on the web for articles and studies that had been done about integrating outdoor biodiversity programs into schools. This served as a reference on how the program can best fit into the already existing middle school curriculum.

We reported to the MAB program our findings on how biodiversity will be able to complement the curriculum used in middle schools. These findings also helped us to create our final recommendations by showing how biodiversity education can be effective across many different subjects taught in middle schools.

5. Results and Discussion

5.1 Inventory of Biodiversity Education Centers

We have found 31 major organizations that have a program or programs that focus on biodiversity education. Our research has yielded 23 organizations which we combined with research done by a past intern, Mike Elion, to reach our total. For a description of our research process for the inventory, please refer to Chapter 4 Section 1.

5.1.1 Government Affiliation of Organizations

Of the 31 organizations we researched in depth, 24 were non-government organizations and 7 had government affiliations. This is represented in Figure 5.1. The non-government organizations were universities, museums, or groups of scientists. The organizations with government affiliations were all state organizations or reported directly to some branch of government.

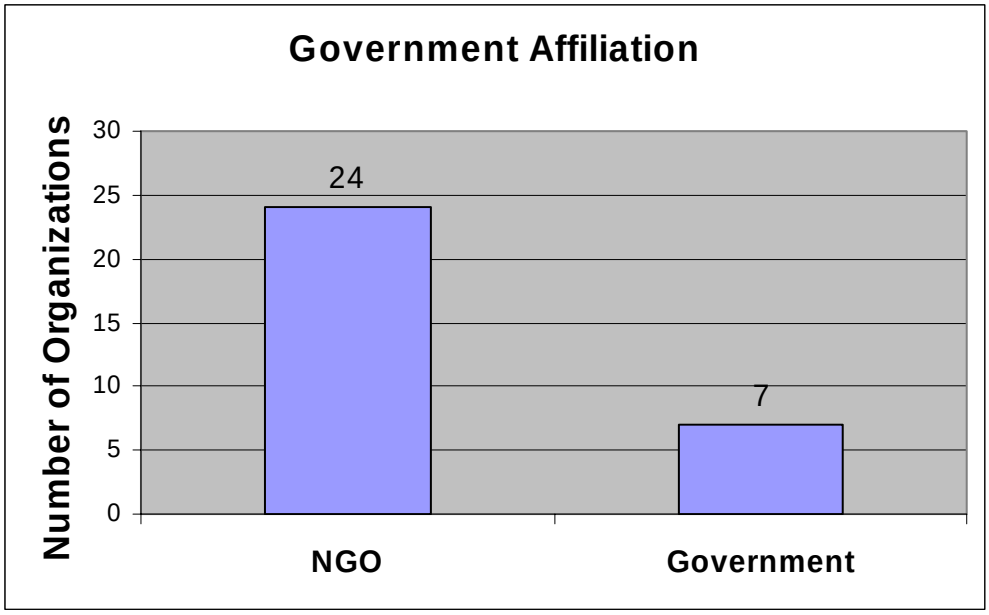


Figure 5.1: Government Affiliation of Organizations (out of 31 organizations)

5.1.2 Main Office Location of Organizations

From our inventory, we found 23 organizations whose main office was located in the United States. Fewer programs had offices located in the United Kingdom, Australia, Belgium, Thailand, and Canada. This is represented in Figure 5.2. Within the United States there was no uniformity of location, the organizations have offices scattered throughout the country.

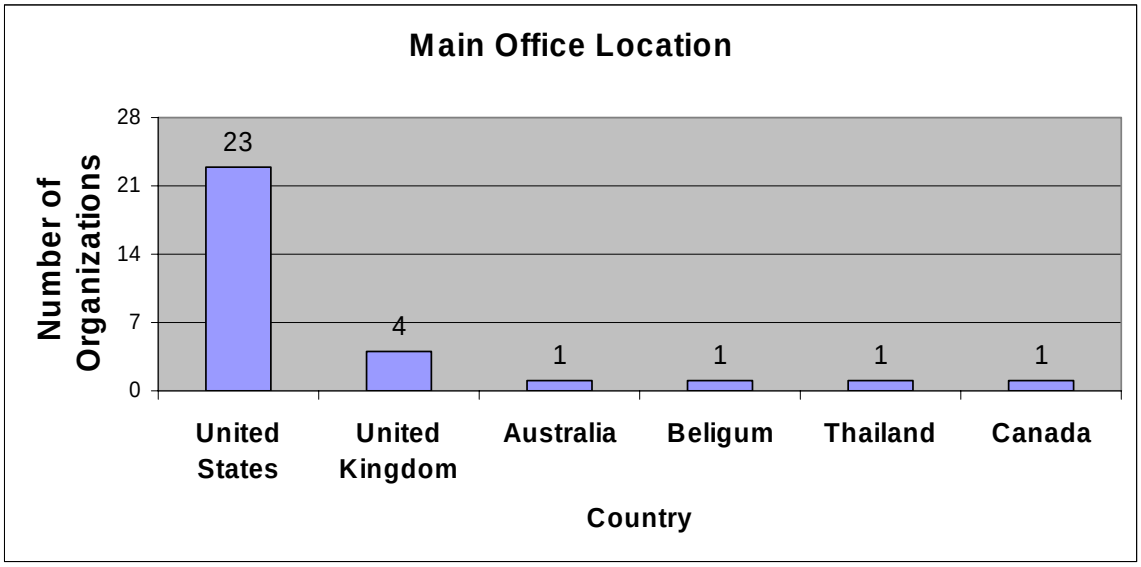


Figure 5.2: Geographic location of Main Offices of Organizations (out of 31 organizations)

5.1.3 Funding of Organizations

These organizations receive funding from a number of different sources. Donations, private funding, and government contributions are the largest. Much of the private funding comes from grant foundations. Other contributions come from corporations, merchandise sales, organization membership fees, and university funds. Refer to Figure 5.3 for a graphical representation of these data.

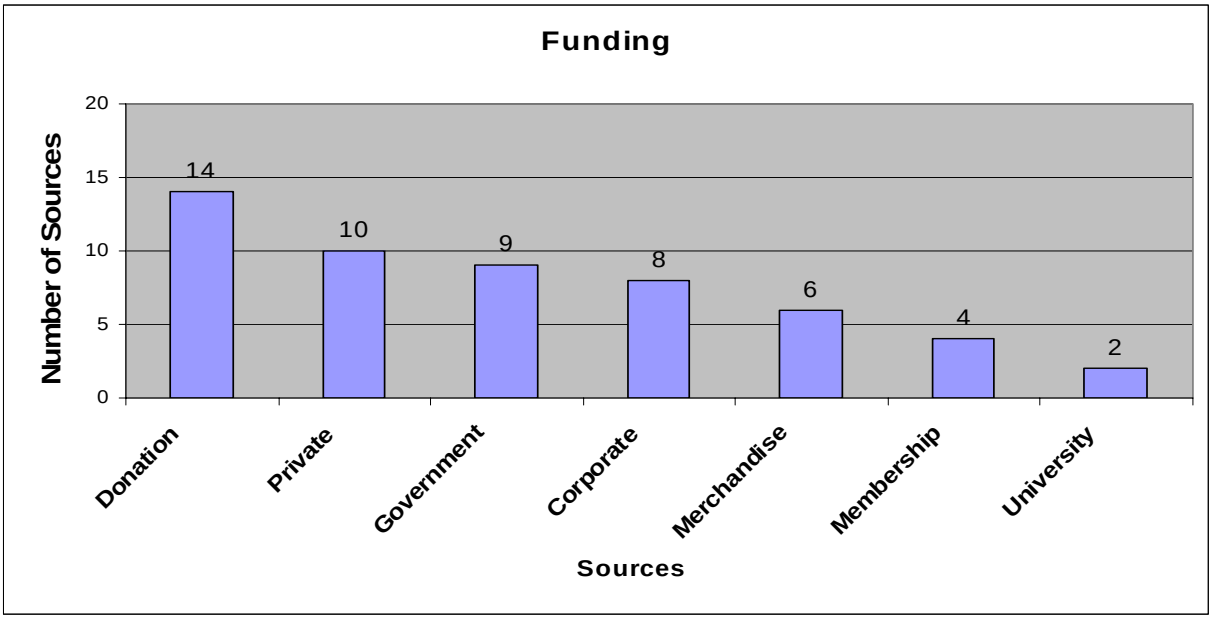


Figure 5.3: Sources of Funding of Organizations (some organizations have more than one source of funding)

5.1.4 Starting Year of Programs

Most of the 31 organizations we researched started their programs within the last 15 years. Fewer programs were started before the 1990s. Since the importance of biodiversity was not widely publicized until the late 1980s, this is not surprising. Many organizations do not make the date they began their programs available on their websites. The information we gathered is represented graphically in Figure 5.4.

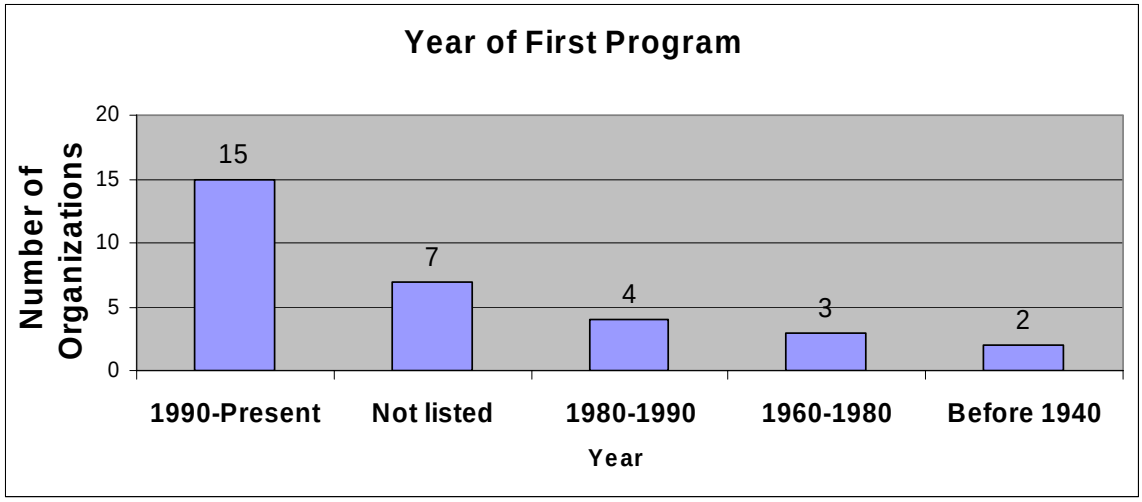


Figure 5.4: Year Organizations Started First Program (out of 31 organizations)

5.1.5 Target Geographical Area of Programs

A majority of the organizations we researched conducted programs within the United States. A few organizations have multiple programs that target audiences around the world. A graph of our findings can be found in Figure 5.5.

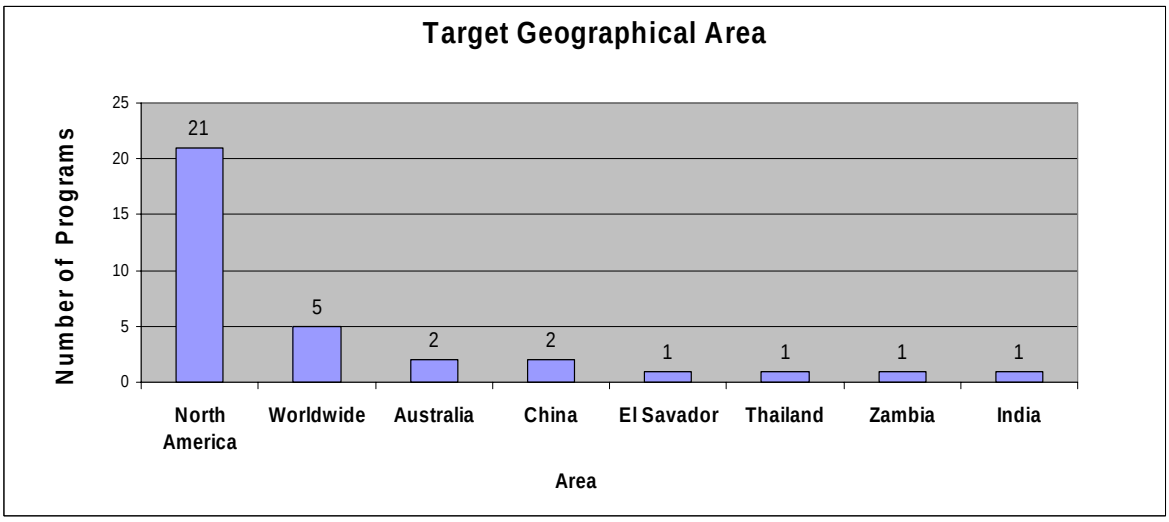


Figure 5.5: Geographical Area of Target Audience of Programs (some programs target more than one area)

5.1.6 Education Methods Used in Programs

There are 6 major methods of education these organizations use to teach about biodiversity. Fieldwork and lectures are the most popular methods used in these programs, which is not surprising because of the nature of biodiversity. Biodiversity is a subject that is tied to the environment and interactions within it. Teaching about biodiversity in an outside setting seems to be the best way of doing so. Other methods include workshops, group work, lab work and discussion. These findings are represented in Figure 5.6.

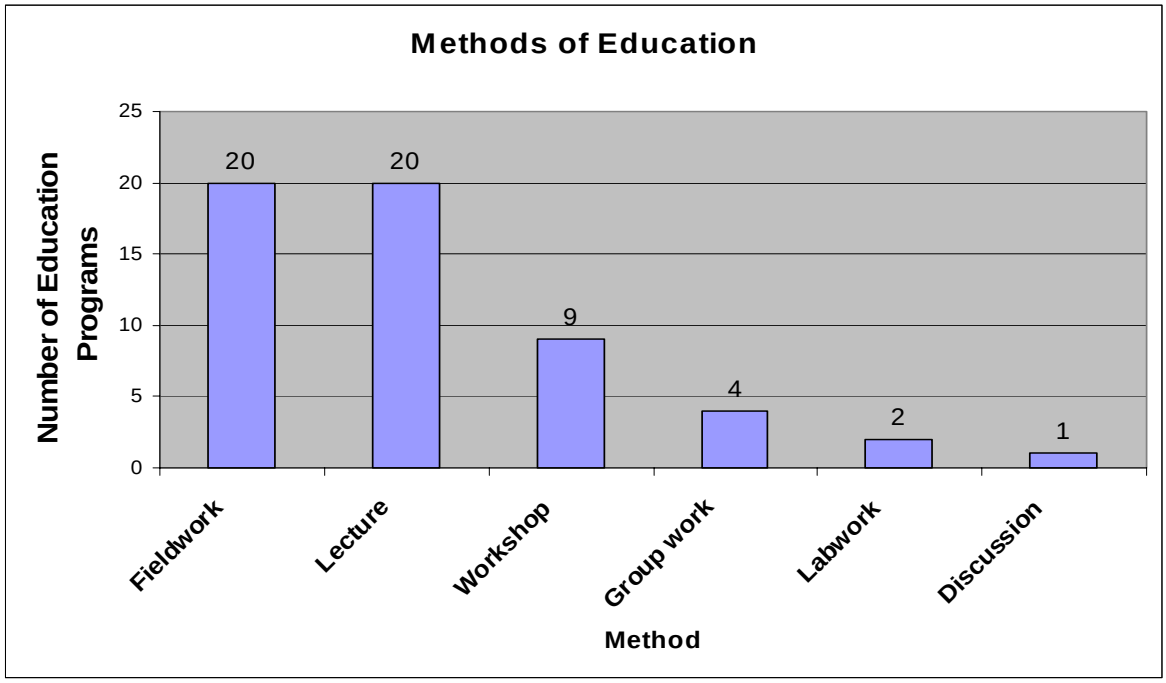


Figure 5.6: Methods of Education used in Programs (some programs have more than one method of education)

5.1.7 Target Audience of Programs

The most targeted audience we found was K-12 students. Since the foundations of education are formed in these years, this was not a surprising result. The breakdown within the K-12 audience shows that education is fairly evenly distributed between

elementary, middle and high school. Professionals are the second largest targeted group. Since professionals in the area of ecology, biology, and the environment make important decisions that affect these areas, it is important to educate them about biodiversity. And since teachers are the people who impart knowledge to students, it seems logical that they are the third largest audience. The two other major audiences were the general public and college and graduate students. These audiences were not targeted as much as the first three audiences were. A visual representation of our findings can be found in Figure 5.7.

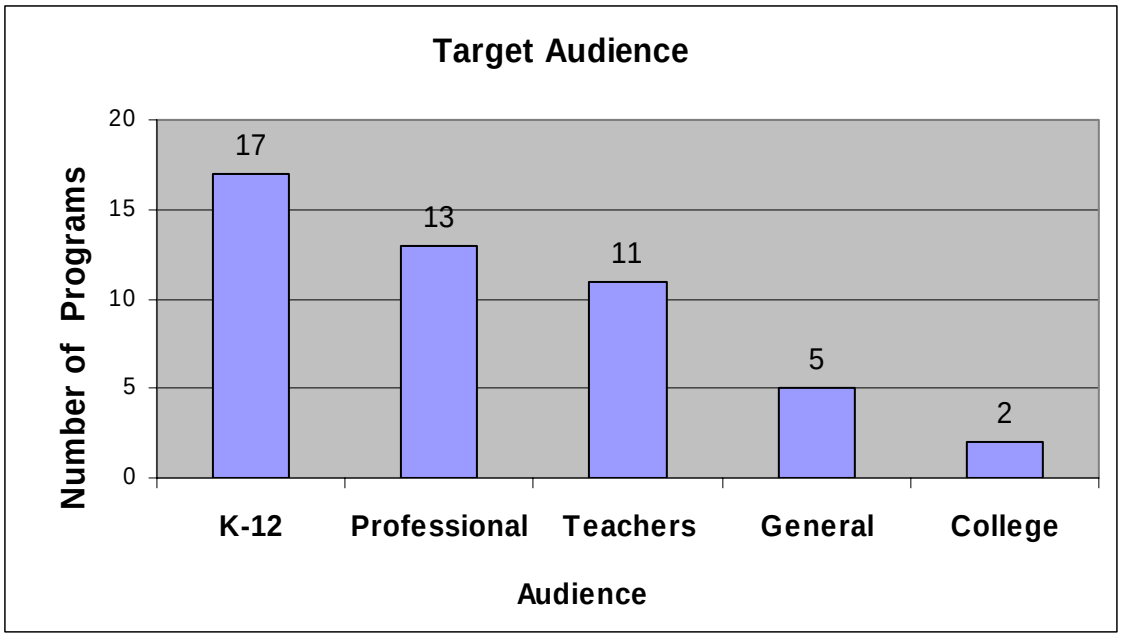


Figure 5.7: Target Audience of Program (some programs target more than one audience)

5.2 Surveys of Middle School Teachers and Students

We sent out questionnaires for middle school science teachers and students to three middle schools; Cumberland/North Yarmouth, Maine; Fitchburg, Massachusetts; and Hendersonville, North Carolina. From these middle schools we received 265 student

questionnaires and 7 teacher questionnaires. The Maine and North Carolina schools were public; the Fitchburg school was private. This section reviews important results from the surveys. A description of the survey process can be found in Chapter 4 Section 2 and copies of the student and teacher questionnaires can be found in Appendix B.

5.2.1 Results and Discussion of Student Surveys

The purpose of the first important question on the student questionnaire was to find out if students knew what the term biodiversity means. Table 5.1 shows that only 7% of students responded with a correct answer based on their grade level. A large majority (82%) of the students did not respond at all or answered "I don't know" to the question. The other 11% of the students attempted to answer the question, but did not really have an understanding of what the term biodiversity meant.

Table 5.1: Do Students Know What "Biodiversity" means? This table shows the percent and number of students from each grade and all grades combined that gave us a correct answer, attempted an answer but were not correct, and did not attempted to answer.

	All Grades		**Sixth Grade**		**Seventh Grade**		**Eighth Grade**	
	%	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**
Correct Answer	7	19	2	2	7	6	11	10
Attempted Answer	11	28	7	6	20	17	6	5
Not Attempted	82	219	91	84	73	62	83	73

Overall, a significantly greater percentage of eighth grade students knew what the term biodiversity meant. However, the survey suggested that most students, not depending on grade, do not know what the term biodiversity means. Interestingly, this does not mean

that students are not learning about biodiversity related topics in school. It simply means that they are not associating the term biodiversity with some of the environmental topics they are learning. Figure 5.8 shows that out of 265 students, 41 said that they had learned about biodiversity related topic such as different types of ecosystems, habitats, and the variety of species of plants and animals.

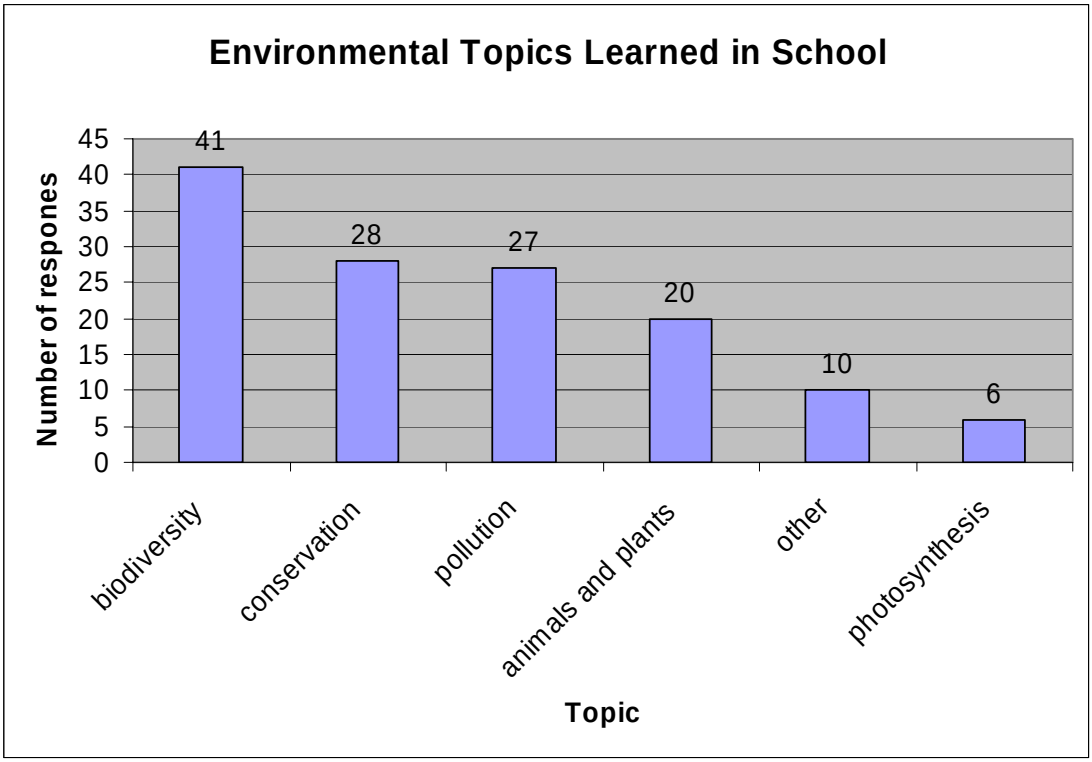


Figure 5.8: Students response to the environmental topics they have learned in school (not all students gave a response and some students gave multiple responses)

Note that "plants and animals" is another group in the environmental topics graph. "Plants and animals" was a general answer given by twenty students, and was put into its own group. It was not considered part of the "biodiversity" because some students answered that they had learned about different types/species of plant or animals which is more closely related to biodiversity than just generally "plants and animals." Between each grade, there were no significant differences in the types of environmental topics

students have learned in school. For all grades, biodiversity related topics were always the most popular response. This suggests that even though students do not know what biodiversity is, they are learning about topics related to biodiversity through education focused on the environment.

We also wanted to know if students thought the environment was important to learn about. Table 5.2 shows that a vast majority (95%) of the students surveyed said that the environment was important to learn about.

Table 5.2: Do Students Think That the Environment is an Important Subject to Learn About? This table shows the percent and number of students from each grade and all grades combined that responded by saying "Yes" and by saying "No."

	All Grades		**Sixth Grade**		**Seventh Grade**		**Eighth Grade**	
	%	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**
Yes	95	242	90	83	96	82	97	85
No	5	13	10	9	4	3	3	3

The sixth grade students responded to this question positively at 90%, with a slightly lower percentage than the whole group. Seventh and eighth grade students responded positively slightly higher than the group at 96% and 97% respectively. This suggests that the students surveyed believe the environment is an important subject to learn about. Also, as the students move into higher grades, the percentage of students responding positively grows. This may be because the students in the sixth grade surveyed have not yet been exposed to topics about the environment, and some students do not yet find importance in learning the subject. Since the seventh and eighth grade students surveyed

have had more of a chance to be exposed to environmental topics those students may be more inclined to feel that the environment is an important subject to learn about.

While the survey showed that students felt the environment is important to learn about, not as many students felt that learning about the environment was interesting. Table 5.3 shows that 65% of students find the environment interesting to learn about.

Table 5.3: Are Students Interested in Learning about the Environment? This table shows the percent and number of students from each grade and all grades combined that respond by saying "Yes" and by saying "No."

	All Grades		**Sixth Grade**		**Seventh Grade**		**Eighth Grade**	
	%	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**
Yes	65	171	71	65	73	62	64	56
No	35	93	29	27	27	23	36	32

Even though 65% is a majority of students who are interested about learning about environment, it leaves quite a large number of students who are not interested. Many students (80) said that the environment is an important subject to learn about also said that they were not interested in learning about it. This poses a problem for environmental, and by association biodiversity, education. How does an environmental, or biodiversity, education program engage those students who feel it is important to learn about, but do not think it is an interesting subject?

One answer may be to use classroom activities that students prefer. This is something we also asked on the surveys. Between ten different choices students chose the classroom activities they preferred best; they were allowed to select more than one

answer. Figure 5.9 shows that experiments and hands-on activities are the most preferred classroom activities for students, with 209 and 208 students responding, respectively.

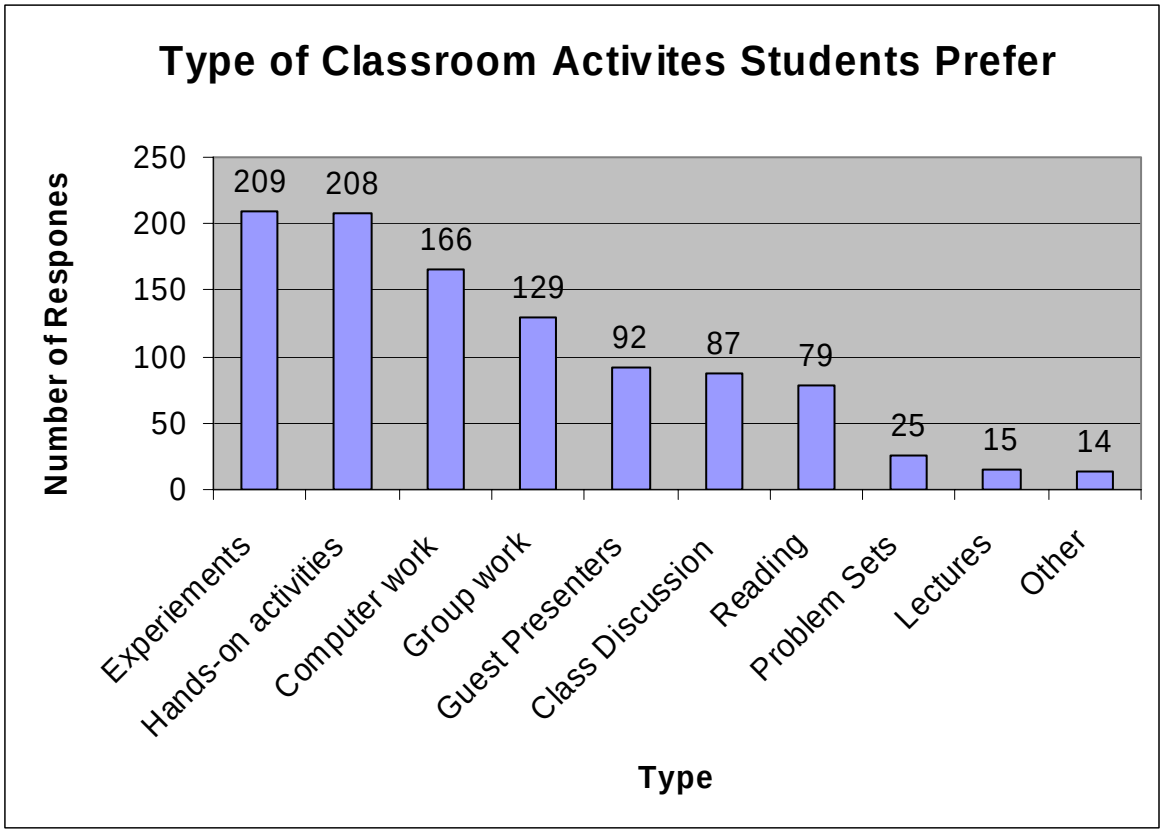


Figure 5.9: Students' response to the types of classroom activity that they prefer; some students gave more than one answer

Computer work and group work are also very popular classroom activities for students. Using activities such as hands-on work, experiments, computer work, and group work while teaching students about biodiversity might be the best way to get them more engaged and interested in the subject.

The results of the survey show that there are some differences between the grades and those differences are discussed. There do not seem to be any significant differences between the public schools and the private school, nor between the geographic locations of the schools.

5.2.2 Results and Discussion of Teacher Surveys

The teacher surveys gave us results from only 7 teachers. This is not enough to give us a clear idea of biodiversity education from the teachers' perspective. However, this does not mean the data given to us by these 7 teachers are not important. When the teachers were asked if students were interested in science related topics, all of the teachers agreed that the students are generally interested, and especially when the topics use some kind of hands-on activities. This goes along with the question about which methods their students learn from and respond to best. All teachers said that students learn best through labs, hands-on activities, and group work. Both of these results directly relate to the students results of which activities they like the best. Students and teachers agree that the best way for students to learn is through hands-on work and group work.

We also asked the teachers if students have an understanding of what biodiversity means. Similar to the results we got from the students, all but one teacher responded that the students get the basic idea of what biodiversity is, although they may not recognize the term. The one teacher who did not give similar answers to the other teachers was a physical science teacher and simply said that the question did not apply to his/her subject material, so he/she did not know. This is consistent with the student results in that they did not know what biodiversity meant, but they do learn about biodiversity related topics. All the teachers except the physical science teacher said that they addressed topics related to biodiversity when they were working on some kind of environmental education.

We also found out about the teachers' resources, funding, and what teachers think the Smithsonian can do to improve biodiversity education. The types of resources that teachers seem to have access to in the classroom are text books, magazines articles,

newspaper articles, and computers. Teachers all agreed that they have very little if any funding to buy students extra material and resources for the classroom. All the teachers said it would be helpful if the Smithsonian were to help educate students about biodiversity. Some of the things that the teachers thought the Smithsonian could do would be to provide lesson plans about biodiversity, activities for the students that help make biodiversity "real", provide extra materials such as videos, and provide teacher workshops.

5.3 Curriculum

The national curriculum is a guideline for all schools in the United States, intended to keep all students at the same academic level and keep consistency between states. The standards researched for this project can be found in Appendix D. Each subject has its own council which sets up and designs the education standards for that subject. In addition, each state also has its own modified set of standards that are more detailed than the national standards, but follow the same pattern and headings as the national standards. The guidelines are also broken up into a set of grades, K-5, 6-8, and 9-12 and then into each grade and subject in order to give the most detailed guideline possible. The standards we looked at were English, Mathematics, Social Studies, and Science in the grade set 6-8 for Maryland, Virginia, Washington, D.C., and nationally.

The national English standards set up by the National Council of Teachers of English include twelve standards. For this project we chose to use standard number seven, which requires the students to produce a written report on a chosen subject and orally report on it in groups and individually. This satisfies the state standards for English

as well. For an educational biodiversity project this standard would be satisfied by an assessment of the project in which the students complete a written and oral project report.

The national Mathematics standards set up by the National Council of Teachers of Mathematics include thirteen standards. The Mathematics standards chosen for this project are Mathematical Connections, Patterns and Functions, and Measurements. The state standards chosen are the ones that are close to the same headings as these three. Part of the scientific process is to collect and analyze data. In order to analyze the data, students need to be able to take accurate measurements for their data, estimate the results, find patterns within the results and, compare ratios of the results. Within the biodiversity educational program these standards are satisfied by the techniques and procedures learned through the experiments done in class.

The national social studies standards set up by the National Council for the Social Studies include ten standards. The standards that are satisfied by the biodiversity project are People, Places and the Environment, and Science, Technology, and Society. The social studies standards on the state level vary more than in other subjects. These standards are based more on the state history and sociology than are the national standards. Therefore a biodiversity project in the students' schoolyard helps to satisfy each state's standards. It is also important for the students to understand the social implications of significant losses of biodiversity locally and worldwide. In addition, students must learn about how people and technology are affecting the environment and what implications that has on society.

The national science standards set up by the National Academies of Science include seven standards. The state standards are the same as the standards that are

satisfied by a biodiversity project: Science as Inquiry and Life Science. Scientific inquiry, another term for the scientific method, would be the basis of an educational program where students participate in a biodiversity project. In addition, the life science standard relates to the genetic, species, and ecosystem diversity that make up biodiversity.

The educational biodiversity project allows the students to apply real-life situations across all aspects of the curricula for national and state standards.

6. Conclusions

6.1 Conclusion from Inventory

We have drawn four major conclusions from the inventory we created. These conclusions are:

1) Fieldwork and lecture are the most popular teaching methods used in biodiversity education
2) North America is the most targeted geographical region for biodiversity education
3) K-12 Students, Professionals, and K-12 Teachers are the most popular audiences for biodiversity education
4) Organizations do not make evaluations of their programs easily accessible to the public

The purpose of this inventory was to give MAB an idea of the current state of biodiversity education in the world as offered by organizations that met the criteria explained in section 3.1. This inventory has done just that.

6.2 Conclusions from Surveys

We have been able to draw six conclusions from surveying the students and teachers from three different schools. These conclusions are:

1) Environmental education is already offered in these into schools
2) Most students believe that the environment is an important subject to learn about; however not as many feel that it is an interesting topic

3) The students in these schools do not know what the term biodiversity means; however the students are learning about biodiversity indirectly through environmental education
4) Experiments, hands-on activities, computer work, and cooperative work are the teaching methods that the students prefer most; Teachers said that students best respond to experiments and hands-on activities
5) Teachers have little to no funding for buying extra resources
6) Teachers suggested that the Smithsonian could help teach about biodiversity by providing lesson plans and activities for the students to do

The purpose of the surveys was to determine the state of biodiversity education in the schools surveyed. These were the conclusions we drew from them.

6.3 Conclusions from Curriculum Standards

We have drawn three major conclusions from the curriculum research of national and state (Washington, D.C., Maryland, and Virginia) standards for middle school. These conclusions are:

1) A biodiversity project could satisfy one English standard, three Mathematics standards, two Social Studies standards, and two Science standards.
2) The standards that are satisfied by a biodiversity project are very similar between national level and the state level (Washington, D.C., Maryland, Virginia) except in social studies.

3) Although the national standard is the basis of each state standard (Washington, D.C., Maryland, Virginia), social studies state standards differ because of state history topics.

The purpose of the curriculum research was to find a way to integrate a biodiversity project into the existing curriculum, in which it satisfies standards in English, Mathematics, social studies and science. The research shows that it fits into the curriculum and satisfies eight standards.

7. Recommendations

7.1 Recommendations for Further Research

1) Continue the surveys

The surveys have provided us with knowledge of biodiversity education in the three schools that we conducted the surveys in, but it has not provided a comprehensive overview of the state of biodiversity education across the country. We recommended that a broader view from around the country be gained. The surveys should include public and private schools, schools in different geographic settings, and schools in different demographic settings.

2) Improve the survey questions

We suggest that MAB use a more quantified approach to the surveys; eliminating most of the open-ended questions. Also, if the students are asked a question, the teachers should be asked a similar question so that MAB can compare the students' answers to the teachers'. Appendix B has the questionnaires we used and Appendix F has a revised set of questionnaires that will be more appropriate for future use at MAB.

3) Continue the research on academic standards

We have researched how a biodiversity education program would fit into the national education standards and the standard from three states; Maryland, Virginia, and Washington, D.C. To implement this program in other states, MAB needs to understand how biodiversity education fits into those states' standards.

7.2 Recommendations for the Content and Structure of the Biodiversity Education Program

1) The biodiversity education program should be interdisciplinary

The biodiversity education program should include many curriculum standards and subjects including mathematics, science, English, and social studies. This will give students the opportunity to sharpen their skills in each subject area while they are learning about biodiversity. Also, if the program can include many different subjects then school systems and teachers will be more likely to implement the program into their schools.

2) Make lesson plans and activities unique for each individual grade

Each grade, six, seven, and eight, should have its own set of lessons and activities. If the program is designed for sixth graders to complete successfully, then it may be too easy and boring for seventh or eight graders. Likewise, if the program is designed to challenge eighth graders, then it probably will be too advanced for sixth or seventh graders. The best way to make this program effective will be to implement individual activities or lesson plans for each grade. This also allows the students to build off the lessons from year to year, and to go a little more in depth each year.

3) Develop specific activities and lessons plans about biodiversity

MAB should develop specific activities and lesson plans about biodiversity, and suggest how teachers can use these in their classrooms. Students are already learning about the environment in school, and some of the topics discussed in environmental

education are related to biodiversity; however, students do not know what biodiversity is. Using specific activities and lesson plans about biodiversity will help students to have a better understanding of biodiversity and its relation to the environment. Also, MAB should create specific activities and lesson plans that teach students about each of the different aspects of biodiversity: genetic diversity, species diversity, and ecosystem diversity. Sample lesson plans can be found in Appendix E.

4) Make the lesson plans and activities simple

The lesson plans and activities for the biodiversity education program should be simple. Simplicity makes it easy for school systems and teachers to implement the lesson plans and activities into the classroom. Simplicity will also allow the teachers to complete the lesson or activities within the amount of time allotted. This will also make it possible for MAB to work remotely, and provide the lesson plans and activities over the internet via their website. Simplicity will also limit the amount of materials and supplies needed for the program. Teachers have limited funds to buy extra materials or supplies to use in the classroom. If supplies and materials that are not already accessible to teachers are needed, then MAB will have to consider ways in which they can provide those resources to the teachers. One way would be for MAB to apply for funding for the needed resources. Another way would be for MAB to help teachers apply for funding for those needed resources.

5) Use a variety of teaching methods

We recommend that MAB suggest that teachers use a variety of teaching methods. In the classroom, hands-on activities and cooperative work are the best methods for getting the students engaged in the lesson or activity. Once the students are engaged and interested in the lesson, lecture or class discussions can be used to allow the teachers to get more information across to the students. Other types of teaching methods such as reading or writing can be used as homework activities when there is little time in the classroom.

6) Provide the teachers with optional assistance with the specific lessons and activities

As with any science topic, biodiversity has many different variables. For example, in our lesson plans (Appendix E) that we gave to MAB as an example for a biodiversity education activity, students will be measuring the circumference of trees. The circumference of trees can change dramatically depending on what season it is. During the rainy season the swells and grow much wider than during the dry season. When teaching a biodiversity program, sometimes students and teachers will come across some of these variables. MAB should provide the teacher some kind of background assistance so that the teacher knows to expect these variables and how to explain them. One way to do this would be to provide the teachers with a comprehensive guide on the possible variables and why they happen through the internet via MAB's website. Another way would be to hold teacher workshops in the summer that explain the lessons and activities

by having the teachers participate in similar lessons and activities. Front Royal, Virginia would be an example of a place in which the workshops could be held.

7) Have ways to evaluate the program

For the program to have continued success once implemented, and because most applications for funding require it, we suggest that MAB use some kind of evaluation process. We suggest that the evaluation consider the students, the students' parents, and the teachers. For the students, an evaluation of what the program has taught them by having the students take a pre-test and a post-test. A control group of students that did not participate in the program would be needed for this type of evaluation. The same test would be given before and after the program. A randomly selected group of the students' parents should be surveyed via e-mail or telephone. The parents who are surveyed will be able to say if they think the program was successful in teaching their child about biodiversity and what their child has learned about biodiversity. The teachers could be surveyed in the same way that parents are, but all of the teachers would be included in the survey. The teachers would be able to tell if the program was running smoothly and if the students are learning about biodiversity. This part will be important for MAB to carry out because the program will have to change and adjust to the needs of teachers and students.

8.0 Appendices

Appendix A: Sponsor Description

Founded in 1986, at the Smithsonian Institution, the Monitoring and Assessment of Biodiversity Program (MAB) was established to "set protocol standards for the measurement and composition of vegetation in the international network of Man and the Biosphere Reserves around the world and provide biodiversity conservation training associated to the research." (Alonso, Personal Communication) Then Smithsonian Secretary Robert M. Adams and UNESCO Director-General Amadou-Mahtar M'Bow founded MAB from UNESCO's original Man and the Biosphere Program. Up until 1994 the MAB program was under the Smithsonian's Assistant Secretary for Science, when Robert Hoffman retired. During subsequent Secretary I. Michael Heyman's administration, the Program moved to the office of Biodiversity Programs. Starting in 1999 MAB became associated with the Conservation and Research Center (CRC), a division of the National Zoo. This was the occurrence of an internal reorganization of the National Museum of Natural History. As a result, MAB became more closely associated with the CRC due to their frequent program interactions.

The Smithsonian Institution receives most of its revenue from the federal government yearly through appropriations pre-signed by Congress. The Smithsonian also receives funding through grants for specific projects. Between the fiscal years of 2002-2004 the Smithsonian received from $1.5 billion to $1.7 billion yearly, with 2004 marking the most money the Smithsonian has ever received to date. From the $1.7 billion total received, the National Zoological Park receives between $30 million to $32 million

yearly. This money is used to fund special programs, research, animal maintenance, and employee salaries.

The Smithsonian Institution's (2004) policy is by its secretary, appointed by the board of regents. The board of regents is made up of the Vice-President of the United States, the Chief Justice (who is the chancellor), three members of Senate, three members of the House of Representatives, and nine private citizens.

The mission of the Smithsonian (2004) is "to increase and diffuse knowledge." The National Zoo (2004) and the Conservation and Research center narrow this goal to promoting leadership and research in conservation science. The MAB program, specifically, aims to further awareness and leadership in the conservation of global biodiversity through education and research. MAB's main research goals are to promote biodiversity data collection and to increase knowledge of ecological functions so that decision-makers can reach informed conservation-based land management decisions.

MAB's Research Program has four main objectives:

- Test and implement protocols for long-term, multi-taxa monitoring of forests.
- Establish biodiversity assessment and monitoring projects to further regional conservation needs.
- Provide data management and analytical procedures that allow rapid assessment and dissemination of information.
- Coordinate the International Biodiversity Monitoring Network (IBMN) to facilitate information exchange, information dissemination, and data quality standards formation. IBMN has a large number of research sites.

The original project description from the Smithsonian Institution explaining our project:

Smithsonian Institution

Monitoring and Assessment of Biodiversity Program

Education and Training Initiative (#1)

Under the National Zoological Park's Conservation and Research Center lies the Smithsonian Institution's Monitoring and Assessment of Biodiversity Program (MAB). MAB uses an integrated approach of research, education and training to promote the long-term conservation of biodiversity on a global scale. We believe sustainable use of resources is possible if reliable data about changes in ecosystems and the impacts on biodiversity can be brought to bear in considering the consequences of human-caused disturbances such as development.

Since 1986, the MAB Program has conducted international research and professional training courses. Recently, countries participating in the Convention of Biological Diversity and the World Summit on Sustainable Development have established 2010 as the target year for significantly reducing the loss of biodiversity. It is, therefore, not only essential that MAB's work continues, but expands to match current and future needs.

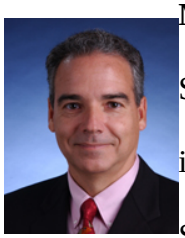
For the past ten years, MAB's Education and Training Initiative has conducted two successful professional training courses for scientists, resource managers, and policy-makers. The MAB Program intends to expand its educational reach and audience base.

Together with the WPI student group, the MAB staff will select a target area and audience for an education and outreach project. Subsequently, the WPI interns will conduct research to evaluate existing educational programs and develop a current needs assessment. Based on the information obtained, WPI students will help design an education and outreach plan for the target area and assist in developing the plan's components. MAB's ultimate goal is to implement this education and outreach project to further its work in promoting the conservation of biology. As this pilot project becomes successful, other target areas and audiences may be addressed by MAB in the future. http://nationalzoo.si.edu/ConservationAndScience/MAB/training/ (my.wpi.edu)

The purposes of our project were to give MAB an idea of the current state of biodiversity education in the world and to give MAB recommendations for a biodiversity education plan for middle school students. MAB works internationally with governments, industries, academia, non-governmental organizations, local communities, and others to assess and monitor the biodiversity in their regions. MAB does this through an integrated approach of research and training. Our project relates to the education and training part of MAB's mission. Through our research, we have given MAB an idea of the current state of biodiversity education and have given recommendations for a biodiversity education program for middle school students. These topics are both related to biodiversity education and thus are related to MAB's mission.

The staff members of MAB as stated on their website:

Francisco Dallmeier, Ph.D.



MAB Director

Since 1975, Francisco has initiated and managed a number of national and international biodiversity surveys and impact assessments. As a Smithsonian scientist and educator since 1986, he has used his B.S. from the Central University of Venezuela and his M.S. and Ph.D. in wildlife ecology from Colorado State University in his work to link biodiversity conservation and development. He has coordinated over 60 international research and training programs in developing countries. In addition, he has advised national and international committees such as the US National Park Service Inventory and Monitoring Program for Vital Signs, the International Union for Forestry Research Organization (IUFRO), the US and UNESCO Man and the Biosphere Program, the EPA National Advisory Group for Place-Based Ecosystem Management, and the IUCN Species Survival Commission, among many others.

Alfonso Alonso, Ph.D.

Assistant Director for Conservation and Development

At MAB, Alfonso does everything from planning project budgets to writing and reviewing scientific papers and educational materials on biodiversity assessment and monitoring to developing and carrying out strategies and designs for vegetation and invertebrate sampling protocols. He manages MAB's international research programs in conservation and development. He

also teaches invertebrate assessment and monitoring protocols for many of MAB's international conferences and training courses.

Patrick Campbell, MS

Research Ecologist

Currently, Patrick works on a number of projects, including the Urubamba Biodiversity Monitoring Project in the Camisea region of Peru. Here, he is examining the structure and composition of the region's tropical forests and their associated mammal community. He is also helping write a book on the Camisea project, which will include information on the natural history and species diversity of the project's sites. In addition, he is co-editor for a special edition journal volume discussing protocols used by MAB researchers in Camisea. Recently, Patrick has taught courses on assessment and monitoring of vegetation and mammals in Cameroon and at the Smithsonian's Conservation and Research Center in Virginia.

Tatiana Pacheco

Administrator

Tatiana's role has expanded to managing all of MAB's logistics, including contracts, budgeting, procurements, personnel actions, travel, training course development and insurance. An expert in the Smithsonian Institution's policies and procedures, Tatiana also handles requests for outside information and works frequently with MAB's overseas teams.

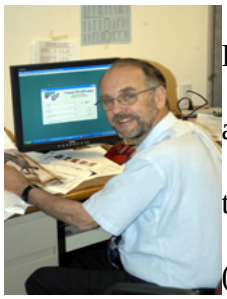
Jennifer Sevin

Education and Training Coordinator

It has been through these endeavors that Jennifer realized the importance of research and education in protecting the environment and biodiversity. She is looking forward to coordinating the Monitoring and Assessment of Biodiversity Courses as well as the Smithsonian Environmental Leadership Courses. She anticipates initiating other MAB education and training programs in the future, and to create partnerships with other organizations and agencies in accomplishing MAB's objectives. Jennifer likes "to get things done," and believes the MAB Program is a good place for her.

Roger E. Soles, Ph.D.

Director of Global Species Address Book project



For over 18 years Dr. Soles lead the U.S. Man and the Biosphere Program at the U.S. Department of State as Executive Director. He was also the team leader in the development of the predecessor project for the current Smithsonian Global Species Address Book project (Biosphere Reserve Integrated Monitoring/ Biodiversity Resources for Inventorying and Monitoring (BRIM)). In that capacity he successfully promoted the application of the initial methods of standardizing and harmonizing biological inventory data among the world biosphere reserve network involving international conservation and scientific organizations.

Smithsonian Institution

National Zoo

MAB

Francisco Dallmeier, Ph. D.
MAB Director

Alfonso Alonso, Ph. D.
Assistant Director for Conservation and Development

Tatiana Pacheco
Administrator

Patrick Campbell, MS
Research Ecologist

Jennifer Sevin, MS
Education and Training Coordinator

Krista Milich
Program Assistant

Roger E. Soles, Ph. D.
Director of Global Species Address Book project

Our project has set the wheels in motion for MAB to expand its target audience from a solely professional- and researcher-education workshop focus to now include middle school students. The start of our survey process will allow MAB to continue our survey nationwide. In addition, our inventory has given MAB a list of organizations that are currently educating people about biodiversity so they are not repeating the same projects that are already being done.

Appendix B: Original Teacher and Student Surveys

TEACHER SURVEY

Smithsonian Institution

Monitoring and Assessment of Biodiversity Program (MAB)

Directions: *This is a survey to determine how the MAB Program can best learn about middle school students in relation to science and biodiversity education. Please read each question and answer it the best you can.* ***NOTE:*** *Please return the Teacher Survey and the Student Surveys by* ***November 26, 2004*** *to the Smithsonian Institution, MAB Program, 1100 Jefferson Drive, SW #3123, MRC 705 PO Box 37012, Washington, DC 20013-7012*

Is your school public or private? _____

Where is the school located? (City and State)_____

What is the name of your school? (Optional)_____

Would you describe the school as urban, rural, suburban, or inner-city? _____

What grade level do you teach?_____How long have you been teaching?__

1. Could you explain what biodiversity or biological diversity means?

_____

2. Could you tell us why biodiversity is important? _____

_____

3. Are your students interested and excited about learning science concepts and topics? Why or why not? _____

_____

4. Do you think the students have some kind of understanding about biodiversity? Describe._____

_____

5. Can you give us a list of teaching methods you commonly use in the classroom? (Ex. videos, hands-on activities, reading, computer-based, etc.)

_____

6. Which of these methods do you prefer to use and are easiest for you to incorporate in your curriculum? _____

_____

7. Which methods do your students learn from and respond to best? Please explain.

---

8. Do you teach your students about biodiversity related issues? YES or NO

If no, Why not?

If yes, How long do you spend teaching this topic during the academic year and what resources do you use?

---

9. Do you currently have access to adequate resources to teach biodiversity related issues?

---

10. What are some resources (supplies/equipment) that you have available in the classroom?

---

12. Do you have the funds to buy extra resources to help educate your students? (i.e. videos or books)

---

11. Can you take the students on field trips?

---

13. If you could fix any single problem with science education, what would it be?

---

14. What does the Smithsonian do?

---

13. How can the Smithsonian Institution help you incorporate biodiversity education into your science curriculum?

---

14. Would you be interested in using or participating in a Smithsonian Institution education program or training workshop? _____

Thank you for taking the time to complete this survey.

Please look on the Smithsonian website at *www.si.edu* for teaching resources for your classroom.

STUDENT SURVEY

Smithsonian Institution

Monitoring and Assessment of Biodiversity Program

Directions: *This is NOT a test. We are looking for information to learn about middle school students on science topics. Please read each question and answer it the best you can.*

Name the city and state that you live in_____

What grade are you currently in? _____How old are you?_____

What kind of music do you listen to? _____

What are your hobbies or interests? _____

What are your favorite subjects at school? _____

What is biodiversity or biological diversity?_____

Have you heard of the Smithsonian Institution? YES or NO

What does the Smithsonian Institution do? _____

What job or profession do you think you might want to have? _____

Would you like to go on to college after high school?_____

Have you ever participated in any activities concerning the environment? YES or NO

If yes, were these activities inside or outside of school? _____

Please describe the activities _____

What have you learned in school about the environment? About biodiversity?

_____

Do you like learning about the environment? YES or NO

Is the environment important to learn about? YES or NO Why?

_____

What type of classroom activities do you prefer (like best)? Circle all the answers that apply:

(1) Hands-on activities (2) Lectures (3) Reading (4) Problem sets (5) Computer work (6) Experiments (7) Group work (8) Class discussion (9) Guest presenters (10) Other method, please specify_____

Thank you for taking the time to complete this survey. Good luck in school!!!

Appendix C: Organization Descriptions

Descriptions written by Mike Eilon:

Organization: The Conservation Leadership Network -A subsidiary of the Conservation Fund

Website: www.conservationfund.org/?article=2033

OVERVIEW: Pioneering a brand of conservation driven by effectiveness, efficiency, and environmental and economic balance, the Fund, a non-membership, non-advocacy organization, is America's foremost conservation nonprofit. Boasting a 1% fundraising ratio and 96% program allocation, The Conservation Fund earned an " A +" and was recognized as the nation's top rated environmental nonprofit by the American Institute of Philanthropy, a prominent charity watchdog. Since 1985, the Fund and its partners, dedicated to tangible, on-the-ground results, have protected more than 4 million acres of our nation's outdoor heritage -our wildlife habitat and watersheds, working landscapes and community open-space.

Mission and Background:
The Conservation Fund forges partnerships to protect America's legacy of land and water resources. Through land acquisition, sustainable programs, and leadership training, the Fund and its partners demonstrate effective conservation solutions emphasizing the integration of economic and environmental goals.

Land Conservation
The Fund helps local, state and federal agencies, and nonprofit organizations acquire property from willing sellers to protect open space, wildlife habitat, public recreation areas, river corridors and historic places.

Sustainable Programs
The Fund works with communities as well as different sectors of industry, including forest and chemical companies, developers, and ranchers to demonstrate sustainable practices that balance economic and environmental goals.

Leadership Training
The Fund serves as a national resource for environmental organizations by providing financial resources and technical assistance as well as formal training to land conservation professionals from all sectors.

Educational Outreach Programs:

Conservation Leadership Network
The Conservation Leadership Network is a strategic alliance of non-governmental and governmental partners dedicated to building the capacity of professionals and

organizations committed to natural resources conservation. It represents a new vehicle for strengthening the American conservation community through courses, workshops, seminars and conferences. Launched by the Fund and its partners in 1998, the Conservation Leadership Network has provided training on topics such as conservation GIS, gateway communities, green infrastructure, fundraising, land stewardship and organizational management to more than 2,000 conservation professionals.

Courses & Workshops
Conservation Leadership Network courses are designed for leaders and decision-makers who are critical to the success and sustainability of the conservation movement. Our courses combine successful strategies with up to date research and top quality instruction that is "by practitioners, for practitioners." Courses are offered at locations around the U.S., including the National Conservation Training Center in Shepherdstown, WV, the headquarters of the Network. In addition, the Fund's new distance learning program, Conservation Direct uses satellite television and the Internet to provide accessible and affordable training to conservation professionals across the nation.

The following training opportunities currently are offered.

GIS Design for Regional Conservation Planning
March 2005 TBD at NCTC in Shepherdstown, WV.

.
GIS Overview for Community-Based Conservation
2005 TBD in Shepherdstown, WV.

Strategic Conservation Planning Using the Green Infrastructure Approach
Spring/Summer 2005

Endangered Species Recovery Implementation--Achieving Success in Recovery
Next offering: 2005 TBD

Conserving Land with Conservation Easements
Next Offering: August 1 -4, 2004 in St. Louis, MO

Building Partnerships between Gateway Communities and Public Lands (Interactive TV Workshop)
Next offering: February 2005

Gateway Communities: Keys to Success (An Interactive Television Workshop)
Next offering: February 2006

The Practice of Environmentally Sensitive Development
Next offering: 2005 TBD

Balancing Nature and Commerce in Gateway Communities

Next Offering: September 2005 in Shepherdstown, WV

Conservation Options: The Land Protection Toolbox
Next offering: 2005 dates TBD

Organizational Management: Basic Training for Executive Directors
Next offering: 2005 dates TBD

Fundraising for Land Trusts
Next Offering: TBD

Conserving Agricultural Lands
Next Offering: **TBD**

Conservation Easement Stewardship
Next Offering: 2005 dates **TBD**

FUNDING & COSTS:

Since 1985 the Fund has protected more than 4 million acres, valued in excess of $2.3 billion. These lands were acquired by the Fund and its partners at a cost of only $1.6 billion -on average only 58 cents are spent for each dollar's worth of land protected.

Efficiency
The Fund's fundraising costs are only 1 %, the lowest rate in the environmental community. Ninety-five cents of every dollar raised are spent on advancing the Fund's mission: to protect America's land and water resources.

Top Rated Environmental Organization
The Conservation Fund earned an " A +" from the American Institute of Philanthropy, a nonprofit watchdog organization. Recognized as the nation's top rated environmental nonprofit, the Fund maintains the lowest fundraising costs among all other conservation organizations.

The Conservation Fund’s IRS Form 990 is available upon request.

ORGANIZATION: **Environmental Education Program -Zoological Park Organization**

WEBPAGE:

http://www.zoothailand.org/khaokheow/education/awareness_education/

OVERVIEW: The Conservation Education program (CE) helps people of all ages understand and appreciate our country's natural resources and how to conserve those resources for future generations. Through structured educational experiences and activities targeted to varying age groups and populations, Conservation Education enables people to realize how natural resources and ecosystems affect each other and how resources can be used wisely. But Conservation Education doesn't preach. Instead, the program equips people to make their own intelligent, informed resource decisions. Through Conservation Education, people develop the critical thinking they need to understand the complexities of ecological problems. It also encourages people to act on their own to conserve natural resources and use them in a responsible manner.

BACKGROUND & MISSION:

Historical Background

Dusit Zoo which was the predecessor of The Zoological Park Organization was established in 1938 by the Municipality of Bangkok. Subsequently, the Minister of Interior, Gen. Banyat Thephasadin Na Ayutthaya proposed to the goverment in 1953 that an organization should be established to administer and direct the zoo efficiently due to the Municipality of Bangkok did not have enough budget, thus hinder the future development of the zoo in Thailand.

On February 15, 1954 The Zoological Park Organization (ZPO) came into existence by Royal Decree. At present, there are five zoos under the administration of the ZPO, which are:

Dusit Zoo (Bangkok)
Khao Kheow Open Zoo & Night Safari (Chonburi)
Chiang Mai Zoo
Nakhon Ratchasima Zoo
Songkhla Zoo

Roles of ZPO

1. Bring people in contact with animals for educational and recreational purposes.
2. Responsibility in the welfare, caring and breeding of animals to prevent extinction.
3. Ensure the animals' quarters are as comfortable as their natural habitat.
4. Produce a zoo environment which serves truly as place of recreation and relaxation.

It has taken Khao Kheow Open Zoo's education division about a year to refine the Environmental Education Program into an important training program, which combines traditional or indigenous knowledge pertaining to environment with contemporary disciplines in wildlife, forestry management, based on research experience provided by Khao Kheow Open Zoo researchers. The program has evolved into an outside-the-school-classroom education program, which teaches students on sustainable use of natural resources outside school classrooms, at the Zoo School in Khao Kheow Open Zoo.

Environmental and conservational education programs are becoming an integral part of formal education, as our societies strive in their bid to take responsibility in earth's environment. Legislation pertaining to education is being revised to incorporate environmental and conservational schooling into the system.

Hence, the Zoo School plays an educational role consistent with our new bid to make formal education extend beyond the classroom, and to be more learner-centric, rather than system-centric or classroom-centric.

The Environmental Education Program combines formal learning process with the experience of outside-the-school-classroom and outdoor learning needed to stimulate students learning process.

Mission:

- Teach children and students the importance of nature and problems concerning the destruction of nature; teaches them sustainable use of natural resources
- To form basis for collective concern for the environment at grassroots level by targeting children and students, so they possess the correct knowledge and attitude towards the management of nature, since early age.
- Provides education and educational activities in environmental conservation for children in under-funded or under-privileged schools for up to 5,000 students per year.
- Promoting the education program will lead to greater public awareness and participation, and generate public interest and acceptance in the program.

FUNDING & COSTS:

Expense budget provided by Esso Oil Refinery, Sriracha

- **Student expenses 220..000 Baht consisting of**
  - **Stationary** @ 10 **Baht each**
  - **Instructor** @ 10 **Baht each**
  - **Transportation** @ **15 Baht each**
  - **Food** @ **15 Baht each**
  -

To accommodate up to 5,000 school children per year:

- Exhibition signs @ 20,000 Baht per year
- Mobile exhibition booth (on school visits)
- Sign posting around the Children Zoo area

EDUCATION:

- Children and students learn and understand about problems concerning the destruction of nature
- Children become conscious of the importance nature and earth's natural resources
- Children become responsible and contribute to protect the environment
- Children become aware of threats towards the environment, and can differentiate between air pollution, water pollution, the greenhouse effect and depletion of the ozone layer.

ORGANIZATION: The Keystone Center

WEBSITE: www.keystone.org/index.html

OVERVIEW: The Keystone Center is a non-profit public policy and educational organization founded in 1975. The Center strives to develop creative problem-solving processes that assist diverse parties address issues of importance and to provide quality science education through hands-on inquiry of the natural world. The Keystone Center pursues this end through its three divisions:

1) Center for Science and Public Policy

2) Professional Education & Leadership

3) Keystone Science School

*The Keystone Center is headquartered in Keystone, Colorado with an office in Washington, D.C.

MISSION & BACKGROUND:

The Keystone Center's mission today is to equip citizens with deliberative frameworks, democratic processes, analytical information, and critical-thinking skills to navigate tough problems and develop solutions. The Keystone Center positions itself to improve decisions about long-term issues by helping students learn, teachers teach and thought-leaders and decision-makers effectively address technically complex, politically uncertain situations.

Since 1975, The Keystone Center for Science & Public Policy has been helping leaders in the public, private, and civic sectors solve problems and advance good public policy. Our specialty is "Dialogue by Design." Through neutral, independently organized, well managed discussions, we assist groups in acquiring the scientific, economic, and political information they need to make collective decisions.

We apply our knowledge, tools, and craft in three practice areas: Energy, Environment, Health and Social Policy. Our key products are consensus-driven decisions, plans, and agreements that advance sound policies and practices in the energy, health, and environment areas. The key components of all Keystone projects are:

Involving those most affected by decisions

Transforming former adversaries into shared-goal partners

Integrating the best scientific and technical information available

Building trust and understanding

Cultivating leadership and collaborative decision-making

Ensuring that solutions are implemented and contain mechanisms to address future conflicts

EDUCATION:

Center for Science & Public Policy
We resolve complex Science & Public Policy conflicts that focus on Environment, Energy and Health and Social Policy.

Keystone Science School
We provide students with inquiry-based experiences to broaden their perspectives of nature, the environment and society.

Professional Education and Leadership
We train leaders to integrate sustainability at their companies. We provide teachers the tools to teach their students to investigate environmental and sustainability issues in a non-biased manner.

At the heart of each of our programs, are the following attributes:

- Curriculum and learning frameworks use in-the-field experiences or hands-on case studies in addition to traditional approaches to education and leadership development;
- In addition to providing generic frameworks or lessons, Keystone staff work with participants to customize outcomes to fit their specific situation;
- An emphasis will be placed on capacity building around solving complex problems in a collaborative manner; and
- Models are tested, and then disseminated through the programs and networks.

The programs are organized around serving three primary audiences:

- Teachers and their students
- Private Sector leaders
- Public Sector leaders

Through these three audiences we are a better able to reach all segments of society needing to partner around issues of sustainable development, including future generations.

Working with the other programs of the Center (Keystone Science School and the Center for Science and Public Policy), the core competencies our programs offer to these audiences are:

- Curriculum development and learning forums around issues-based frameworks

- Strategic planning, learning forums, and consultation around education, sustainable development, and stakeholder engagement

Teacher Training and Curriculum Development Programs

Key Issues Institutes: These institutes are national teacher development programs with a focus on the environment and sustainability. Designed primarily for middle school teachers, participants spend one week during the summer using a framework to investigate issues and learning consensus-building tools to use in the classroom.

Key Issues: Bringing Environmental Issues to the Classroom strives to partner with corporations, foundations and educators to improve students' decision-making abilities by providing them with real-life activities that use science as the backdrop. The program emphasizes the importance of utilizing a balanced, non-biased, comprehensive, and interdisciplinary approach to investigate environmental issues within the context of a scientific analysis.

Key Issues II: Bringing Sustainability to the Community provides teachers and their students with the tools to analyze their communities' needs and effectively understand the complex interplay of social, economic, and environmental factors and how they might affect quality of life for current and future generations.

Site-specific programs: Using the pedagogy described above, these programs are based on curriculum designed for a certain location. For example, DuPont initiated a project to develop a learning progression and teacher training for Delaware, New Jersey and Pennsylvania teachers; the curriculum will focus on environmental issues challenging the inhabitants of the Delaware River watershed. In addition, Monsanto is supporting curriculum development and implementation with educators in Idaho.

Issue-specific programs: PEL staff utilizes the success of the Center for Science and Public Policy and Key Issues II to design curriculum that brings relevant topics to the classroom in a non-biased manner. Working from Science and Public Policy dialogues, The Keystone Center staff uses a scientific framework to help teachers and students investigate emerging issues. For example, NASA has contracted with The Keystone Center to develop curriculum and a teacher training based on Mars exploration issues. The Department of Energy is considering a similar project with the focus on Global Climate Change. Using Key Issues II as a catalyst, curriculum modules take the concepts of sustainability and apply them to pertinent topics. In existence are modules on Sustainable Agriculture, Sustainable Architecture, Sustainable Forestry and The Civil War. Sustainable Rivers and Sustainable Transportation are currently in development.

Private Sector Programs

Keystone Leadership Forum: The Forum is a series of three two and a half day meetings for companies establishing or expanding upon their business case for sustainable development. Keystone works with participating companies to achieve three outcomes:

1) a rich understanding of concepts, trends, issues, and strategies pertaining to sustainable development and how they affect their company;
2) an action plan for moving forward with the business case for sustainable development; and

3) a set of tools for negotiating strategies that add value with internal and external stakeholders.

Organization-Specific Learning Forums: These forums build on our expertise in the above areas and are designed to meet the needs of a specific organization. Topics include integrating community relations and sustainable-development efforts, and building long-term stakeholder processes. The Center has now developed forums for several companies, and seeks to broaden this work to government agencies and other organizations.

Public Sector Programs

The core area of emphasis within the public sector at the moment is to facilitate the development of partnerships among public land agencies, schools, and community organizations to implement experience-based education programs that meet resource conservation and community needs, as well as academic standards in the formal school curriculum. Keystone is currently providing strategic guidance and frameworks for two programs: US Fish and Wildlife Service's The Nature of Learning and Hands on the Land.

The Nature of Learning: Promoting Education and Stewardship in the Community: Program of the US Fish and Wildlife Service (formerly known as Earth Stewards)

TNL's vision is to provide a process that empowers community investment in quality education and civic engagement by using public lands and experiential education to build critical thinking skills in youth. ,

The goals of the Nature and Learning initiative are to:

- Build educational value on refuges so that visits, exposure, and enthusiasm on public lands expand and continue
- Introduce a process to enhance critical thinking skills and better prepare students as future community leaders
- Create long-lasting relationships among teachers, corporate representatives, community leaders and refuge personnel

- Develop and nurture a. strong sense of stewardship and civic pride using the refuge and community as outdoor classrooms
- Modify and replicate processes for developing Earth Stewards partnerships and sites across the country in interested communities.

Hands on the Land: Program of Partners in Resource Education

HOL is a consortium of federal land management agencies providing education at their sites. HOL's vision is to provide a national network of field classrooms to enhance kindergarten through high school student-learning through the environment

The goals of the HOL program are to:

- Enhance student learning in natural, historical and archeological settings, Promote resource conservation through education, and
- Develop a framework to maintain and expand the HOL program nationwide

Science School

Keystone Science School is a residential field science school that challenges citizens - from children to adults -to develop critical thinking skills as they follow a path that explores nature and science education. Making extensive use of the outdoor laboratory around us, we nurture scientific inquiry and cultivate sensitivity to the natural environment. Keystone Science School knows that today's youth are the future leaders who will develop policies and make decisions impacting our world. To help them be engaged citizens in the future, Keystone Science School has created educational and interactive science education programs that stimulate young minds and make them comfortable with scientific and critical thinking.

School Groups Programs

Classroom Access to Science Education (CASE), a program for school groups that complements their classroom curriculum while staying for 2- 7 days at our historic Keystone campus

The Keystone Center Policy Summit, a collaborative project with the National Consortium of Specialized Secondary Schools in Mathematics, Science and Technology (NCSSSMST) exploring the use of sustainable energy for transportation

Summer Youth Programs

Discovery Camp, a residential summer camp for ages 9-14

Counselor Assistant Program, a residential leadership program for 15-17 year olds

Keystone Science Adventures, a summer backpacking program for youth ages 13-17

Keystone Resort Activities, fun, educational summer programs

FUNDING & COSTS:

For over a decade, partnerships between corporations, foundations, and The Keystone Center (TKC) have provided summer learning opportunities for middle level educators nationally and internationally. During the summer of2003, 40 funders made 177 sponsorships available for teachers to attend Key Issues: Bringing Environmental Issues to the Classroom, which took place in Summit County, Colorado. Additionally, Key Issues II: Bringing Sustainabi1ity to the Community celebrated its fourth year. Seven sponsors provided 26 sponsorships for teachers to attend Key Issues II, which was held in Racine, Wisconsin.

ORGANIZATION: Network of Conservation Educators and Practitioners -through the American Museum of Natural History's Center for Biodiversity and Conservation.

WEBSITE: http://research.amnh.org/biodiversity/ncep/uslworkshop.php

OVERVIEW:

The Network of Conservation Educators and Practitioners (NCEP) is a global project to improve the practice of biodiversity conservation by improving training in biodiversity conservation. NCEP targets educators working with undergraduate and graduate students, and trainers working with conservation professionals in a variety of settings. NCEP seeks to:

- **connect** those involved in doing and teaching biodiversity conservation;
- **create** and make widely available a variety of resources to teach biodiversity conservation;
- **develop** networks and resource centers to increase mentoring and training opportunities in biodiversity conservation worldwide.

Mission and Background:

Studying the immense variety of life on the planet and the complex relations among living things-what we now call biodiversity-has been a fundamental activity of the American Museum of Natural History since its founding, In 1993, responding to concern among its scientists over rapid species loss and increasing environmental degradation around the world, the Museum created the interdisciplinary Center for Biodiversity and Conservation.

The Center for Biodiversity and Conservatiol1's mission is to mitigate critical threats to global biodiversity by:

- expanding scientific research on diverse species in critical ecosystems;
- using rigorous scientific results to enhance conservation strategies and inform public policy;
- building professional and institutional capacity; and
- contributing to the Museum's efforts to heighten public understanding and stewardship of biodiversity.

In the United States, a recent NCEP workshop was held as part of the 2004 annual meeting of the Society for Conservation Biology (SCB). Participants of the workshop, which consisted of more than 35 professors from the United States and eight other countries, reviewed conservation biology modules and discussed how the modules can be used in the classroom. Results from the workshop include important feedback and evaluation of the modules and the development of new and improved strategies for

classroom use of the modules. Participants stated that the workshop provided a useful opportunity to review educational materials, promoting a better understanding of their content and stimulating their interest in using the materials in the future.

EDUCATION:

Workshops

NCEP workshops bring together conservation educators and practitioners for a variety of purposes. Some workshops have served to introduce new audiences to the NCEP project, with a focus on reviewing the structure of NCEP modules and how these modules might be used in the classroom. Other workshops have focused on new module creation, or the process of adapting existing modules to a new language or country. Future NCEP workshops will seek to train university faculty and other teachers and trainers in specific module content. To date, NCEP workshops have been held in Bolivia, Lao PDR, Madagascar, Mexico, the United States, and Vietnam.

Modules

NCEP modules are resources for teachers. The modules, currently designed for the undergraduate level, are designed to facilitate student participation and engender the application of critical thinking to conservation problems. Each module includes a synthesis document that brings together key background information and references for a topic, an easily modified visual presentation with notes and discussion questions, and a practical exercise for laboratory or field use, with accompanying solutions. NCEP modules are designed to be easily adaptable, and to support rather than replace materials teachers may have already developed on these topics. They can be used as an integrated package or an a la carte menu. For instance, a professor might use several slides from a presentation, assign parts of the synthesis to students, use an in class-exercise, or combine all of these.

Modules on more than 100 topics relevant to biodiversity conservation are in development or scheduled for development in the next three to five years. The range of topics represented means that NCEP modules may be suitable for use in a wide variety of courses in the biological and environmental sciences, and in social sciences and humanities courses with environmental content. Modules are available for use, adaptation and distribution without cost for educational use. We invite you to download a sample module before registering for full access to all available modules. Please contact us if we can assist you to use and evaluate these materials in your classes. We are also always interested in hearing from people who may be interested in developing or contributing material for new modules.

FUNDING & COSTS:

The Network of Conservation Educators and Practitioners (NCEP) of the Center for Biodiversity and Conservation (CBC) of the American Museum of Natural History

(AMNH) gratefully acknowledges the current support of the following organizations, foundations and individuals:

- The United States National Science Foundation
- The United States Fish and Wildlife Service
- New York Community Trust
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- The Overbrook Foundation
- The Munson Foundation

Global partners of NCEP include the Wildlife Conservation Society (WCS), the College of Environmental Science and Forestry State University of New York-Syracuse, and the University of Maine. In each country where we work, NCEP has developed a network of partnerships in the higher education and conservation communities. Please visit the home pages for each country for further information on these partners.

ORGANIZATION: The National Environmental Education Advancement Project (NEEAP)

WEBSITE: www.uwsp.edu/cnr/neeap/aboutus/index.htm

OVERVIEW:
The National Environmental Education Advancement Project (NEEAP), located at the University of Wisconsin-Stevens Point, supports the development and expansion of quality environmental education (EE) programs through a variety of state and local capacity building efforts. Many NEEAP efforts encourage the development and implementation of Comprehensive Environmental Education Programs at the state and local levels. NEEAP is a member of the Environmental Education and Training: Partnership (EETAP).

MISSION & BACKGROUND:
The National Environmental Education Advancement Project (NEEAP) supports the development and expansion of quality environmental education (EE) programs through a variety of state and local capacity building efforts. Many NEEAP efforts encourage the development and implementation of Comprehensive Environmental Education Programs at the state and local levels.

Background
Since 1993, NEEAP's unique niche in the field of EE has been to research and provide programs about and for EE leaders working to build the infrastructure for environmental literacy. NEEAP's state capacity building programs have partnered closely with leadership teams in 21 states and have included the Demonstration States, EE 2000 States, EET AP States and Challenge Zone programs. EE leaders from all 50 states and Puerto Rico have also been supported through NEEAP's referral and resource services and through joint efforts with NAAEE to provide Leadership Clinics and conference workshops on planning, networking and professional development for state capacity building.

At the local level NEEAP coordinated the Community Outreach Project for EE, an outreach project piloted in five diverse Wisconsin communities, and is currently working together with two other national partners in three communities across the nation in the Demonstration Communities Project.

Growing out of our state and local programs are research and feature articles, training and organizing manuals, web resources, an organizational assessment tool and other custom-designed resources specifically geared to those interested in and working to build EE capacity at the local, state, regional and national levels.

EDUCATION:

Current Programs

EET AP States Program

Leadership Clinics

- 2004 Leadership Clinic Design Workshop
- Leadership Clinic Mini-workshops
- 2005 EET AP Leadership Clinic

Past Programs

- Demonstration Communities Project
- CZaPP (Challenge Zone: A Partnering Project)
- Community Outreach Project for EE
- EE 2000 & EE 2000 Associate States
- Demonstration States

FUNDING & COSTS:

Partners

Organizational
Association of Supervision and Curriculum Development (ASCD)
North American Association for Environmental Education (NAAEE)
EE-Link (Environmental Education on the Internet)

Northern Illinois University
National Project for Excellence - Guidelines for Excellence
Project del Rio (PdR)
Project Learning Tree (PLT)
Project WET (Water Education for Teachers)
World Wildlife Fund (WWF)

Funding
United States Environmental Protection Agency (US EPA)
Office of Environmental Education
University of Wisconsin-Stevens Point (UWSP)
College of Natural Resources (CNR)
Environmental Education and Training Partnership (EETAP)

Past Funding

National Fish and Wildlife Foundation (NFWF)

National Wildlife Federation (NWF)

Wisconsin Environmental Education Board (WEEB)

The Tides Foundation

National Environmental Education and Training Foundation (NEETF)

ORGANIZATION: The Pinhead Institute

WEBSITE: www.pinheadinstitute.org

OVERVIEW: People preserve only what they love; they cannot love what they do not know. Pinhead Institute connects people to the natural world by teaching them how to read it. It is a skill called "bioliteracy," akin to literacy. The focus is not words, but rather natural landscapes and species within them. Bioliteracy is a fundamental human skill, essential for making wise conservation choices for our communities, our regions, and our planet. Pinhead Institute is a grass roots organization, yet has an international network of the world's best scientists to support its educational programs to build bioliteracy locally and globally.

The Pinhead Institute, a 501(c)3 nonprofit organization, is a Smithsonian Affiliate, the first in Colorado. There are currently 140 Smithsonian Affiliates nationwide. We have been in operation since 2001, based in Telluride, Colorado. Our Federal Tax ID number is 84-1605984.

MISSION & BACKGROUND:

PINHEAD INSTITUTE IS

Committed, we believe in what we're doing.
Visionary, yet know that the angels are in the details
Brave, take on daunting challenges with a healthy amount of fear Collaborative, and recognize that we need all the help we can get
Entrepreneurial, identify opportunities to generate income to support our programs and mission

OUR GOALS

Help people discover their essential connection to the natural world
Establish Telluride as the place where scientific groups convene to further the Pinhead mission
Enrich collaboration among schools, conservation groups, academic institutions, and research organizations, both locally and globally
Produce intellectually satisfying, academically challenging, and entertaining educational programs for the Telluride community and beyond Grow Pinhead into a sustainable organization

HISTORIC ROOTS
A historic Telluride/Smithsonian connection dates back to the early part of the last century. From the first time they met in 1905; Charles Walcott, Secretary of the Smithsonian from1907 to 1927, and the famous Telluride engineer and entrepreneur L.L. Nunn were close friends. Over time, Walcott and his sons invested in Nunn's businesses, and conversely, Nunn's philanthropic foundation, the Telluride Association, funded a

Smithsonian expedition to ,Siberia, a pet project of Walcott's, to discover a frozen Woolly Mammoth.

Another historic relationship -this time between Telluride and Comell University provides another compelling affiliation prospect.

In 1910, Nunn established the Telluride House ("Cornell Branch") at Cornell University in Ithaca, NY, as a scholarship residence for bright young men, many of whom had passed through Nunn's Institutes out West, including Telluride which was his first. Not coincidentally, Cornell opened its engineering school the same year.

In 1911, with the encouragement of Charles Walcott, then the Secretary of the Smithsonian, Nunn founded the Telluride Association (TA), entrusting most of his fortune. TA was founded to advance Nunn's educational philosophies, which Walcott shared. Walcott's eldest son, Sydney Walcott became the first President of the Telluride Association. Walcott's other two sons also become Constitutional Members of the Telluride Association at the same time.

OUR NAME

In 1903, L.L. Nunn started construction on Telluride's new hydroelectric power plant at the mouth of Provo Canyon. Completed in 1904, this facility contained not only a modem power plant but the Telluride Institute, a laboratory, company offices and his own personal residence. The new plant was named in honor of Fay Devaux (Fred) Olmstead, an assistant to Paul Nunn, who died of tuberculosis before the completion of the plant.

Finding that few, if any, men knew much about electricity, Nunn began to train men at his Ames plant as early as 1890. This was the beginning of the Telluride Association. Nunn founded and endowed the Association with grants to Cornell University in order to meet the demand for electrical engineers. When Nunn laid out the plans for Olmstead, he included a building for more in-depth education. This building, named the Telluride Institute, contained living quarters, library, classrooms and kitchen. An affiliated structure was the laboratory constructed across the lawn. Students studied history, English, German, algebra, geometry, physics, drawing, public speaking and theory.

The Telluride students were divided into three groups, each group having different responsibilities. One group was called the "first year" or 24-hour men. These persons only studied when time and work permitted. Another group, the "5-hour" men, worked five hours a day and studied the rest. The last group consisted of the "scholarships." These men had no regular duties and were committed to study, research and experimentation. During the early period of the Institute, old students and workers became exasperated with some of the young students and referred to them as "pinhead." This term eventually became a sign of distinction, meaning well-trained, dependable and disciplined.

THE BENEFITS OF A SMITHSONIAN AFFILIATION

The Smithsonian/Telluride affiliation is a two-way spark. There is genuine excitement among Smithsonian scholars about working in the Telluride region. Telluride gives the Smithsonian an unprecedented opportunity to work with an entire community at once because our town is so small (we are the affiliate with the smallest population) and because the program is so inclusive (our local partners include the schools, libraries, museums, and other non-profits such as the Nature Conservancy). The Smithsonian is anticipating that the Pinhead Institute Affiliation will serve as a model for their other affiliates, and therefore is willing to work with us closely to create programs and exhibits.

The mission of the Smithsonian Affiliation program is twofold: One, to make the extensive Smithsonian collection more accessible to the American people by lending artifacts to museums and cultural institutions across the country for exhibits, and; Two, to make its scholars accessible by sending them into communities for educational and cultural programs. The goal of the Smithsonian is to establish meaningful relationships with communities by working with local institutions, schools, and museums to maximize the educational and cultural benefits that both the Smithsonian and the affiliate can impart.

EDUCATION:

K-12 Education

Pinhead Institute designed and implemented a "Biodiversity Education Program" in four schools. The program provides structure for student-directed, inquiry-based, investigative learning in science, math, and art, which prepares children to think critically and creatively, while raising bioliteracy. Our Program meets 87% of all the Colorado State math and science requirements with an innovative, engaging curriculum that is not bleakly geared towards standardized test results. The program meets the highest priorities (only recently set) of the National Science Foundation and the National Research Council for math and science education by 1) partnering K-12 schools with an institution of higher learning (in our case, the Smithsonian); 2) connecting children to the natural world; and 3) revamping science education from fact-based to inquiry-based. Pinhead Institute was recognized by the Smithsonian Institution in June of 2003 as one of only two among their 137 Smithsonian Affiliates as an "Exemplar of Excellence in Education," for our Biodiversity Education Program. Pinhead has been a Smithsonian Affiliate since June, 2002.

This Biodiversity Education Program serves almost 500 students, and delivers more than 10,000 student program hours at no cost to the schools or students. It has three integrated components.

Biodiversity Monitoring Project (BMP)

Working with the Smithsonian Institution, Pinhead Institute brings real-world science to students through the Biodiversity Monitoring Project. This program exposes students to science as it is practiced in the modern world. Students and teachers use the same

scientific protocols as practiced by Smithsonian scientists at research sites throughout the world (simplified for younger students). By conducting and planning authentic investigations of their local environment, students and teachers learn about scientific data collection, analysis techniques, and scientific concepts and principles. With the help of The Nature Conservancy, Pinhead designated 25 "living outdoor laboratories" (20 meters square) in riparian forests along the San Miguel Watershed. The data collected and analyzed by the students contributes to the community's knowledge of our local environment. It also becomes part of the Smithsonian data base. Four schools are participating in monitoring the biodiversity of those plots: Telluride Elementary 5th grade; Telluride Middle/High Schools 7th and l0th grades; Norwood High School 10th grade; and the Mountain School 6-9th grades. To launch this program, Pinhead held a week-long training program in August 2002, for 45 students, teachers, and community members, taught by six Smithsonian scientists and environmental science educators.

Scholars in the Schools

Punctuated throughout the school year, internationally renowned scientists lead labs, workshops, and field expeditions for BMP students. The scientists train students how to identify species, follow protocols, understand ecosystems, and generally how to follow the scientific methods of inquiry-based learning. In this program, BMP students are able to work side-by-side with the scientists and interact with them personally. These scientists also present their original research to students during all-school assemblies in an accessible manner. This allows students outside the BMP to be exposed to professional scientists. Pinhead is able to bring four to six scientists to the schools each year. Visiting scientists have included such giants in the field of biology as Peter Raven, Director of the Missouri Botanical Gardens; Terry Erwin, Smithsonian Entomologist; Dan Janzen, Professor of Ecology, University of Pennsylvania; Jack Dumbacher, Curator of Ornithology at California Academy of Sciences; and many more.

Smithsonian in the Rockies: Celebrating Biodiversity through Art and Science (CBAS)

The Smithsonian in the Rockies Student Workshops and Exhibit: Celebrating Biodiversity through Art and Science allows students to explore and discover nature through art. This part of the program is especially important for those students who do not grasp science well, and therefore need an6ther pathway to bioliteracy. CBAS also introduces children to the collaborative style of real-life, team-based projects, and provides a myriad of professional mentors. The project culminates in a week-long exhibit in Telluride's central square, called Elks Park, held during our local festival, Mountain Film, which attracts thousands of conservation minded visitors and boosts the attendance of the student's exhibit. The exhibit is part of the Mountain Film Gallery Walk.

CBAS is currently part of the curriculum in the 7th and l0th grades at the Telluride Middle/High School. It is Pinhead's most resource intensive program, and one of the most beloved.

In the months before the two-day intensive art workshops, held in April and led by professional artists, students meet numerous times with the artists and Pinhead staff to co-

create the entire exhibit plan. The subject matter of the art is inspired by the stories of the flora and fauna residing in the BMP plots which the students have monitored throughout the school year. But the exhibit is designed using the language and concepts of art. This year, the theme is "Struggles in Nature." Students are able to choose which workshop speaks to them: photography, welding, pastel drawing, sculpture, etc. Workshops are limited to 8 students each.

The next stage involves even more teamwork and collaboration. Students from each workshop must collectively build a piece of sculpture. For example, this year, two Wire Sculpture Workshops will build about fifty, 20" long, wire ants, half in copper wire and half in aluminum wire. The copper wire ants will be slave-maker ants from the genus Polyergus, fighting their way into the ant nest of another species, Formica neorufibarbis, to steal the larvae and pupae to take back to their own nest; a necessary practice for their survival. The aluminum wire Formica ants fight to save their offspring. Similarly, the Welding Workshops will make sculpture representing an invasive plant species, Russian knapweed, displacing local flora, sage and juniper. In CBAS, students learn about the natural history of species found in or near their own back yards, and recreate the story visually on a giant scale. Additionally, students will have an opportunity to mentor with professionals to manifest the exhibit and generate publicity for it.

Global Education

In partnership with the Smithsonian National 'Museum of Natural History (NMNH) and the Telluride Institute, Pinhead launched an initiative called the Encyclopedia of Life (EOL). In February 2004, 35 internationally renowned information specialists and biologists gathered for a four-day workshop in Telluride, Colorado to assess the feasibility of assembling a web-based Encyclopedia of Life (EOL). The participants agreed that a widely-known, well-integrated, easily accessible, encyclopedic source of biodiversity information "providing all information known about all known species" has the keen potential to provide a critically needed baseline of biological knowledge. An EOL also has the potential to increase awareness of government officials, scientists, industry leaders, and most importantly, the general population, to the beauty and astonishing breadth of life on Earth -and to the dire need to protect and nurture this irreplaceable diversity. An Encyclopedia of Life could become one of the greatest tools of bioliteracy.

At the conclusion of the meeting, the NMNH offered to take an early leadership role in launching this global EOL initiative by funding the creation of a prototype and business plan, hosting the Internet portal of the site, incentivizing its scientists to contribute to EOL, and actively collaborating with the international taxonomic community to make the EOL a truly global initiative and resource. .

In the spirit of the Pinhead Town Talks, Pinhead held a public symposium before the workshop, called the "The Need to Inventory Life on Earth," on February 12, 2004 in Telluride and 400 people attended the evening event to hear the scientists talk about an Encyclopedia of Life.

*The Pinhead Institute also has a variety of changing seminars on specific topics for local students.

FUNDING & COSTS:

Program is subsidized by donations from private citizens and NGO's.

ORGANIZATION: Training Resources for the Environmental Community -TREC

WEBPAGE: www.trecnw.org

OVERVIEW: TREC is a social change organization committed to sustainable environmental integrity and diversity in Western North America. As activists serving activists, we catalyze the habitat conservation community through leadership development, capacity-building and leveraging resources. Our coaching, consulting and training services are focused on organizations dedicated to habitat conservation and wilderness protection.

BACKGROUND & MISSION: Training Resources for the Environmental Community (TREC) is a social change organization committed to sustainable environmental integrity and diversity in Western North America. As activists serving activists, we catalyze the habitat conservation community through leadership development, capacity-building, and leveraging resources. Our training and consulting services are focused on organizations dedicated to habitat conservation and wilderness protection.

FUNDING & COSTS: Thanks to the generous support of the Wilburforce Foundation, TREC's services are available at minimal cost to client organizations. In addition, some participant fees can be "earned back" through incentive rebate programs.

EDUCATIQN:

- Organizational Effectiveness Program
- Sustaining Organizational Excellence Program
- Fundraising for the Future Training and Consulting Series
- Leadership Development Program
- Head to Heart Workshop
- Customized Training and Consulting Services
- Information and Knowledge Service

Note:
In order to take advantage of TREC's services you must be an environmental or conservation organization that meets each of the following criteria:

1. Working to save wilderness in the following states or provinces:

- Alaska
- Arizona
- Idaho
- Montana
- Nevada
- New Mexico
- Oregon
- Utah

- Washington
- Wyoming (Greater Yellowstone Ecosystem only)
- Alberta (Rockies only)
- British Columbia
- Yukon Territories

2. Organizations with U.S. IRS SOI(c)(3), or 501(c)(4) or Canadian 149(1)(f) classification

3. Organizations that are current program grantees of Wilburforce Foundation, or that have proposals pending on an upcoming Wilburforce docket.

MISCELLANEOUS:
TREC is committed to providing the highest quality services. We value:

Confidentiality - *not* sharing information about your organization with anyone outside TREC, including Wilburforce Foundation and any other funding sources

Quality - bringing you the best and the brightest resource people (TREC staff, trainers and consultants), and the most effective approaches available

Customization and Flexibility - responding to your unique needs and circumstances

Responsiveness - proactively identifying needs, quick turnaround on commitments

Replicability and Sustainability - so that the changes we help create can be leveraged across the client organization and keep working long after we are gone

Innovation - always seeking better ways to ensure our clients achieve their mission

Accessibility and Affordability - thanks to the generosity of Wilburforce Foundation, the vast majority of costs are covered for client organizations

Descriptions written done by Vinny, Meryl, and Pete

Organization: The American Society of Limnology and Oceanography (ASLO)

Website: www.aslo.org

Mission and Background:

Limnology is the study of the physical, geological, chemical, and biological components of inland waters and their interactions. Oceanography is the study of these components in marine systems.

ASLO was officially established in 1948. It is a non-profit organization based out Wisconsin. It is a membership organization that has more than 3800 member in 58 countries around the world.

The mission of ASLO is to "foster a diverse, international scientific community that creates, integrates, and communicates knowledge across the full spectrum of aquatic sciences, advances public awareness and education about aquatic resources and research, and promotes scientific stewardships of aquatic resources for the public interest."

ASLO can accomplish this by using a number of different methods. ASLO is best known for its journals, interdisciplinary meetings, special symposia, and education and outreach. The journals that ASLO produces are *Limnology and Oceanography*, *Limnology and Oceanography Bulletin*, and *Limnology and Oceanography Methods*. ASLO hosts 2 meetings annually to discuss with scientists and professionals of other disciplines Limnology and Oceanography. Symposia conducted by ASLO have been held to confront many different topics of special issues that include iron effecting aquatic ecology (1992) and whether or not phosphates limit algal production (1972). ASLO also maintains a public policy office in Washington DC and provides education and outreach programs to teach the public about some issues surrounding Limnology and Oceanography.

Educational Outreach Programs:

ASLO offers a number of educational outreach programs located mostly on the eastern seaboard of the United States with one located in Colorado and two in Washington. The purpose of these programs is to "advance kindergarten through graduate education in the scientific fields of limnology and oceanography and related aquatic sciences."

In the 2003 ASLO Aquatic Sciences meeting, ASLO created a set of original presentations meant to further the education of K-12 students and teachers in aquatic sciences.

Funding:

ASLO is funded mainly by the revenue generated by the sales of its journals and by donations and fees provided my members and some outside sources.

Organization: Audubon Society

Website: www.audubon.org

Mission and Background:

Audubon's mission is to conserve and restore natural ecosystems, focusing on birds, other wildlife, and their habitats for the benefit of humanity and the earth's biological diversity.

Their national network of community-based nature centers and chapters, scientific and educational programs, and advocacy on behalf of areas sustaining important bird populations, engage millions of people of all ages and backgrounds in positive conservation experiences.

A very detailed history of the Audubon Society can be found here:
http://www.audubon.org/nas/timeline.html

Educational Outreach Programs:

The Audubon Society offers a number of camps and workshops focusing on environmental education. Links to descriptions of these programs can be found here:
http://www.audubon.org/educate/cw/

Audience: Children, teenagers, and adults

Funding:

The Audubon Society is funded by a number of means. They accept donations, there are membership programs which require a fee, they accept stock gifts, and have a method to deduct money directly from paychecks to go towards the Audubon Society.

Organization: Beahrs Environmental Leadership Program (ELP) University of California, Berkeley

Website: http://nature.berkeley.edu/BeahrsELP/

Overview: "The Beahrs Environmental Leadership Program* (ELP) links state-of-the-art environmental and natural resource science and policy at the University of California, Berkeley, with environmental professionals around the world. It is the leading international program within the Center for Sustainable Resource Development of the College of Natural Resources."

Mission & Background: Their mission is to "enhance environmental knowledge, policy analysis, management and leadership around the world." "The purpose of the summer certificate course is to provide diverse groups of mid-career professionals an opportunity to interact with UC Berkeley faculty and each other to improve understanding of the complex biophysical, economic and social aspects of natural resource and environmental management." The organization started in 2001 and since then they have had 150 people from around the world come to California to be a part of their program.

Education: "Teaching methods include lectures, discussion, panels, small group work, skills- building exercises, group presentations, and informal exchanges among participants, faculty and invited speakers. The curriculum is enhanced by field trips where participants experience the ways and means that California is handling diverse agricultural and natural resource challenges"

Participants in the summer course will:

Develop an interdisciplinary understanding of key environmental topics; explore a range of policies, technologies and institutions that promote sustainable livelihoods and environments; strengthen conflict management, communication and leadership skills; and experience cross-cultural and crosssectoral learning from peers around the world.

Audience: Mid-career environmental professionals and decision makers

Funding and Costs: Partial scholarships are available however people who are accepted must find a way to cover the fees of the program and the traveling expenses. They suggest finding coverage from "employer, government, foundations or other funding institutions."

The course cost $7000 US dollars and it includes $250 US dollars for food and incidentals "The fee covers the costs of instruction, housing, most meals, field trips, materials, certificate and health insurance."

Organization: Belmont Bay Science Center

Website: http://www.bblsc.org/default.htm

Overview: The Science Museum of Virginia (SMV) is a state-agency science center with a statewide mission. Since Northern Virginia is one of the nation's largest metropolitan areas without a hands-on science center, it is a natural opportunity for the creation of a new science center in support of schools, general visitation, and tourism. The new Belmont Bay Science Center will utilize as a theme, "The Unity and Diversity of Life," with an emphasis on supporting Virginia's Science Standards of Learning in Life Science.
The Science Museum of Virginia also hopes to create synergistic partnerships with many different local entities such as the Occoquan Bay National Wildlife Refuge, the area's school systems, George Mason University and private industry.

Education:
Backyard Explorers:
In this hands-on science class, students learn about the diversity of life that exists in their own backyard. This course is given by an ecologist and teaches students how to differentiate between different leaves, different animals and make plaster castings of animal tracks. These classes meet at the EAGLES center in Woodbridge, Va. The course costs $110 for a group of students from a range of K-5.

Audience: K-5 students

Funding and Costs: The Belmont Bay Science Center's Fund is a pool of unrestricted funds from individuals, corporations, foundations and organizations
that supports the museum's general operating budget.

Organization: Connecticut State Museum of Natural History at UCONN

Website: http://www.mnh.uconn.edu/

Overview:
In 1987 the Office of State Archaeology (OSA) was established as a part of the Connecticut State Museum of Natural History to provide local municipalities the technical assistance they needed to help preserve archaeological resources within their communities. In 2004, the Connecticut Archaeology Center was born out of this 17-year relationship between the OSA and the Museum. This expanded partnership is intended to bring the OSA's expertise in technical assistance together with the Museum's strengths in collections conservation and educational programming to create a comprehensive source for archaeology resources in Connecticut.

The Connecticut Archaeology Center, located at University of Connecticut in Storrs, is evolving to serve a variety of audiences -- federal, state and town officials, professional and amateur archaeologists, academics, graduate and undergraduate students, K-12 educators, community groups, and the general public -- with a variety of tools and services including professional training, research resources, university teaching, professional publications, public and school programming, exhibits, educational kits and internet resources.

Mission:
The mission of The Connecticut State Museum of Natural history is to encourage the preservation of Connecticut's archaeological resources through a combination of research, collections conservation, technical assistance and education.

Background:
The Connecticut State Museum of Natural History is a part of the University of Connecticut.

Programs:
BioBlitz: The Connecticut State Museum of Natural History is host to a unique program called the BioBlitz. Designed as part contest, part festival, part educational event, part scientific endeavor, the BioBlitz brings together scientists from the University of Connecticut and other organizations from across the region in a race against time to see how many species they can count in a 24-hour biological survey of a Connecticut park. The public is invited to observe the scientists' activities, to interact with them, and to participate in other activities that are presented by the Museum and a host of invited nature-oriented organizations.

Audience: BioBlitz is open to the general public.

Funding: The museum is supported by donations and a membership fee.

Organization: British Trust for Conservation Volunteers (BTCV)

Website: http://www.btcv.org/

Overview: BTCV specializes in working with people within their communities to bring about positive environmental change in both rural and urban settings. Working through a wide range of partnerships, we have 40 years' experience of managing volunteer programs, developing and delivering community support, and running employment and training initiatives.

In the early years, BTCV developed volunteering as a means to achieve an environmental goal. A bigger picture is now emerging where conservation volunteering is also becoming a focus for the achievement of wider social goals - tackling social exclusion and encouraging personal development and lifelong learning.

For a more in depth history of the organization:
http://www.btcv.org/history.html

Mission:
BTCV believes that it can best maximize its long-term sustainable impact by continuing to expand the boundaries of conservation volunteering. Our goal is to create an organization that values each person as an individual, is as inclusive as possible through our open door policy, and helps people make an effective contribution by developing their potential in ways that best suit them.

Education:
BTCV has a number of training programs for professionals which are explained here:
http://www.btcv.org/prospectus.pdf

A course of note is the Environmental Conservation program. The course focuses on habitat surveying, habitat creation and management, and working with the community.

Audience: Professionals

Funding and Costs: BTCV receives strategic financial support in England from the Department of Environment, Food and Rural Affairs (DEFRA), and through Are You Doing Your Bit, a joint initiative between DEFRA and the Department of Transport, Local Government and the Regions (DTLR).

Organization: Chesapeake Bay Foundation

Website: http://www.cbf.org/site/PageServer?pagename=homev3&printer_friendly=1

Overview: CBF was founded in 1967 and is a 501(c)(3) not-for-profit organization. It is supported by more than 116,600 active members and has a staff of approximately 165 full-time employees. More than 90 percent of CBF's $17.5 million annual budget is privately raised.

Mission & Background: The Chesapeake Bay Foundation (CBF) is the largest conservation organization dedicated solely to saving the Chesapeake Bay watershed. Our motto, “Save the Bay”, defines the organization's mission and commitment to reducing pollution, improving fisheries, and protecting and restoring natural resources such as wetlands, forests, and underwater grasses. CBF headquarters is in Annapolis, MD, and has state offices in Maryland, Virginia and Pennsylvania. CBF also operates 15 environmental education programs.

Education: The Chesapeake Bay Foundation runs a program called Chesapeake Classrooms. This program combines the best CBF has to offer teachers with an exciting new partnership with National Geographic's Geography Education Outreach (GEO). Through Chesapeake Classrooms, CBF and GEO will provide professional development and materials to interested teachers over one year to implement multi-week units focused on the local watershed environment. Chesapeake Classrooms will help increase students' environmental literacy, stewardship, and engagement in the learning process.

More information about the program can be found at:
http://www.cbf.org/site/DocServer/CC_Website_Program_Overview.pdf?docID=1763

Audience: 4-12 Teachers

Funding and Costs: More than 90 percent of CBF's $17.5 million annual budget is privately raised.

Organization:UK Natural History Museum

Website: http://www.nhm.ac.uk/botany/coffee/projectmain.html

Mission:
The aim of this program is to promote the conservation of biodiversity by providing the tools, training and information necessary to empower local people to monitor and assess the biodiversity of the forests associated with shade coffee farms in El Salvador.

Background:
The UK Natural History Museum began as a part of the British Museum in Bloomsbury. The section that housed the collection of Sir Hans Sloane eventually became the Natural History Museum. It was a varied collection ranging from dried snake skins from the West Indies, 338 volumes of dried plants, animal and human skeletons, to artifacts from the ancient world. In 1856 Professor Richard Owen was appointed superintendent of the natural history departments of the British Museum who immediately began a campaign to convince the government of the need for a new museum, which he succeeded at. After many years of still being a part of the British Museum, in 1963, the Natural History Museum was established and housed all the collections that were part of the natural history department of the British Museum.

Programs:
Coffee and Biodiversity Conservation in El Salvador: Biodiversity Training Course:
The main focus of these courses is the transfer of basic biodiversity assessment skills to a wide ranging audience. The courses cover the acquisition, preparation and use of biodiversity data through lectures, practicals, fieldwork, and group discussions.

Audience: This program is aimed at Salvadoran nationals.

Funding: The museum is funded by donations and membership costs.

ORGANIZATION: The Cornell Lab of Ornithology

WEBSITE: www.birds.cornell.edu

OVERVIEW:
"A partnership between students and professional scientists to conduct large-scale research. An opportunity for teachers to promote scientific inquiry, interdisciplinary learning, and environmental awareness. A way of teaching about the natural world while incorporating teaching standards."

MISSION & BACKGROUND:
"Mission is to interpret and conserve the earth's biological diversity through research, education, and citizen science focused on birds. Our programs work with citizen scientists, government and non-government agencies across North America and beyond. We believe that bird enthusiasts of all ages and skill levels can and do make a difference. We invite you to learn more about our areas of study"

EDUCATION: The programs are set up to encourage students to study the birds in their backyard and report on-line their findings, so that scientist can study the data and discover where the populations are high and low and in what areas. Some of the sites include ebird, Classroom FeederWatch, Project PigeonWatch, The Birdhouse Network, and Great Backyard Bird Count.
They have nightly seminars, a book you can buy about bird biology, and 8 week bird watching program with lectures and field trips.

AUDIENCE: all ages, they have a grade 5-8 education program

FUNDING AND COSTS: An on-line store where all the benefits go to the lab's research and conservation; non-profit membership institution.

ORGANIZATION: The Field Museum of Natural History

WEBSITE: http://www.darwin.gov.uk/

OVERVIEW: The projects are designed to cover the project objectives:
"institutional capacity building, training, research, work to implement the Biodiversity Convention, and environmental education or awareness"

MISSION & BACKGROUND:
The Darwin Initiative is a small grants program that aims to promote biodiversity conservation and sustainable use of resources in less developed countries. "The Darwin Initiative has funded biodiversity projects for ten years since its launch at the Rio Summit in 1992. The Secretary of State officially launched Phase II of the Darwin Initiative on 19 November 2002. The new phase includes a commitment to more than double the money for the Darwin Initiative over the next 3 years, to £7 million a year from 2005/6. The current £3m annual budget will be boosted by £1m in 2003, which will double the amount for new projects in Round 11. This increases to an extra £2m the following year, and £4m in 2005/06, bringing Darwin funding to 7 million per year from Round 13nwards."

EDUCATION:
The offer a variety of grants for projects about the conservation of biodiversity. A list of the completed projects can be found at http://www.darwin.gov.uk/projold.htm.

AUDIENCE: British Institutions and Organizations

FUNDING AND COSTS: "The Initiative is funded and administered by the UK Department for Environment, Food and Rural Affairs, (Defra)."

"ACHIEVEMENTS OF THE INITIATIVE SO FAR:

- Committed £27m to over 270 projects in over 100 countries.
- Held ten rounds of competition since 1993.
- Involved over 80 renowned British institutions.
- Contracted the monitoring and evaluation of projects to consultants whose reports so far have confirmed that progress is generally very encouraging.
- Published the results in annual Darwin reports"

Organization: Earthwatch Institute

Website: www.earthwatch.org

Mission and Background:

The mission of the Earthwatch Institute is to "engage people worldwide in scientific field research and education to promote the understanding and action necessary for a sustainable environment." They believe that decision making involving the issues surrounding sustainable environments requires field research of objective scientific data and the engagement of the general public by active participation in the collection of the data. This is accomplished by three objectives, research, education, and conversation. Earthwatch is implements a very different technique towards research and the education of the public. By having the public involved in the collection of field data, the Earthwatch Institute can educate and get people interested in the environment. The people who participate in these programs become part of the action (collecting field data about the environment), they learn new skills, and develop a better understanding about the importance of the environment.

Earthwatch describes itself as "a unique catalyst and a liaison between the scientific community, conservation and environmental organizations, policy makers, business, and the general public." They offer more than 300 fellowships to students and teachers to promote the education about the environment. It is a non-profit organization that was originally based out of Boston, MA. It now has site worldwide, including Oxford, England, Melbourne, Australia, and Tokyo, Japan with over 50,000 members and supporters. Earthwatch field research projects are located in over 50 countries around the world.

Education:

Earthwatch educates by putting students, teachers, and other public volunteers into the field and collecting field data with scientists. Over the past 30 years Earthwatch has sent 10,000 volunteers into the field. This is accomplished by offering full and partial fellowships provided to Earthwatch by donations, but Earthwatch does also let people go on expeditions if they can provide their own funding. The groups targeted are students over the age of 16, teacher and educators, conservation professionals, and community members nearby the areas the field research is being conducted. There is an application process for the fellowships.

The range of the expeditions' topics and locations are great. Topics include archaeology, **biodiversity**, cultural diversity, endangered ecosystems, global change, oceans, SCUBA/snorkel, and world health. Locations for these expeditions are on every continent except Antarctica.

Biodiversity Expeditions:

There are a large number of expeditions provided by Earthwatch that specifically deal with biodiversity. Like other expeditions, the target audiences are high school students over 16 years old, college students, teachers and other professionals, and community members.

One example is the Alaskan Rainforest Wildlife expedition. This expedition is to take place over 4 two week intervals during the 2005 year. It focuses on the tracking of flying squirrels in the Tongass National Forest. The purpose of this expedition is to learn more about the flying squirrel, and to determine if the belief that the flying squirrel is an indicator species for the forest is true. In other words, they want to find out if the health of the flying squirrels is directly related to the health of the forest. The cost of going to this expedition is $1995 for people in the US, 1620 pounds for people in Europe, and $A2795 for people in Australia.

Miscellaneous:

Because of the way Earthwatch sponsors people to go on these expeditions, many of the fellowships are selective, and may only select those who already show a lot of interest in the environment and issues concerning the environment. For example, those most likely to go on these expeditions would be high school students who want to major in college in environmental sciences or biology, environmental sciences or biology teachers, and those people in the public already involved with conversation. Also, these expeditions are conducted most of the time in pretty rugged and untouched areas, so it will not interest people who do not enjoy camping and hiking.

Organization: The Field Museum of Natural History

Website: www.fieldmuseum.org

Overview:
"Each year, more than 250,000 school children visit The Field Museum to learn more about their world. More than 10,000 teachers take advantage of our resources for professional development and planning engaging learning activities. And thousands of families and adults visit us for unforgettable experiences that are as enriching as they are fun."

Mission & Background:
"The Field Museum is an educational institution concerned with the diversity and relationships in nature and among cultures. It provides collection-based research and learning for greater public understanding and appreciation of the world in which we live. Its collections, public learning programs, and research are inseparably linked to serve a diverse public of varied ages, backgrounds and knowledge."

Education:
Projects in the classroom, field trips to the museums and workshops for teachers. In addition, they have on-line programs.
The Harris Education Loan Program offers money to educators in Chicago area schools to connect the schools to the field museum. The loan also offers three types of educational media for the aid of learning to students which include books, display cases, and experience boxes.

Calumet Environmental Education Program is a program designed by the Field Museum for Chicago Schools. The three programs are Mighty Acorns (early elementary), Earth Force (Middle School), and Illinois Urban Watch (high school).

Audience: Based in Chicago, updated 2004, the education program was started in 1922. All ages.

Funding and Costs: Proceeds of their on-line museums store go to their education and research programs. The Museum cost money to enter, and can get a membership.

Organization: Foundation for National Parks & Wildlife (Australia)

Website: http://www.fnpw.com.au/index.htm

Mission and Background:

The mission for the Foundation for National Parks & Wildlife in Australia is to protect Australia's native plants, animals and cultural heritage through fundraising and raising awareness for environmental education and conservation projects. It considers biodiversity to be a global problem, with emphasis on Australia. This is because the serious loss of Australia's unique flora and fauna since European settlement. The Foundation feels that there is a serious need to take immediate action to conserve biodiversity.

The Foundation for National Parks & Wildlife in Australia is a non-profit, independent (non-government) organization. The organization takes pride in the fact that it is philanthropic, not controversial, politically driven, and "Australian and committed to Australian parks and wildlife.

The foundation sponsors projects that have a measurable, crucial conservation or education outcome. These projects include Threatened Species Recovery, education and awareness raising, cultural heritage conservation, visitor facilities, and land acquisition.

Education:

The Foundation for National Parks & Wildlife considers educating the public one of the first steps needed to be taken to converse biodiversity. The education projects funded by the foundation are visitor centers in national parks, interpretative education centers, signage in national parks, and environmental education programs for schools and the community. These education projects are a way for the foundation to inform the public about the need for conservation and about the ways in which they can get involved.

One education program the Foundation provides is called the Eco Ranger School Biodiversity Education Program. This program focuses directly on biodiversity. The objective of the Eco Ranger program is "to develop knowledge and understanding, skills and values and attitudes for biodiversity conservation in Junior High school students." The program hopes to benefit students by:

Helping them learn about natural heritage and its conservation

- Developing practical skills in science-based biodiversity surveying
- Building life skills in team work
- Developing skills and behaviors which respect the environment and minimize negative environmental impacts
- Encourage expression of their understanding of natural heritage values
- Participating in an enriching and meaningful learning experience

Another education program funded by the Foundation was the Frog Conversation Program. In 1998, the Foundation raised $12,839 (Australian) to educate the general public about native Australian frogs. The money was used in 2001 to raise awareness to the Australian general public about the major reasons of dramatic decline in native frog populations. The achievements of this program were, 1) the create of a report for any one

who is interested called the *Hygiene Protocol of the Control of Diseases in Frogs*, 2) the "Helping Frogs Survive" Poster, and 3) the Cane Toad Identification Brochure. There is further continuing work that is underway using these funds. The Foundation also hosts lectures with renowned speakers.

Funding:

Funding for the Foundation for National Parks and Wildlife is based solely on the generosity of other. On their website they offer several ways for others to give to the program which include;

- Donations of money. All donations over $2 are tax deductible and will be receipted.
- donations of property over $5,000 in value, including land
- bequests and planned giving
- sponsorship of projects or events
- donation of goods, services & expertise
- volunteering for fundraising and other activities

The efforts of the Foundation are based on the fund-raising that it produces.

Organization: United Nations University and Department of Ecology of the Ghent University

Website: http://www.unu.edu/ and http://www.rug.ac.be/

Mission:
The mission of the United Nations University is to contribute, through research and capacity building, to efforts to resolve the pressing global problems that are the concern of the United Nations, its Peoples and Member States.
The mission of Ghent University is the realization of an open and democratic education by availability of social facilities and professional guidance concerning the study career.

Programs:
The UNU and Ghent University runs a biodiversity training course aimed students from third world countries. The course is designed to train students in the biological, economical, legislative and political aspects of global biodiversity, with a special focus on the problems in their own country. The course lasts 6 months and consists of lectures, workshops, demonstrations, group discussions and individual work on case studies and written papers. Part of the program includes trips to laboratories and institutions in Western Europe involved in biodiversity research and conservation.

Audience: Students from third world countries

Funding: The program is funded by the Government of Flanders

Organization: Globio – Where kids Discover the World™

Website: http://www.globio.org

Overview:
The organization is a non-profit and international teaching children about the diversity of life through the internet programs, and provides them a say in the future. The knowledge gained allows them to formulate choices about the quality of their lives and the natural resources that are affected by their choices. Globio has touched more than six million people in nineteen countries.

Mission & Background:
"GLOBIO's mission is to engage children in cross-cultural communication and understanding, inspiring them to protect the diversity of life on Earth." This will hopefully encourage children to become lifelong active members in their community to protect earth. Ultimately creating an internet-based community for children to learn and get involved about biodiversity.

Audience: Kids in United States and China

Education:
The "living classrooms" is a way for wildlife centers to reach children and educate them. The purpose of the program is to teach kids about living wildlife and at the same time teaching them about ecology and biodiversity. The "living classrooms" are started in China, Kenya and the USA. In addition, some programs show native animals in their habitats through the internet in digital exhibits like the "Virtual Panda".

Globio Website Phase I: GLOSSOPEDIA™ is an online encyclopedia designed for kids to teach them about diversity on earth and aid to any curriculum as an information source for children. The website also tells real-life survival stories of endangered or orphaned species.

Globio Website Phase II: Designed to create a safe place for kids to talk to other kids about the biodiversity in their backyard and compare backyards and why their backyard is like no one else's in the world.

GLOBIO philosophy and approaches will include**:**

1. **Engagement vs. Content**
2. **Unlimited Exploration**
3. **Kids Creations**
4. **Global Community & Communication**
5. **Connected to Hands-on Activities**
6. **Interest in the Whole Child**
7. **Safe and Thoughtful**

Funding and Costs: The organization is funded through donations and the profit of their book collection about “Discovering the Diversity of Life” which is sold on-line.

Success Statement: “We focus on only one effort - children's education about the diversity of life on Earth. We are building the only open access (free) internet resource tool, an interactive library of life - GLOSSOPEDIA TM. We emphasize partnerships with like-minded organizations. We strongly focus on interdisciplinary approaches to learning throughout all our efforts.”

Organization: Hands on the Land

Website: www.handsontheland.org

Mission and Background:

Hands on the Land is a network of field classrooms around America. It is sponsored by five federal agencies, and non-profit organizations. It is a project offered by the Partners in Resource Education (PRE). It uses public lands to show people how rich these lands are in historical, archeological, and environmental diversity. These public lands also provide a great number of learning opportunities for the students who participate in the program.

The mission of Hands on Land is to provide a national network of field classrooms to enhance kindergarten through high school student-learning through the environment. Hands on the Land as produced a few goals to accomplish this mission:

- To enhance student learning in natural, historical, and archeological settings
- To develop a framework to maintain and expand the Hands on the Land program, and
- To promote resource conversation through education.

Education Programs:

Hands on the Land provides a number of services to realize its goals, of which include several Educational programs. These programs are designed for students of all ages from elementary to high school and teachers for educational purposes in the classrooms. There are a variety of different topics covered in the programs.

Colorado Junior Duck Stamp

This program is based out of Alamosa, Colorado. This program is conducted by visiting classrooms around the Alamosa area. It targets all levels of students up to high school. It covers science and art subjects by introducing the students to art concepts, wildlife conversation and the National Wildlife Refuges in their own backyards.

Design a Science Day

This program is located in Anchorage, Alaska. For students from kindergarten to sixth grade, it is a field trip based program where students come on site to learn about various different topics which include arctic survival, orienteering, team building, animal tracking, earth science, and ecosystems. The idea behind these projects is that the students get more interested in science and the environment.

Earth Ranger Academy

This program is also located in Anchorage, Alaska. It is designed to be the "culminating experience for elementary sciences." The program starts before the students even get on site by teaching the students better observation skills and arctic safety. They then spend three days at a Science Center (the students can stay over night or come back each day) learning more about ecology and the environment.

Educator Workshop Series

This program is based in Pisgah Forest, North Carolina. It is a teacher workshop that addresses many topics related to natural sciences, natural resource management, stewardship, and enjoyment. The idea is for teachers to create programs for their students in schools.

Hand on the Land also provides many other programs, but these few show the diversity of students and topics that the organization focuses on.

Funding:

The funding for Hands on the Land mainly comes through the PRE organization. Some of the funding comes from the USDA Forest Service, the Bureau of Land Management, US Fish and Wildlife Services, National Park Services, Natural Resource Conversation Service, the Keystone Center, Wilderness Technology Alliance, WEB Development and Education, Washington Office of the Superintendent of Public Instruction, the EPA, and the National Environment Education & Training Foundation.

Organization: Journey North

Website: http://www.learner.org/jnorth

Overview: "The Project uses media and communications to improve math and science education for the nation's 44 million school children. Journey North is regarded as a "best practices" model for math/science education reform."

Mission & Background:
"More than 400,000 students in 11,000 classrooms are participating in the 2004/2005 Journey North Program. These students are from all 50 U.S. States and 7 Canadian Provinces. Established in 1991 with a grant from the Annenberg Foundation to the Corporation for Public Broadcasting"

Education:
"Students track migration patterns of monarch butterflies, bald eagles, hummingbirds, whooping cranes, and other animals; the budding of plants; changing sunlight; and other natural events. These young scientists share their own field observations with classrooms across the Hemisphere."

Audience: students and teachers in the classroom

Funding and Costs: **"**Journey North is a free online educational service, supported by the Annenberg/CPB. Journey North is an independent 501(C)3 non-profit organization"

The teacher's manuals and videos cost money but the website is free.

Organization: Kananaskis Field Stations: Environmental & Ecology Education Program Partners and Memberships

Website: http://www.ucalgary.ca/UofC/research/KFS/edprog3c.html

Background:
This organization is part of the Kananaskis Field Stations (KFS) which is an institute of the University of Calgary. There ~e two fi~ld stations, one is the Barrier Lake Station which is located in the Kananaskis Valley 80 km west of Calgary and the second is the R.B. Miller Station located in the Sheep River Wildlife Sanctuary 110 km southwest of Calgary.

Goals of Education Program:

The KFS goals are to promote the understanding of the ecology and environment of Canada around the Calgary area. They target mainly students and teachers to get ecology and environment education into schools in the area. They provide education programs to the public and students to "communicate current peer-reviewed environmental research and to foster ecological literacy in schools through field study programs and professional development workshops, and for the public through interpretative and non-formal adult education programs." The programs are developed through partnerships and collaborations with other universities, local government agencies, professional societies and leading education providers in the community, professional societies and leading education providers in the community. The programs are funded mainly on the idea of cost-recovery by user-fees, but also rely on funding partnerships. This makes the program self supporting and maintains affordable user fees. The program provides access to:

- Programs based on peer-reviewed environmental and education research
- Personnel including environmental researchers and education specialists
- Sites throughout the mountain and foothill ecosystems of Kananaskis Country
- Facilities that include on-site dormitories, dining room, classrooms, and labs
- Lab and field equipment for aquatic and terrestrial studies, including GPS
- Reference collections and keys for local flora and fauna
- Reference print and electronic resources including textbooks, lab manuals, journals, papers, research reports, theses and Internet access.
- Interpretive Trails at the Barrier Lake Forestry Trails & Colonel's Cabin Historic site.

From 1989 to 1999 the program has grown dramatically; increasing from 1000 users to 10000 users. During this time it was also recognized for its work and received number of awards for the education programs. They have many different kinds of programs that cover a variety of topics. They have day trips as well: overnight trips that last up to 5 days. The user price varies depending upon the program. The audience is mostly elementary through high school students, but they have programs for professionals (i.e. teachers as well). Here is a list from the website.

Education Programs:

Elementary Programs

(Division II): Ecological Explorations

I. Forests -A Natural Resource: Social Studies 4 ~ Topic A or B
A day-trip program based at the Barrier Lake Forestry Trails and Colonel's Cabin Historic Site, which includes an exploration of the forest ecology and management trails, and local history regarding the Forestry Experimental Station and a World War II Prisoner of War Camp.
Program Fee: $5.35/student: Day-trip ~ Sept.-Nov. & April-June

2. Forest Explorations I: Science 6 ~ Trees & Forests
A day-trip program based at the Jumpingpound Demonstration Forest, which includes an exploration of a working forest and management issues of Alberta forests. This is an off-site partnership program.
Program Fee: $3.25/student: Day-trip ~ Sept.-Nov. & April-June
NOTE: Register through the FEESA Southern Office (403-220-2819) for booking this program.

3. Forest Explorations II: Science 6 ~ Trees & Forests
A two-day residential program based at the Barrier Lake Field Station and Forestry Trails, which includes identification and examination of the structure, function and adaptations of local tree species, investigation of who lives on, in and under trees, and exploration of the history and management issues of Alberta forests.
Program Fee: $64.20/student: 2-day Residential ~ Sept.-Nov. & April-June

Junior High Programs

(Division III): Ecological Adventures

1. Winter Environments: Science 7 ~ Characteristics of Living Things
A three-day residential program at the Barrier Lake Field Station and Peter Lougheed Provincial Park which includes field and lab investigations into plant, animal and human adaptations to winter, an exploration of winter habitats via snowshoes or x-c skis, and an introduction to ecological research in winter environments.
Program Fee: $107/student: 3-day Residential ~ January-March
NOTE: Rental fee for x-c skis or snowshoes arranged by KFS: $15/person.

2. Environmental Inquiry: Science 8 ~ Interactions & Environment
A three-day residential program based at the Barrier Lake Field Station and Ribbon Creek Trails, which includes student-designed field and lab explorations into the measurement of abiotic factors and estimation of plant and animal populations in typical Montane forest communities, exploration of local food webs and interactions, and examination of human impact via a hike at Ribbon Creek.
Program Fee: $107/student: 3-day Residential ~ Sept.-Nov. & April-June

3. Monitoring Streams & Rivers: Science 9 ~ Environmental Quality

A three-day residential program based at the Barrier Lake Field Station and the Lower Kananaskis River with field and lab explorations into physical, chemical and biotic indicators of water quality; examination of how scientific knowledge contributes to environmental decision-making process, and exploration human impact in watersheds via a river float on Lower Kananaskis River.
Program Fee: $107 */student: 3-day Residential ~ Sept. -Nov. & April-June*
NOTE: Outdoor Program Centre rafts & guides: $25/person.
NOTE: These programs will be revised to match the new Alberta Program of Studies for Junior High School Science starting in September 2000.

C. Senior High School Programs (Division IV): Ecological Research

1. Forest Ecosystems: Science 20, Biology 20, and IBP/AP-Biology
A day-trip field study based at the Barrier Lake Field Station and various research sites throughout Kananaskis Country, which includes an investigation of populations and competition within the forest communities, and examination of the role of ecological research in management of sustainable forest ecosystems.
Program Fee: $10. *70/student: Day-trip -Sept.-Nov. & April-June*

2. Stream Ecosystem Monitoring: Science 20/30
A day-trip field study based at the Barrier Lake facility and various monitoring sites throughout Kananaskis Country, which investigates physical, chemical and biotic indicators of water quality of local stream and river monitoring sites, and examines the role of ecological research in management for water quality.
Program Fee: $10. *70/student: Day-trip -Sept.-Nov. & April-June*

3. Stream Ecosystems Research: Biology 20, and IBP/AP-Biology
A day-trip field study based at the Barrier Lake Field Station and various research sites throughout Kananaskis Country, which investigates the predictive power of the River Continuum Concept in examining physical structure, function and invertebrate composition of mountain streams, and examines current ecological research for stream ecosystems.
Program Fee: $10. *70/student: Day-trip ~ Sept.-Nov. & April-June*

4. Winter Ecosystems: Biology 20
A day-trip field study based at the Barrier Lake Field Station and various monitoring sites throughout Kananaskis Country, which includes calculation of thermal gradients and indices for snow-pack, an exploration of subnivean environment, effect of global change on winter environments and special features of winter ecology research. *Program Fee:* $10. *70/student: Day-trip ~ Sept.-Nov. & April-June*

Self-Directed Programs

1. Barrier Lake Forestry Trails: Environmental & Outdoor Education Classes
A day-trip exploration of the Barrier Lake Forestry Trails and Colonel's Cabin Historic Site which include interpretive trails on forest ecology and management, and history of the WWII Prisoner of War camp. In self-directed programs, the classroom teacher leads the program. Please book well in advance of your field trip, so that there is not another program utilizing the trails on the same day.
Program Fee: Free: Day-Trip -September-June

2. University Lodge & Lab Classrooms: Environmental & Outdoor Education
When not booked with core residential programs, the University Lodge is also available during the week for 2-5 day self-directed residential programs developed and led by classroom teachers. Fee includes meals, accommodation and classroom access. The Lodge serves as an excellent base for schools to explore Kananaskis Country and Banff National Park.
Meals/Accommodation/Classroom: $41. *75/personlday -October-May*

3. Forestry Lodge & Classroom: Environmental & Outdoor Education Classes
The Forestry Lodge is also available during the week for 2-5 day residential self-directed programs developed and led by classroom teachers. The Forestry Lodge provides a hostelling-like facility for groups to prepare their own meals and serves a base for exploring the nearby hiking trails, ski hills and parks.
Accommodation/Kitchen/Classroom: $11.25/person/night ~ October-May

4. Self-Directed Day- Trip Meetings & Workshops for School Staff
During the week our Forestry Conference Room and Library serve as quiet locations for school staff to hold planning meetings or self-directed professional development days. Groups in this category can choose to bring a bag-lunch or arrange for lunch in the University Lodge.
Conference Room, Coffee & *Snacks: $5.25/person OR with Lunch:* $12.85 *-September-June*

E. Professional Development for Educators

1. Master of Teaching Program
We provide field experience and undergraduate research opportunities for the University Of Calgary Faculty Of Education Master of Teaching Program. The field experience explores science teaching and learning outside of a traditional classroom and the research opportunities allow student to investigate topics in environmental and ecology education

2. Cooperative Education Program
We also provide workplace experience and project opportunities for Ecology and Environmental Science students of the University of Calgary Co-operative/Intern Program. The co-op experience provides science students an opportunity to explore

science education and to complete independent research projects connecting environmental research and education.

3. Day Workshops with KFS Education Staff

Day-trip workshops facilitated by KFS Education staff are also available for professional development. Topics include current trends in ecology and environmental education, forest and stream ecology, ecosystem research, environmental monitoring programs and the history of the Kananaskis Valley.

Facility, Coffee/Snacks & Workshop: $15.95/person OR with Lunch: $23.55/person - October-May

4. Weekend Workshops & Summer Courses for Teachers

A wide array of weekend workshops and summer courses are scheduled throughout the year by KFS and partner agencies. Notices and applications are distributed to all Calgary and area school districts on a regular basis.

Organization: The National Environmental Education and Training Foundation

Website: http://www.neetf.org

Location: Washington, D.C. Copyright 2003

Overview: "We link environmental education (EE) to many of society's core goals such as: better health, improved education, environmentally sound and profitable business, and volunteerism in local communities. Each of our programs also focuses on the needs of under-resourced people in American society."

Mission & Background: The mission is for "a stronger future through environmental learning-Improved health, education, business, and ecological protection through innovative environmental learning." The foundation is "dedicated to advancing environmental education in its many forms". The foundation started in 1990 with a charter from Congress. "Since it was established, the Foundation has become a leader in the development of new policies, grant-making approaches, and direct programming to advance environmental literacy in America."

Education:
GreenBiz.Com, The EnvironMentors Project, National Public Lands Day, the NEETF/Roper Report Card, our TV Weather and Environment program, our Health and Environment initiative
"The Challenge Grant Program was designed to create leverage for non-federal investment in environmental education. Over the years, this program has awarded $3.7 million in grants, leveraged $5.4 million in non-federal dollars producing a total of $9.1 million in total project value."

Audience: k-12 programs, adult programs

Funding and Costs: non-profit organization, donations

The Foundation receives a modest annual appropriation through the National Environmental Education Act which it leverages into some $15 million to $18 million in grants and contributed program support-a 25-to-one return on Congressional investment.

Organization: Project WILD

Website: http://www.projectwild.org/index.htm

Mission and Background:

Project WILD is a joint project of the Council for Environmental Education (CEE) [formerly Western Regional Environmental Education Council, Inc. (WREEC)] and the Western Association of Fish and Wildlife Agencies (WAFWA). WREEC was founded in 1970 in a unique and visionary effort to create a partnership between education and natural resource professionals in the 13 western states.

Educational Outreach Programs:

Project WILD:

The activities found in Project WILD are intended for use in both classroom and informal settings. The instructional materials are designed to support state and national academic standards appropriate for grades K-12. The activities can easily be adapted to meet the learning requirements for academic disciplines ranging from science and environmental education to social studies, math, and language arts. Educators may choose one or more Project WILD activities to teach a concept or skill. The activities may be integrated into existing courses of study, or an entire set of activities may serve effectively as the basis for a specific course.

In the two decades since Project WILD began, more than 900,000 educators in the U.S. have participated in Project WILD workshops. These educators in turn have provided instruction using Project WILD to more than 48 million youth.

For evaluations of this program: http://www.projectwild.org/evaluation/evaluation.htm

Audience: Project WILD's primary audience is educators of kindergarten through high school students.

Funding: Project WILD is funded by a number of government and non-government sources. For a full list:http://www.projectwild.org/aboutPW/sponsors.htm

Organization: Royal Botanical Gardens, Kew
Website: http://www.rbgkew.org.uk/index.html

Overview:

The Royal Botanical Gardens, Kew is a garden and research facility that deals specifically with plants.

A detailed history of the Royal Botanical Gardens, Kew can be found here:

http://www.rbgkew.org.uk/heritage/index.html

Mission:

"The mission of the Royal Botanic Gardens, Kew is:

To enable better management of the Earth's environment by increasing knowledge and understanding of the plant and fungal kingdoms - the basis of life on earth.

This mission will be achieved by:

- developing our global reference collections and making them more accessible to the greatest possible variety and number of users;
- undertaking world-wide research into systematics, economic and ethno botany, biological interactions, conservation and horticulture;
- supporting the conservation and sustainable use of plant resources in the UK and overseas;
- informing the wider public about our activities, through the maintenance and development of world-class Gardens that provide a window into our work;
- providing education, advice and information in various forms to our stakeholders, and building the global capacity for studying and conserving plant diversity through collaborative partnerships and by training scientists from developing countries. "

Education:
Every two years, the Royal Botanical Gardens, Kew conducts a plant conservation education course.

The course has the following objectives:

- To enhance the participants' awareness of the issues and methods used in plant conservation.
- To develop an analytical and problem-solving approach to plant conservation.
- To facilitate individual, more specialized studies related to participants' own ecological, economic and social context.

- To develop contacts and communication channels with other professionals working in plant conservation.

Audience: Professionals in the field of plant conservation

Funding and Costs: The Royal Botanical Gardens, Kew is funded by donations, grants, admission fees, and retail. They report to The British Parliament.

Organization: Wildlife Conservation Society

Website: http://wcs.org/sw-home

Mission and Background:

The Wildlife Conservation Society saves wildlife and wild lands. They do so through careful science, international conservation, education, and the management of the world's largest system of urban wildlife parks, led by the flagship Bronx Zoo. Together, these activities change individual attitudes toward nature and help people imagine wildlife and humans living in sustainable interaction on both a local and a global scale. WCS is committed to this work because they believe it essential to the integrity of life on Earth.

Since 1895, WCS has worked from their Bronx Zoo headquarters to save wildlife and wild lands throughout the world.

They uniquely combine the resources of wildlife parks in New York with field projects around the globe to inspire care for nature, provide leadership in environmental education, and help sustain our planet's biological diversity.

Today WCS is at work in 53 nations across Africa, Asia, Latin America and North America, protecting wild landscapes that are home to a vast variety of species from butterflies to tigers.

Their environmental education programs reach millions locally, nationally and internationally.

Educational Outreach Programs:

WCS provides 5 international courses in Papua New Guinea, Cuba, China, Zambia, and India. They also provide courses at the Bronx Zoo, the New York Aquarium, and Central Park.

For detailed descriptions of each of these courses: http://wcs.org/sw-education

Audience: WCS education programs are targeted at K-12 teachers

Funding: WCS is funded by a multitude of private and corporate sources which can be found at: http://wcs.org/media/file/CONTRIBUTORS.pdf

Organization: World Wildlife Fund for a living Planet

Website: www.worldwildlife.org

Overview: "WWF directs its conservation efforts toward three global goals: saving endangered species, protecting endangered habitats and addressing global threats such as toxic pollution, over-fishing and climate change".

Mission & Background: "Our Mission is to advance biodiversity conservation worldwide through the development and application of innovative scientific principles, tools and information." "Now in its fifth decade, WWF works in more than 100 countries around the globe to conserve the diversity of life on earth. With nearly 1.2 million members in the U.S. and another 4 million worldwide, WWF is the world's largest privately financed conservation organization." Started in 1960, national affiliates in 30 countries.

Education:
The organization offers workshops through local schools, zoos, museums and national conservation organizations.
"The Russell E. Train Education for Nature Program (EFN) aims to build a dynamic and highly qualified corps of conservation leaders in Africa, Asia, and Latin America." "WOW curriculum materials are designed to help students explore the social, political, scientific, economic, and ethical issues surrounding biodiversity and to help them develop the knowledge and skills they need to build a more sustainable future." The books are designed for middle school students. They include three topics: Biodiversity Basics includes 30 activities to choose from, Wildlife for Sale has 15 activities and Ocean's for life includes 27 activities.

Audience: everyone

Funding and Costs: donations, a WWF credit card the organization gets one percent of the sales from bank one, also a range of products from stuff animals, stamps, books, hair products, calendars, holiday cards, checks and kites.

Appendix D: National and State Standards stated from the cited websites

I. English
National Standard Seven
Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience (NCTE, 1998-2004)

http://www.ncte.org/about/over/standards/110846.htm

Maryland Standard

4.0 Writing – Students will compose in a variety of modes by developing content, employing specific forms, and selecting language appropriate audience and purpose (MD: Eng, 2004)

http://mdk12.org/share/vsc/vsc_english_gr38.pdf

Washington, D.C. Standard

3.0 Language for Research and Inquiry – Students use language and symbol systems (e.g., timelines, maps, graphs, and charts) to define as indicated problems, retrieve interpret, and organize information, and communicate that information to defined audiences (DC: Eng, 2004)

4.0 Language for Social Communications – Students use a language in a variety of social contexts, participate in a number of language communities, and understand the social and cultural influences on text (DC: Eng, 2004)

http://www.k12.dc.us/dcps/curriculum/content/English/s-rela-ov.pdf

Virginia Standard
Oral Language (VA: Eng, 2004)
Writing – The student will plan, draft, revise, and edit writing (VA: Eng, 2004)

http://www.pen.k12.va.us/VDOE/EnhancedSandS/

II. Mathematics
National Standard 4: Mathematical Connections

- See mathematics as an integrated whole;
- Explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations;
- Use a mathematical idea to further their understanding of other mathematical ideas;
- Apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, psychology, science, and business;
- Value the role of mathematics in our culture and society. (Educationworld: Mathematics, 1996-2003)

National Standard 8: Patterns and Functions

- Describe, extend, analyze, and create a wide variety of patterns;
- Describe and represent relationships with tables, graphs, and rules;
- Analyze functional relationships to explain how a change in one quantity results in a change in another;
- Use patterns and functions to represent and solve problems. (Educationworld: Mathematics, 1996-2003)
-

National Standard 13: Measurement

- Extend their understanding of the process of measurement;
- Estimate, make, and use measurements to describe and compare phenomena;
- Select appropriate units and tools to measure to the degree of accuracy required in a particular situation;
- Understand the structure and use of systems of measurement;
- Extend their understanding of the concepts of perimeter, area, volume, angle measure, capacity, and weight and mass;
- Develop the concepts of rates and other derived and indirect measurements;
- Develop formulas and procedures for determining measures to solve problems (Educationworld: Mathematics, 1996-2003)

http://www.educationworld.com/standards/national/math/5_8.shtml

Maryland Standards

1.0 Knowledge of Algebra, Patterns, and Functions – Students will algebraically represent, model, analyze, or solve mathematical or real-world problems involving patterns or functional relationships (MD: Mathematics, 2004)

3.0 Knowledge of Measurement – Students will identify attributes, units, or systems of measurements or apply a variety of techniques, formulas, tools or technology for determining measurements (MD: Mathematics, 2004)

7.0 Processes of Mathematics – Students demonstrate the processes of mathematics by making connections and applying reasoning to solve and to communicate their findings (MD: Mathematics, 2004)

http://mdk12.org/share/vsc/vsc_mathematics_gr38.pdf

Washington, D.C. Standard

1.0 Number and Operation – The student interprets multiple uses and forms of numbers and how they relate to each other; fluently uses computational tools and strategies; estimates when appropriate; and solves real-life and career-related problems (DC: Mathematics, 2004)

2.0 Patterns, Functions, and Algebra – The student generalizes patterns and functional relationships; uses symbols to represent mathematical situation; analyzes change in real and abstract situations; and solves real life and career-related problems (DC: Mathematics, 2004)

5.0 Measurements – The student selects and uses appropriate tools and units for systems of measurement; applies a variety of techniques to determine measurements; and solves real life and career-related problems (DC: Mathematics, 2004)

http://www.k12.dc.us/dcps/curriculum/content/Math/s-ma-ov.pdf

Virginia Standard
While learning mathematics, students will be actively engaged, using concrete materials and appropriate technologies such as fraction calculators, computers, spreadsheets, laser discs, and videos. However, facility in the use of technology shall not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency in basic computations. Students will also identify real-life applications of the mathematical principles they are learning and apply these to science and other disciplines they are studying. (VA: Mathematics, 2004)

Number and Number Sense (VA: Mathematics, 2004)
Measurement (VA: Mathematics, 2004)
Patterns, Functions, and Algebra (VA: Mathematics, 2004)

http://www.pen.k12.va.us/VDOE/EnhancedSandS/

III. Social Studies
National Standard 3: People, Places, and Environments

During the middle school years, students relate their personal experiences to happenings in other environmental contexts. Appropriate experiences will encourage increasingly abstract thought as students use data and apply skills in analyzing human behavior in relation to its physical and cultural environment. (Social studies, 1995-2004)

National Standard *8*: Science, Technology, and Society

By the middle grades, students can begin to explore the complex relationships among technology, human values, and behavior. They will find that science and technology bring changes that surprise us and even challenge our beliefs, as in the case of discoveries and their applications related to our universe, the genetic basis of life, atomic physics, and others. (Social studies, 1995-2004)

http://www.socialstudies.org/standards/strands/

Maryland Standard

2.0 Geography – Students will use geographic concepts and processes to examine the role of culture, technology, and the environment in the location and distribution of human activities and spatial connections throughout time (MD: Soc, 2003)

5.0 People of the Nations and World – Students will understand the diversity and commonality, human interdependence, and global cooperation of the people of Maryland, the United States and the World through both a multicultural and historic perspective (MD: Soc, 2003)

http://mdk12.org/share/vsc/vsc_social_studies_gr38.pdf

Washington, D.C. Standard
3.0 Scientific, Technological, and Economic Change – Students recognize scientific, technological, and economic changes and understand how they have affected societies, culture, and politics throughout history (DC: Soc, 2004)

4.0 Social Diversity and Social Change – Students understand how the origins, evolution, and diversity of societies, social classes and groups have been affected and changed by forces of geography, ideology and economics (DC: Soc, 2004)

http://www.k12.dc.us/dcps/curriculum/content/Social%20Studies/s-ss-ov.pdf

Virginia Standard

USII. 7 - The student will demonstrate knowledge of the economic, social, and political transformations of the United States and World between the end of World War II and the present (VA: Soc, 2004)

WHI.12 – The student will demonstrate knowledge of social, economic, and political changes and cultural achievements in the late medical period (VA: Soc, 2004)

USII.5 – The student will demonstrate knowledge of the social, economic, and technological changes of the early twentieth century (VA: Soc, 2004)

http://www.pen.k12.va.us/VDOE/EnhancedSandS/

IV. Science
National Standard 1: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry (Educationworld: Science, 1996-2003)

National Standard 3: Life Science

- Structure and function in living systems
- Reproduction and heredity
- Regulation and behavior
- Populations and ecosystems
- Diversity and adaptations of organisms (Educationworld: Science, 1996-2003)

http://www.educationworld.com/standards/national/science/5_8.shtml

Maryland Standards

1.0 Skills and Processes – Students will demonstrate the thinking and acting inherent in the practice of science. (MD: Sci, 2003)

3.0 Life Science – Students will use scientific skills and processes to explain the dynamic nature of living things. (MD: Sci, 2003)

http://mdk12.org/share/vsc/vsc_science_gr38.pdf

Washington, D.C. Standard
1.0 Scientific Inquiry – Understand and develop abilities to do scientific inquiry by asking questions based on current knowledge, performing investigations and devising logical explanations (DC: Sci, 2004)

2.0 Life Science – Observe, investigate, describe and classify living things; explain life cycles, diversity, adaptations, structure and function of cells and systems reproduction, heredity, interdependence, behavior, flow of energy and matter and changes over time (DC: Sci, 2004)

http://www.k12.dc.us/dcps/curriculum/content/Science/s-sc-ov.pdf

Virginia Standard

Scientific Investigation, reasoning, and Logic - Inquiry skills at this level include organization and mathematical analysis of data, manipulating variables in experimentation, and identifying sources of experimental error. (VA: Sci, 2004)

Life Science - The Life Science standards emphasize a more complex understanding of change, cycles, patterns, and relationships in the living world. Students build on basic principles related to these concepts by exploring the cellular organization and the classification of organisms; the dynamic relationships among organisms, populations, communities and ecosystems; and change as a result of the transmission of genetic information from generation to generation. (VA: Sci, 2004)

http://www.pen.k12.va.us/VDOE/EnhancedSandS/

Appendix E: Lesson Plans

Outdoor Lesson:

Purpose:
To have students learn about species diversity

Goals:
The goals of this project are to:

1. Gain knowledge of one of the aspect of biodiversity: species diversity.
2. Improve skills in the subjects English, Mathematics, Social Studies, and Science.
3. Experience live tree and plant identifications outside a classroom.
4. Experience putting raw data into tabular form, analyzing the data, and drawing conclusions about the data.
5. Practice writing a scientific report.
6. Practice presenting orally their results and conclusions.

Materials:
Flexible tape measure, meter sticks, composition notebook for journal, calculator, string and stakes

Prerequisite:

1. Mathematics:
    - Students will have to know what an x-y plot is,
    - How to measure circumferences
    - How to find a diameter from knowing a circumference.
2. Science:
    - Knowledge of trees and plants that occur in the area
    - Students will have to be able to identify species of trees based on the bark and leaves from reference materials such as a science text book.
3. English:
    - Students will have to be able to write a written report from a set criteria and an oral report about their findings
4. Social Studies:
    - Knowledge of how humans and technology affect biodiversity

Preparation: (for Students)

Homework:

Have students come up with hypotheses about what they expect to find. Ask the students to have about 5 different hypotheses ready. Make this assignment due the day before the lesson.

Day before:

The day before the students go outside, split the students up into small cooperative groups of 3-4 students. Have the students compare and discuss their

hypotheses within their groups. Ask each student group to keep two hypotheses that they would like to test in the field. For homework have the students create a journal with the first entry as the hypotheses that they developed in their groups with reasons as to why they selected them. Have them bring the journal for the first day of fieldwork with their homework in it.

Note: The journal will be used throughout the project for collecting data and thoughts and reflections on the day's lessons.

Procedure:
Data Collection:

1. Mark the corners of a 20m by 20m square plot of land with four stakes. Establish boundaries by tying the four stakes together to make a square.

2. Then break the square into smaller sub sections of 5m by 5m. This should give you at least one subplot for each student group

3. Explain to the students that the plot is much like an x-y plot. Name one axis the x-axis and another the y-axis

Note: Steps 1 and 2 can be done by with the help of the students if time permits. If the students are helping to set up the plot, then after it is set up explain step 3. If there are time constraints, then do steps 1 and 2 prior to the day of the activity. Also, explain the set up of the plot and step 3 prior to the activity.

4. Have students record all data in their journal so they have all the data in one place

5. Ask the students to mark the place of each tree by finding the distance of each tree from the x and y axis. With the plot laid out in 5 by 5 meter sections, the students will only have to reference the trees to the x and y axis in their smaller plots. Later the location of the trees on the main x and y axis can be determined. Also have the students count out and mark the location of any other plants they find. However for plants like grass and moss which are very abundant, they can be described as present and not counted and students take the measurements of one of each species.

6. Measure the diameter of each tree at about shoulder height or 1.3 meters, using the circumference and the formula diameter = circumference/pi. For any other plants in their plot have the students measure the height. The purpose of measuring other plants is in the case that the area being used has very few trees.

7. Determine the tree species as the tree is registered. Use the bark, leaves, and other external characteristics.

Note: The data collection process should take approximately 2 class periods to measure all of the trees and plants within their plot. If there are time constraints the

lesson can be adjust to only 1 class period where the students might not measure all trees, but as many as they can within that time period.

Data Organization and Results

1. Each group should enter data into a computer spreadsheet if computers are available or by hand into a table if computers are not available. Have the students use the same format as the given data sheet. Also have the students graph the data is a scatter plot with the x-y coordinates to get an idea of the plot set-up.

2. Combine all groups' results into a MASTER table and have students compare their results to the MASTER table and discuss similarities and difference in the discussion section.

3. Have students use ratio and percentages to generate the results

4. Have students look for patterns within their data and the master data

5. Have students propose the affects of humans and technology on their plots, and how the results would change if the circumstances changed…. If it was a parking lot, a football field, a playground, a swamp, a field, etc.

Note: If this project has been done in years before by students ahead of them, then the students can also compare their results to the results from past years.

Homework: Every night after the project is worked on the students take some time to write in their journal about their lesson that day: difficulties and successes, results, changes in procedure, conclusions drawn

Final Assessment: Written report in scientific method format, purpose, background, hypothesis, procedure, results, discussion, and conclusion. Oral report with poster about 5-7 minutes long, with each student in the group talking the same amount. The written and oral report should discuss whether or not their hypotheses in the beginning were correct.

Final Note: Teachers, if you can, MAB encourages you to send the data the students have collected to them. This data will be put on MAB's website where you and your students can view data collected by other schools from across the country.

DATA SHEET:

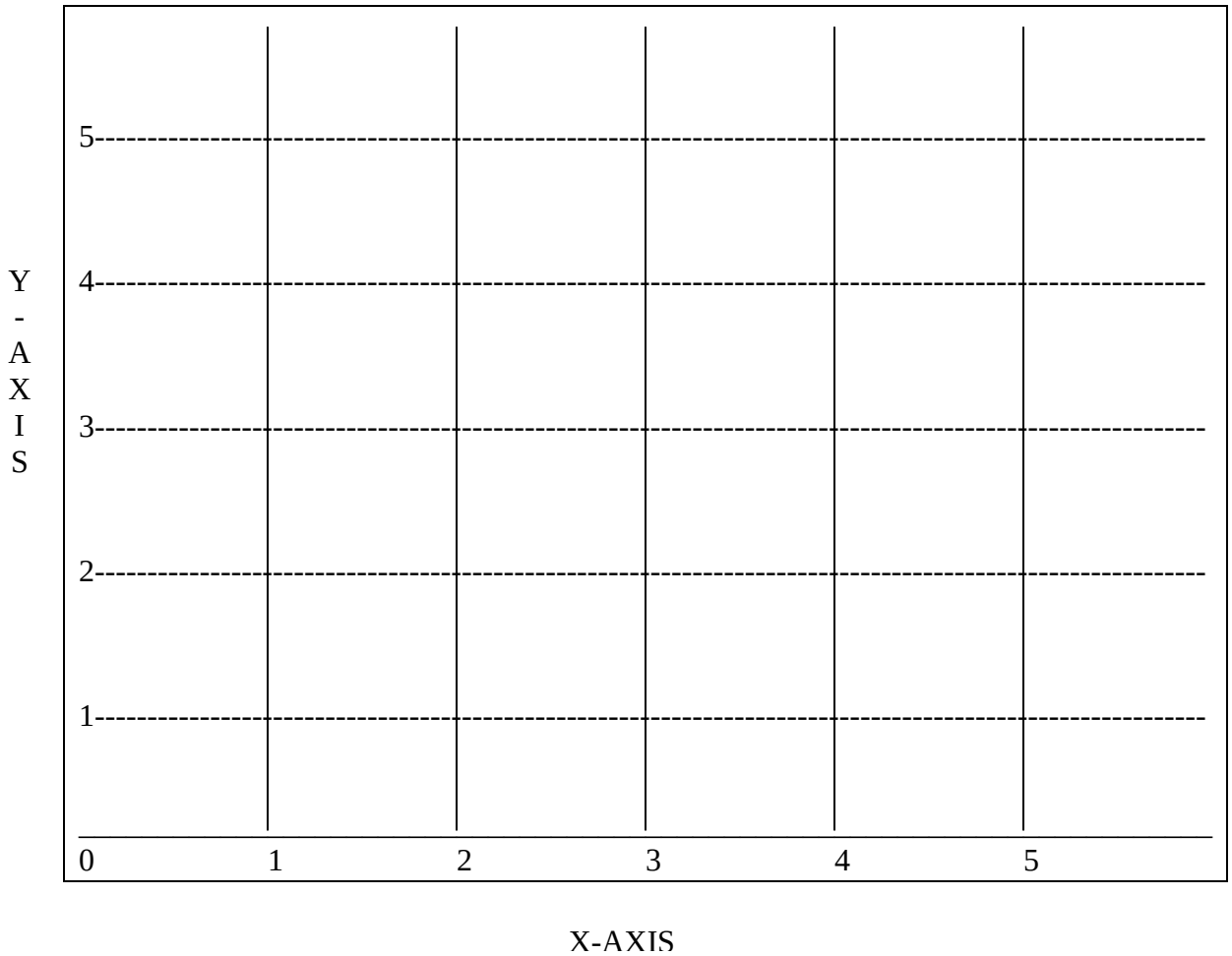
Table 1: Tree Data

Number of Tree(s)	x- axis Coordinate	y- axis Coordinate	Circumference	Diameter	Leaves	Bark	Species

Table 2: Plat Data

Number of Plant(s)	x- axis Coordinate	y- axis Coordinate	Height	Color	External Characteristics	Species

Figure 1: Scatter Plot: Students graph the tree(s) and plant(s) x-y coordinate(s)



Indoor Lesson:

Purpose:
To have students learn about species diversity

Goals:
The goals of this project are to:

7. Gain knowledge of one of the aspect of biodiversity: species diversity.
8. Improve skills in the subjects English, Mathematics, Social Studies, and Science.
9. Experience live tree and plant identifications outside a classroom.
10. Experience putting raw data into tabular form, analyzing the data, and drawing conclusions about the data.
11. Practice writing a scientific report.
12. Practice presenting orally their results and conclusions.

Materials:
Tape Measure, Meter Sticks, composition notebook for journal, calculator, shoes

Prerequisite:

3. Mathematics:
    - Students will have to know what an x-y plot is,
    - How to measure circumferences
    - How to find a diameter from knowing a circumference.
4. Science:
    - Knowledge of trees and plants that occur in the area
    - Students will have to be able to identify species of trees based on the bark and leaves from reference materials such as a science text book.

3. English:
    - Students will have to be able to write a written report from a set criteria and an oral report about their findings

4. Social Studies:
    - Knowledge of how humans and technology affect biodiversity

Preparation: (for Students)

Homework:

Have students come up with hypotheses about what they expect to find. Ask the students to have about 5 different hypotheses ready. Make this assignment due the day before the lesson.

Day before:

The day before the students go outside, split the students up into small cooperative groups of 3-4 students. Have the students compare and discuss their hypotheses within their groups. Ask each student group to keep two hypotheses that they would like to test in the field. For homework have the students create a journal with the

first entry as the hypotheses that they developed in their groups with reasons as to why they selected them. Have them bring the journal for the first day of the lesson with their homework in it.

Note: The journal will be used throughout the project for collecting data and thoughts and reflections on the day's lessons.

Procedure:
Data Collection:

1. Tape out a 10ft by 10ft square plot on the floor. Divide the 10ft square into 2ft by 2ft squares (Depending on space and availability of different areas inside the school, the plot can be bigger or smaller).

2. Explain to the students that the plot is much like an x-y plot. Name one axis the x-axis and another the y-axis

3. Have a class discussion on which trees are the most abundant kinds in the area. Guide the class in their decisions. Then have each student take off one shoe. Explain to students that each shoe type is a species and each student is a tree. The most popular type of shoe should represent the most abundant species of tree.

Note: Steps 1 can be done by with the help of the students if time permits. If the students are helping to set up the plot, then after it is set up explain step 2 and 3. If there are time constraints, then do steps 1 prior to the day of the activity. Also, explain the set up of the plot and step 2 and 3 prior to the activity.

4. Have students toss shoes at random into the taped out plot to set up tree plot data.

5. Have students record all data in their journal so they have all the data in one place.

6. The students in each group now measure the circumference of each others' arms. This will represent the circumference of the "trees." Have the students find the diameter by using the formula diameter = circumference/pi.

Note: The data collection process should take approximately 2 class periods to measure all of the trees and plants within their plot. If there are time constraints the lesson can be adjust to only 1 class period where the students might not measure all trees, but as many as they can within that time period.

Data Organization and Results

6. Each group should enter data into a computer spreadsheet if computers are available or by hand into a table if computers are not available. Have the students use the same format as the given data sheet. Also have the students graph the data is a scatter plot with the x-y coordinates to get an idea of the plot set-up.

7. Combine all groups results into a MASTER table and have students compare their results to the MASTER table and discuss similarities and difference in the discussion section

8. Have students use ratio and percentages to generate the results

9. Have students look for patterns within their data and the master data

7. Have students propose the affects of humans and technology on real plots, and how the results would change if the circumstances changed….

Note: If this project has been done in years before by students ahead of them, then the students can also compare their results to the results from past years.

Homework: Every night after the project is worked on the students take some time to write in their journal about their lesson that day: difficulties and successes, results, changes in procedure, conclusions drawn

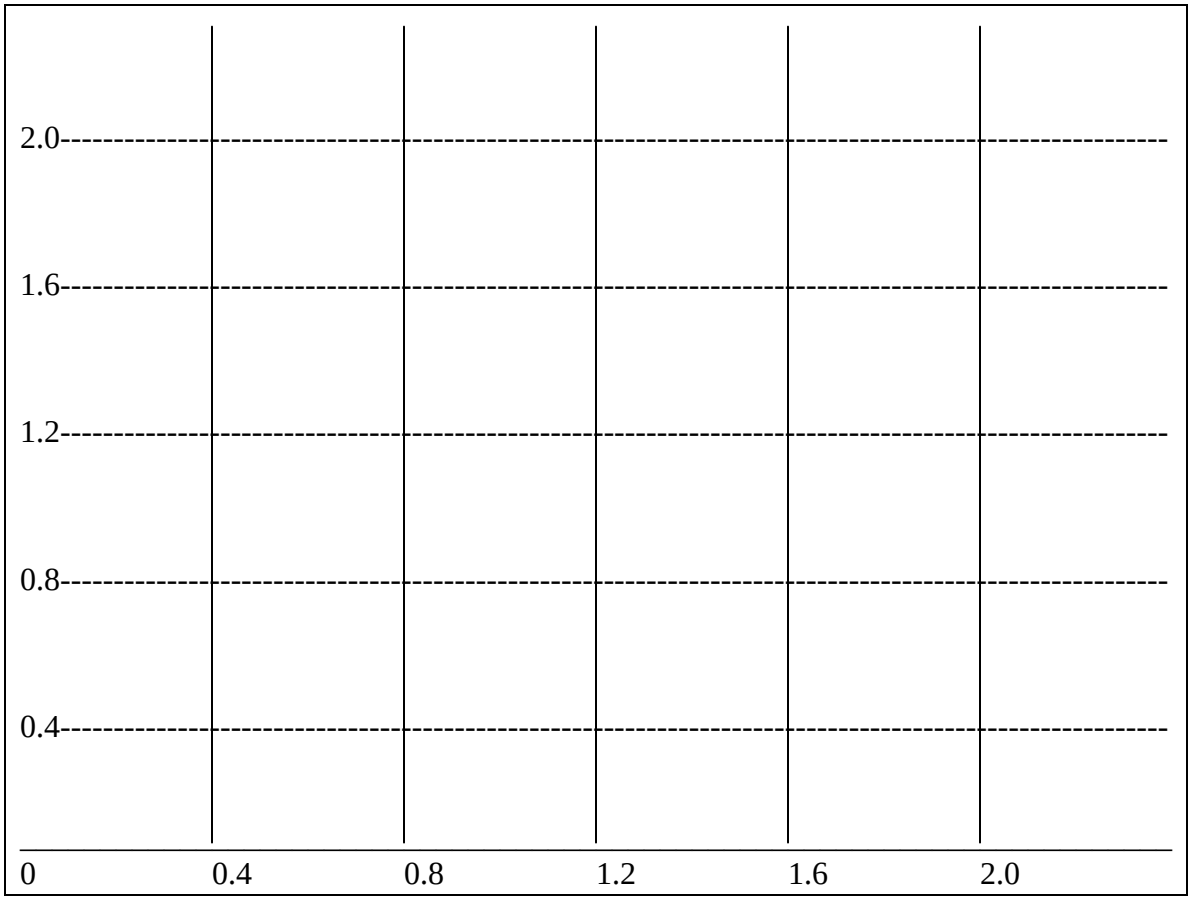
Final Assessment: Written report in scientific method format, purpose, background, hypothesis, procedure, results, discussion, and conclusion. Oral report with poster about 5-7 minutes long, with each student in the group talking the same amount. The written and oral report should discuss whether or not their hypotheses in the beginning were correct.

DATA SHEET:

Table 1: Tree Data

Number of Shoe(s)	x- axis Coordinate	y- axis Coordinate	Circumference of Arm	Diameter	Brand of Shoe	Species

Figure 1: Scatter Plot: Students graph the shoe(s) at its x-y coordinate(s)



Appendix F: New Teacher and Student Surveys

TEACHER SURVEY
Smithsonian Institution
Monitoring and Assessment of Biodiversity Program (MAB)

Directions: *This is a survey to determine how the MAB Program can best learn about middle school students in relation to science and biodiversity education. Please read each question and answer it the best you can. Please to the Smithsonian Institution, MAB Program, 1100 Jefferson Drive, SW #3123, MRC 705 PO Box 37012, Washington, DC 20013-7012*

Is your school public or private? _____

Where is the school located? (City and State) _____

What is the name of your school? (Optional) _____

Would you describe the school as urban, rural, suburban, or inner-city? _____

What grade level do you teach? _____ How long have you been teaching? _____

1) I understand the concept biodiversity or biological diversity and its importance.

(a) Strongly Agree (c) Disagree (e) Not sure

(b) Agree (d) Strongly Disagree

2) I feel comfortable teaching about biodiversity related issues.

(a) Strongly Agree (c) Disagree (e) Not sure

(b) Agree (d) Strongly Disagree

3) Biodiversity is currently a topic in the school curriculum.

Yes No

4) Teaching about biodiversity is/should be an important part of the school curriculum.

(a) Strongly Agree (c) Disagree (e) Not sure

(b) Agree (d) Strongly Disagree

5) In a typical year, how often do you teach about biodiversity in your classroom?

(a) Not at all (c) 3-4 class periods (e) More than a week

(b) 1-2 class periods (d) Full week

6) I feel that my students have a good understanding of biodiversity and biodiversity related issues.

(a) Strongly Agree (c) Disagree (e) Not sure
(b) Agree (d) Strongly Disagree

7) A need exists for educational resources designed to help middle school students to become literate about biodiversity.

(a) Strongly Agree (c) Disagree (e) Not sure
(b) Agree (d) Strongly Disagree

8) If MAB produced educational curriculum materials focusing on biodiversity, which would you prefer?

(a) A progressive look that took approximately 2-4 class periods
(b) A progressive look that took approximately 5-8 class periods
(c) A collection of separate teaching activities that could be adapted and sequenced as needed
(d) A complete course that could serve as a science or social studies text
(e) Other, please state;

_____

9) Which resource would you find to be the most helpful in enhancing your efforts to teach about biodiversity? (please circle only your **first choice**)

(a) Lesson plans and activities that focus on biodiversity
(b) Teacher workshops that focus on biodiversity
(c) Printed background information for teachers
(d) Articles, information, textbooks, and workbooks for students
(e) Videos, slide show presents, and interactive computer programs
(f) Guest speakers for biodiversity
(g) Other, please state;

_____

10) Which of these resources listed in question nine would be second most helpful?

_____

11) Which of these resources listed in question ten would be third most helpful?

_____

12) Environmental education is currently part of the school curriculum.

Yes No

13) Teaching about the environment is/should be an important part of the school curriculum.

(a) Strongly Agree (c) Disagree (e) Not sure

(b) Agree (d) Strongly Disagree

14) In a typical year, how often do you teach about the environment in your classroom?

(a) not at all (c) 3-4 class periods (e) More than a week

(b) 1-2 class periods (d) Full week

15) I feel that my students have a good understanding of the environment and environmental related issues.

(a) Strongly Agree (c) Disagree (e) Not sure

(b) Agree (d) Strongly Disagree

16) What are the resources that you currently use to teach the students about the environment? (please circle all that apply)

(a) Lesson plans and activities that focus on biodiversity

(b) Teacher workshops that focus on biodiversity

(c) Printed background information for teachers

(d) Articles, information, textbooks, and workbooks for students

(e) Videos, slide show presents, and interactive computer programs

(f) Other, please state;

16) Is biodiversity one of the topics covered when teaching the students about the environment?

Yes No

17) I feel that biodiversity and the environment interrelated subjects, and should be taught in a way that shows the students how they affect each other.

(a) Strongly Agree (c) Disagree (e) Not sure

(b) Agree (d) Strongly Disagree

18) There is funding in my school system to buy extra resources for my class.

(a) Strongly Agree (c) Disagree (e) Not sure

(b) Agree (d) Strongly Disagree

19) Which teaching methods do your students respond to best? (Please circle all that apply)

(a) Hands-on activities

(b) Experiments

(c) Cooperative work

(d) Computer work

(e) Lecture

(f) Reading

(g) Writing

(h) Other, please state;

Thank you for taking the time to complete this survey.

Please look on the Smithsonian website at *www.si.edu* for teaching resources for your classroom.

STUDENT SURVEY
Smithsonian Institution
Monitoring and Assessment of Biodiversity Program

Directions: *This is NOT a test. We are looking for information to learn about middle school students on science topics. Please read each question and answer it the best you can.*

Name the city and state that you live in: _____

What grade are you currently in? _____ How old are you? _____

What kind of music do you listen to? _____

What are your hobbies or interests? _____

What are your favorite subjects at school? _____

1) I understand what the term biodiversity (or biological diversity) means.

(a) Strongly Agree (c) Disagree (e) Not sure

(b) Agree (d) Strongly Disagree

2) Have you learned about biodiversity at your school? Yes or No

3) Do you learn about the environment at your school? Yes or No

4) If yes to question #3, what have you learned about the environment?

(Please circle that apply)

(a) That it is important to protect the environment

(b) That there are many different species of plants and animals

(c) The green house effect

(d) The effects of pollution on the environment

(e) Ways to help solve problems caused by pollution

(f) The many different ecosystems of the world

(g) The genetic differences in a species

(h) Other; please state

_____

5) Have you ever participated in environmental activities? Yes or No

6) If yes to #5, were these activities through your school or not through your school?

Through your school Not through your school

7) If these activities were not done through your school, was some kind of environmental organization or an organization such as boy scouts or girl scouts involved? Yes or No
If yes, please state the organization if you can:

_____

7) If yes to #5, what kinds of activities were they?

(a) Cleaning up the environment
(b) Planting trees or gardens
(c) Field trips
(d) Nature walks
(e) Recycling drives
(f) Learning how to identify different species of trees, plants, or animals
(g) Bird watching
(h) Learning about pollution
(i) Other; please state

_____

8) Do you think that the environment is important to learn about in school? Yes or No

9) Are you interested in learning about the environment? Yes or No

What type of classroom activities do you prefer (like best)? (Please circle all that apply)

(1) Hands-on activities (2) Lectures (3) Reading
(4) Problem sets (5) Computer work (6) Experiments
(7) Group work (8) Class discussion (9) Guest presenters (10)
Other method, please specify_____

Thank you for taking the time to complete this survey. Good luck in school!!!

9. References

Alonso, A., Dallmeier, F., Granek, E., & Raven, P. (Eds.). (2001). Biodiversity: Connecting with the Tapestry of Life. Washington D.C.: Smithsonian Institution/Monitoring and Assessment of Biodiversity Program and President's Committee of Advisors on Science and Technology.

Borich, Gray D. (1992). Effective Teaching Methods. (second edition). New York: Merrill, an imprint of Macmillan Publishing Company.

Brinthaupt, T. M. & Lipka, R. P. (2002). Understanding Early Adolescent Self and Identity: Applications and Interventions. Albany, New York: State Press of New York.

Bryant, P.J. (2002). Biodiversity and Conservation. Retrieved on November 16, 2004, from http://darwin.bio.uci.edu/~sustain/bio65/Titlpage.htm

Dill, D. (1990). What Teachers Need to Know. San Francisco: Jossey-Bass Publishers.

Dunn, R. & Dunn, K (1993). Teaching Secondary Students Through Their Individual Learning Styles: *Practical Approaches for Grades 7-12.* Boston: Allyn and Bacon.

Eble, K. E. (1988). The Craft of Teaching. (second edition). San Francisco: Jossey-Bass Publishers.

Education World. (1996-2003). Retrieved on November 12, 2004, from http://www.educationworld.com/standards/national/math/5_8.shtml

Education World. (1996-2003). Retrieved on November 12, 2004, from http://www.educationworld.com/standards/national/science/5_8.shtml

Evolution: Library: The Current Mass Extinction. (2001). Retrieved on November 16, 2004, from http://www.pbs.org/wgbh/evolution/library/03/2/l_032_04.html

Harmin, M. (1994). Inspiring Active Learning: *A Handbook for Teachers*. Alexandria, Virginia: Association for Supervision and Curriculum Development.

Haury, D. (1998). Teaching About Biodiversity. Columbus, Ohio: ERIC/CSMEE.

Hertz-Lazarowitz, R., & Miller, N. (1992). Cambridge: Press Syndicate of the University of Cambridge.

Human Impact Triggers Massive Extinctions. (1999). Retrieved on November 16, 2004, from http://www.uwsp.edu/geo/courses/geog100/EBBPlantExtinct.htm.

Lancaster, O. E. (1974). Effective teaching and learning. New York: Gordon and Breach.

Letendre, G. K. (2000). Learning to be an Adolescent. New Haven, Connecticut: Yale University Press.

Merriam- Webster OnLine. (2004). Retrieved on November 1, 2004, from http://www.m-w.com/cgi-bin/dictionary?book=Dictionary&va=biodiversity.
Meyer, C., & Jones, T. (1993). Promoting Active Learning. San Francisco: Jossey-Bass Publishers.

National Council for Social Studies. (1995-2004). Curriculum Standards for Social Studies: II. Thematic Strands. Retrieved on November 12, 2004, from http://www.socialstudies.org/standards/strands/

National Museum of Natural History. (2004). Biodiversity Programs. Retrieved September 2004 from http://www.mnh.si.edu/biodiversity/biopro.htm

National Zoo | Fonz. (2004). Retrieved September 24, 2004, from http://nationalzoo.si.edu

Pintrich, P., & Schunk, D. (1996). Motivation in Education: Theory, Research, and Applications. Columbus, Ohio: Prentice Hall.

Santrock, J. W. (2004). Educational Psychology. (second edition). New York: McGraw-Hill Higher Education.
School Improvement in Maryland. (2004). What do our students need to know and be able to do? Retrieved on November 12, 2004, from http://mdk12.org/mspp/vsc/index.html

Standards for teaching and Learning: Secondary Level. (2004). Retrieved on November, 12, 2004, from http://www.k12.dc.us/dcps/curriculum/content/scnd-stl.htm

The National Council of Teachers of English. (1998-2004). Standards for the English Language Arts. Retrieved on November 12, 2004, from http://www.ncte.org/about/over/standards/110846.htm

Virgina Department of Education. (2004). Retrieved on November 12, 2004, from http://www.pen.k12.va.us/VDOE/EnhancedSandS/

WPI. (2004). IGSD. Retrieved October 7, 2004, from www.wpi.edu