Integrating environmental education into a science curriculum: A proposal for Missoula County Public School District

Kathyrn E. Meyer

The University of Montana

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INTEGRATING ENVIRONMENTAL EDUCATION INTO A SCIENCE CURRICULUM- A PROPOSAL FOR MISSOULA COUNTY PUBLIC SCHOOL DISTRICT

by

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B.A. Middlebury College

Presented in partial fulfillment of the requirements

for the degree of

Master of Science

in Environmental Studies

University of Montana

1999

Approved by

[Signatures]

Chair, Board of Examiners

Dean, Graduate School

Date

5-25-99

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CHAPTER ONE:

Environmental Education

Introduction

As we approach the turn of the century, evidence of environmental degradation has become harder to ignore. Increased desertification, deforestation, and the loss of global biodiversity are some of the most obvious examples of the predicaments that plague the planet. Such issues have forced people to question the impact that these dilemmas will have on their lives and determine how to solve them. Over the past 30 years, an increasing number of people have turned to education as a means of solving such problems. Advocates of environmental education agree that informing people about these issues will help establish a citizenry that can make more responsible decisions to benefit the environment in the future (U.S. Congress, 1990a). Accordingly, environmental education has been recognized as one of the most practical long-term solutions to the earth's environmental problems (U.S Congress, 1990a; Braus and Wood, 1993; Leverman, 1992; Markinowski, 1991).

Since the late 1960's, environmental education has played a significant role in establishing the publics' interest in environment issues. In 1990, the federal government acknowledged the importance of environmental education by enacting the National Environmental Education Act (NEEA) and since then more than 60 per cent of the states have developed some type
of environmental education guidelines (Braus, 1995). Even so, many students are still not educated about environmental issues, and environmental degradation continues at an alarming rate.

Environmental education is interdisciplinary in nature, but a great deal of its content lies within the field of science. Because science is the basis for solving so many of our environmental problems, one of the most common way that environmental education has been integrated into the traditional education system has been through science lessons (Simmons, 1989, and Leiberman and Hoody, 1998).

Although natural resources and the environment are central to Missoula area residents life, the Missoula County Public School (MCPS) system currently does not have a formal approach to educating students about environmental issues. Fortunately, the local school district has recently been involved in the process of rewriting their science curriculum, making it possible to weave environmental education into the new curriculum so that all of the local students have the opportunity to learn about the environment.

This paper is designed to help the MCPS system's science curriculum committee integrate environmental education into its new science curriculum by providing an overview of environmental education and making specific recommendations about how to incorporate environmental education into the new curriculum. The organization of this paper is broken into four chapters. The first chapter will present readers with an overview of
environmental education in terms of its history, definitions, and current status in Montana. The second chapter includes a summary of science education reform in the United States and the role that national standards play in this movement. Specifically, this chapter contains a description of where environmental education fits within the current science education system. The third chapter includes a detailed account of the MCPS curriculum review process, an outline of the events that transpired throughout the course of the year, and an overview of my role in the process. The fourth chapter outlines the specific recommendations and considerations that I have made to the MCPS curriculum committee and case studies which serve as working examples of science programs that have successfully integrated environmental education into their curriculums.
An Overview of Environmental Education

Historical Roots of Environmental Education

Education about the environment has roots which go back nearly 100 years, yet the field of environmental education did not formally emerge in the United States until the late 1960's. Environmental education's antecedents are many, but most experts in the field trace it back to the creation of our National Parks, the nature study movement, conservation education, and outdoor education (Archie and McCrea, 1996; Braus and Disinger, 1996).

In the early part of this century, various conservation and preservation advocates such as John Muir, Gifford Pinchott, Theodore Roosevelt, and Bob Marshall contributed to a heightened environmental awareness. Their advocacy efforts awakened Americans to the degradation that was occurring to our limited natural resources, and prompted an educational focus on the scientific characteristics, aesthetic qualities, and utilitarian aspects of the environment (Braus and Disinger, 1996). As people began to better understand the importance of our resources and support programs for their management, efforts were made to set aside large expanses of land in the form of National Parks, game reserves, and other types of public land.

By the 1920's, people's views of natural resources began to expand. Ecology emerged as a scientific field, thus emphasizing relationships, interdependencies, and networks instead of parts (Braus and Disinger, 1996). Ecology's systemic view allowed people to begin to conceptualize the environment and the idea of environmental quality, thus encouraging a
better understanding of their role in the natural order. In 1949, much of the early thoughts about the environment culminated in Aldo Leopold’s visionary book, *The Sand County Almanac*, which introduced the notion of a land ethic.

**The Birth of a New Field**

In the 1960’s, the public became increasingly aware of environmental degradation through the highly visible effects of ecological disasters such as major oil spills and the loss of arable land. Furthermore, Rachel Carson’s notable book, *Silent Spring*, initiated widespread concern about less discernible problems related to the abuse of industrial chemicals—particularly DDT—and their potentially negative effects on the food chain. Accordingly, people became overwhelmed with the effects of pollution, pesticides, and resource degradation and a quest for environmental quality ensued.

By focusing on human health and quality of life, people saw a need to take responsibility for the quality of the environment. By the end of the 1960’s, the word “environment” was formally introduced to describe the all-inclusive category which comprised both human and natural habitats (Dowie, 1992). People were no longer considering themselves apart from the whole and the negative affects of their activities were being highlighted.

Because of this increased public concern for the environment and a need to inform people about the threats to it, the field of environmental education formally emerged in the late 1960’s. Environmental educators responded to calls for a form of education that would foster citizen’s
willingness and ability to participate in maintaining a clean and healthy environment for all life (Archie and McCrea, 1996). They agreed that people would need to understand their interactions with the environment in order to act in an environmentally responsible manner and make appropriate decisions about its future.

At the time when the field of environmental education was formalized, its philosophy and approach were seen as an amalgamation of several existing educational movements. From the field of nature study came an emphasis on learning through observation, inquiry, and discovery; from conservation education came wise use of natural resources; from outdoor education came the approach of using the out-of-doors as a learning setting; and from citizenship education came a commitment to action (Schoenfeld, 1970). Additionally, environmental education was influenced by the progressive education movement, led by John Dewey in the 1920's which focused on learning by doing.

Based on these educational influences, environmental education became a cohesive field which finally gained practitioners and imposing theories of content and methodology. In 1969, experts in the field began publishing the Journal of Environmental Education. This publication became the sounding board for the field and a vehicle by which scholars could more formally define environmental education.
Early Federal Support for Environmental Education

In 1969, the National Environmental Protection Act (NEPA) was passed. This was the first effort by Congress to identify education as a mechanism for improving the quality of the human environment (U.S. EPA, 1996). Subsequently, on October 30, 1970, the National Environmental Education Act (NEEA) was signed into law by President Richard Nixon. The act was intended to establish an Office of Environmental Education within the Department of Education, Health, and Welfare, provide funding in the form of grants for the development of interdisciplinary environmental education curricula, establish an advisory council for environmental education, and provide technical assistance to states for developing state-wide programs in environmental education (U.S. Congress, 1990a).

Within 3 years, the implementation of the NEEA of 1970 had lost momentum. The Department of Education had never established an Office of Environmental Education or a National Advisory Council for Environmental Education because they seemed to object to a law that dictated how they should address environmental education (U.S. Congress, 1990d). Also, Congress failed to commit the funds that the law required for implementation. Only $6 million of the $45 million authorized in funding had actually been appropriated. Furthermore, the environmental education community had become less supportive of the legislation because only 75 of the proposed grants were ever funded (U.S. Congress, 1990a).
Internationally Recognized Goals and Objectives

Although the NEEA of 1970 did not live up to its expectations, it brought environmental education to the attention of the federal government and served as a source of encouragement for the new field of environmental education. Additionally, the act offered enough funding to enable several states to develop state-wide master plans for environmental education within their education systems (Braus and Disinger, 1996).

By the middle of the 1970's, the role of environmental education was recognized by the rest of the world. In 1975, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) held an international conference on environmental education in Belgrade, in the former Yugoslavia. At this meeting, representatives from around the world outlined the basic structure and aims for environmental education in a document which is known as the Belgrade Charter. In this document, the participants concluded that:

The goal of environmental education is to develop a world population that is aware of, and concerned about the environment and its associated problems and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones (UNESCO-UNEP, 1976).

Building off of the Belgrade Charter, the United Nations sponsored another international conference in 1977 in Tbilisi, Georgia which advanced a set of goals and guiding principals for the field of environmental education.
worldwide. The Tbilisi Document declared the following unified objectives for environmental education:

To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;

To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;

To create new patterns of behavior of individuals, groups, and society as a whole towards the environment (UNESCO, 1978).

Both statements marked the first international discussion and agreement about the urgency of environmental education and established goals and objectives for the field which are still prominent today.

Following these conferences, environmental educators began looking for a fixed definition for the field of environmental education. By reviewing the findings from early research within the field and summarizing the founding documents of environmental education, experts agreed that a comprehensive program in environmental education should stress the following five objectives: awareness of the environment and its associated problems, knowledge of ecosystem functions and humans role in this system, attitudes or values that guide a students behavior towards preserving the environment, skills to identify and investigate environmental problems, and participation in positive actions toward the resolution of environmental issues (UNESCO, 1978; Beutler, 1988; Braus and Wood, 1995; and Weilbacher,
1995). Today, environmental education programs continue to strive to meet all five of these objectives

Revitalized Federal Role in Environmental Education

By 1981, the NEEA of 1970 was formally repealed by an Omnibus Budget Reconciliation Act. Meanwhile, an anti-environmental sentiment was advancing throughout the nation. President Reagan publicly proclaimed that "approximately 80% of our air pollution stems from hydrocarbons released by vegetation," and "all of the waste in a year from a nuclear power plant can be stored under a desk" (U.S. Congress, 1990a). Such misinformation became characteristic of the establishment's view of environmental issues. With minimal support from the federal government, the growth of environmental education programs stagnated during the 1980's.

By the late 1980's, American's environmental attitudes were changing again. Membership among the mainstream environmental organizations was at its peak and the environment had become a major issue in the national media (Dowie, 1996). Accordingly, interest in a reestablished federal role in environmental education was mounting. In 1988, The Blueprint for the Environment was presented to President Bush by a number of different national environmental groups. This report provided several suggestions for improving the condition of the environment, including strong support for a reestablished federal role in environmental education (U.S. Congress, 1990a).
As a result of this heightened awareness about the environment and a clearer understanding of the need for environmental education, the NEEA of 1990 was introduced to both the House of Representatives and the Senate in early 1990. The introduced bills were intended to "renew and reestablish the federal role in environmental education" (U.S. Congress, 1990a).

In the findings section of the bill, Congress recognized that there is an increasing amount of evidence regarding environmental problems that affect human health and the environment. Accordingly, they propose that effective solutions to those problems require an "understanding of the natural environment, awareness of the problems, and the skills to solve them" (U.S. Congress, 1990b). Additionally, they declared that the federal government had not been adequately educating the public about these issues. Finally, they acknowledged that education could establish a foundation for long-term solutions to environmental problems. Accordingly, the major goal of the act was to develop an awareness of environmental problems and the skills to solve them among primary, secondary, and post-secondary students in the United States (U.S. Congress, 1990a).

Distinguished witnesses from the EPA, environmental education organizations, and education organizations testified at both the Senate and House Hearings on the bill. In general, most witnesses expressed strong support for the bill and recognized a need for an educational approach to solve environmental problems. On November 17, 1990 this nonpartisan and
evidently noncontroversial bill was signed into law by president George Bush (Public Law 101-619).

This NEEA was established to help focus federal efforts in environmental education. It aimed to improve environmental education by extending programs in curriculum development and teacher training, providing a national grant program, and placing the EPA in charge of establishing the Office of Environmental Education. While no mandates were forthcoming, the Act did create incentives for environmental education throughout the country (refer to Appendix A for a detailed description of the NEEA of 1990).

Implementation of the NEEA

When the NEEA was first signed into law, the 1990’s became heralded as the “Golden Age for Environmental Education” (Marcinkowski, 1991). Existing programs had expanded, new programs were able to get off the ground, and everyone seemed to agree with the importance of the field. Throughout the nation, environmental education was becoming more prevalent than ever.

By 1991, The 22nd Annual Gallup Poll of the public’s attitudes towards the public schools revealed that two-thirds of the adults surveyed favored requiring every high school student to study environmental problems and issues (Elam, 1991). Additionally, many teachers started using environmental education to complement their science lessons. A study which was completed in 1992 concluded that more than half the U.S. science
teachers were using at least some environmental education material in their classroom (Hammond, 1991).

Also, audiences for environmental education were expanding from school children and teachers to include decision makers in government, businesses, non-profits, employees in environment-related jobs, college students, and the general public. Reports were formally indicating the benefits of environmental education programs and their need. In a survey of parents in Minnesota, researchers found that 60 percent of the parents considered the environment to be one of the most important subjects for high school graduates to know—ahead of geography, government, science, history, and fine arts (Simmons, 1995). Additionally, by 1996, 20 states required or strongly encouraged environmental education within their education systems (U.S. Congress, 1996a).

At the same time, the 1990's led to an expanded definition of environmental education in order to put more of a focus on social equity, economics, culture, and politics. Because research was indicating that the disproportionate impacts of pollution and other environmental hazards were on communities with high populations of low-income residents and people of color (Fuller, 1998), efforts were initiated to target a broader range of audiences.

In 1992, at the United Nations Conference on the Environment and Development which took place in Rio, world representatives emphasized the importance of educating people so that they view the environment within
the context of human influences (National Association of Conservation Districts, 1998). Additionally, environmental educators were being encouraged to prepare individuals to be more responsive to the rapidly changing technological world, to better understand contemporary world problems, and to provide the skills needed to play the most effective role in the improvement and maintenance of the environment (Ramsey, Hungerford, and Bybee, 1998).

Even with the signs of environmental education's expanding influence, within a few years of NEEA's enactment, people began to question how much of an effect the federal government could actually have on environmental programs throughout the nation. There was also concern about the amount of funding which was actually being appropriated to environmental education programs and a fear that the legislation would find its demise as its predecessor of the 1970's had (Lewis and Zeldin, 1991).

During the first five years of implementation, the EPA received approximately 10,000 grant applications requesting $300 million, but was only able to fund about 1,200 proposals from the $13 million appropriated by Congress (U.S. EPA, 1996). Actual appropriations for the first six years was only between $5.6 million and $7.8 million a year (U.S. EPA, 1996). Because only about half the anticipated authorizations were actually committed to the programs there was increasing concern about the EPA's ability to carry out the provisions of the act.
Compounding the problems of the NEEA's effectiveness was the fact that the field of environmental education was being placed under increasing attack by political conservatives by the middle of the 1990's. Some people felt that environmental education was too one-sided and that it was giving students incomplete information about ecological dangers (Schmidt, 1996). In the June 10th, 1996 issue of *U.S. News and World Report*, Michael Satchell reported that there was a growing concern that children were being indoctrinated rather than educated about environmental issues. There was also concern that environmental education was taking away from the teaching of traditional disciplines and that "green education" was to blame for U.S. school children's weak math and science skills. (Satchell, 1996).

Five years after the NEEA was signed into law, the Environmental Education Advisory Council to the EPA came out with a status report on the act and provided recommendations for its future reauthorization. They maintained that the acts' programs were beneficial and a federal role in environmental education should be continued (U.S. EPA, 1996).

In July of 1996, bills were introduced in both the Senate and House to reauthorize the NEEA (S. 1873 and H.R. 3645 respectively). The reauthorization included a number of amendments which were intended to "clean up the law and make programs run more efficiently" (U.S. Congress, 1996a).

The amendments responded to some of the recent criticism of environmental education by requiring that programs funded by the act be
"balanced and scientifically sound" (U.S. Congress, 1996a). Such changes were an attempt to allow students to learn about environmental issues in a more objective setting (refer to Appendix B for a detailed description of the National Environmental Education Reauthorization Act of 1996 and 1998).

The reauthorization of 1996 passed the Senate on August 2, 1996, but died in committee in the House at the end of the 104th Congress (Lefebvre, 1997). During the summer of 1998, The National Environmental Education Amendment Act of 1998 was reintroduced in the Senate. This act was identical to the NEEA Amendments of 1996 and was placed on the Senate legislative calendar after it was passed in committee, but never reappeared before Congress convened at the end of the 105th session.

While President Clinton authorized the legislation of the act through 1998, the future of the NEEA is uncertain. It is anticipated that Clinton will reauthorize the act, though it seems unlikely that the Senate will reintroduce the act because of the outcome in the 104th and 105th Congresses.

**Excellence in Environmental Education Project**

In response to the National Environmental Education Act of 1990 and an increasing demand for environmental education, the North American Association for Environmental Education (NAAEE) initiated a Project for Excellence in Environmental Education in 1993. Because previous efforts to implement environmental education at a national level had been inconsistent, the NAAEE set out to establish a set of common guidelines for the development of balanced and scientifically accurate environmental
education programs based on the generally understood goals and objectives of the field. These guidelines are being established to give a sense of order to the field of environmental education and demonstrate to the educational community that there can be a common scope and sequence, as well as goals and objectives, for the field (Hungerford, 1996). The main purpose of this ongoing project is to determine what it means to be environmentally literate (Simmons, 1999). Upon completion, the project will provide students, parents, teachers, and the general public with a set of common, voluntary guidelines for effective environmental education programs, material, and instruction.

The final outcome of the NAAEE's Project for Excellence in Environmental Education will be three complete sets of guidelines. The first set of guidelines to be produced was the Environmental Education Material: Guidelines for Excellence which came out in 1996. This document is intended to evaluate the design and content of various environmental education material and direct further curriculum development by considering all aspects of curriculum design, the learner, presentation, and assessment. The second set of guidelines, Environmental Education Guidelines for Excellence: Initial Preparation of Instructors, is in the process of being reviewed and should be published by the fall of 1999. These guidelines will address what environmental educators should know and be able to convey to their students. Finally, the project includes the recently completed Excellence in Environmental Education- Guidelines for Learning.
(K-12) which were published in March, 1999. This document offers guidance to educators for fostering and gauging environmental literacy in Kindergarten through twelfth grade.

The experts involved in the development of these guidelines believe that environmental education should be linked with formal education. In such a way, teachers can promote environmental literacy so that we can progress toward a sustained, healthy environment and an improved quality of life for everyone (Simmons, 1999). The project emphasizes the five main objectives of environmental education that were recognized in the goal statement of the Belgrade Charter and three main objectives of the Tbilisi Declaration. Additionally, it is rooted in the optimistic notion that humans can live compatibly with nature and make informed decisions that consider future generations.

Because environmental education encompasses the knowledge and skills that are essential for maintaining an equilibrium between quality of life and quality of environment, these standards are thought to be an integral part of every student’s education (Simmons, 1995). Accordingly, the authors of these standards agree that environmental education standards can play a significant role in reaching several goals from the Goals 2000: Educate America Act.

Environmental education can prepare students for responsible citizenship by ensuring that they learn to use their minds effectively (Simmons, 1995). Also, through the hands-on study of natural systems,
environmental education can significantly enhance the development of science process ability and student understanding of concepts in a real world context. Finally, by providing students with the skills necessary to make informed decisions and the motivation to take responsible action, the environmental education guidelines can ensure that students “possess the knowledge and skill necessary to compete in a global economy and exercise the rights and responsibilities of citizenship,” (National Education Goals Project, 1993).

Guidelines for the Learner

*The Excellence in Environmental Education- Guidelines for Learning (K-12)* suggest expectations that are appropriate for learner performance and achievement at the end of fourth, eighth, and twelfth grades. The guidelines foster the development of effective and comprehensive education using the environment and demonstrates how environmental education can be used as a means for meeting the standards set by the traditional disciplines (Simmons, 1999). Specifically, these guidelines outline what it means to be environmentally literate.

The student performance guidelines are organized under four diverse strands which represent all the goals of environmental education (Table 1).
### Excellence in Environmental Education—Guidelines for Learning (K-12) Strands

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<td>• Working with models and simulations</td>
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The first strand, Questioning and Analysis Skills, emphasizes students learning in terms of asking questions about the world around them,
speculation and hypothesizing, seeking information, and developing answers so that they can understand the environment and investigate environmental problems. The second strand, Knowledge of Environmental Processes and Systems, focuses on student understanding of both human and natural systems and their interactions. The third strand, Skills for Understanding and Addressing Environmental Issues, addresses students' abilities to learn about, evaluate, and act on environmental issues. Finally, the fourth strand, Personal and Civic Responsibility, emphasizes cultivating an understanding that students' actions as individuals and in groups can make a difference.

Within each of the four strands there are guidelines which identify the general goals for learner achievement and sample indicators which illustrate how learner achievement could be demonstrated. The guidelines are designed to fit within the context of our formal education system. They are written so that educators can reference where environmental education goals directly coincide with other disciplinary standards including, the arts, civics and government, economics, English, language arts, geography, history, mathematics, science, and social studies. Additionally, the guidelines highlight the importance of student understanding of the local environment throughout their education. By adding an understanding of students' surroundings into the standard curriculum, learners can develop a foundation of skills and knowledge which enhances a deeper conceptual understanding of issues associated with the environment, thereby increasing environmental literacy (Simmons, 1999).
The environmental education guidelines build off of 30 years of research in the field of environmental education, state environmental education frameworks, and models created by various environmental organizations. They respond to criticism about the field and attempt to put forth a sound program that works within the formal education system to develop environmental literacy in all of our students. Eventually, these guidelines will be submitted to the National Education Goals Panel in order to be nationally certified. In doing so, they can be formally recognized by the education community.
Montana’s Environmental Education History

Although the federal government plays an important role in enhancing environmental education in the United States, state and local governments are the most influential force in formal environmental education because of their responsibility for public education (U.S. EPA, 1996). Fortunately, the NEEA of 1990 prompted a reemergence of environmental education as a state governmental priority. By 1995, three states had mandates requiring environmental education training for teachers and eleven states required environmental education to be incorporated into a core curricula (U.S. EPA, 1996).

State involvement in environmental education appears to be crucial to the success of any environmental education program. Many experts believe that comprehensive state environmental programs, including a state environmental education office, state coordinators, or environmental education councils, are the most effective way to enhance quality environmental education programs in the United States (U.S. EPA, 1996).

Unfortunately, Montana’s government has been reluctant to embrace environmental education as a priority (Durgin, 1993; Gunderson, 1989; Light, 1984; and Palen, 1991). For the most part, the environmental education efforts within the public schools of Montana have been inconsistent and lack solid support from the Office of Public Instruction (OPI) and the Montana Board of Public Education (BOCE) (Durgin, 1993). After interviewing a different leaders in the Montana educational community, Richard Durgin...
(1993) recognized that BOPE and OPI have been disinclined to encourage environmental education until it is supported by more Montanans and becomes less controversial.

Montana is ranked as one of the lowest ten states in terms of state level environmental education support. In 1996, the results of a national survey on the comprehensive environmental education programs at the state level indicated that Montana had only 2 of the possible 16 components listed (U.S. EPA, 1996).

Although the state of Montana does not have a strong infrastructure for environmental education, there are a number of different educators throughout the state that have taken the initiative to integrate environmental education into local classrooms. Additionally, a number of successful grassroots environmental education efforts began here and have led to nationally recognized programs. For example, the Project Wild was developed by a consortium of Northwestern states including Montana and the national headquarters for Project WET is currently housed in Bozeman.

Several different organizations have been created to promote environmental education in Montana. Specifically, the Montana Environmental Education Association (MEEA), an organization that was formed in 1991, has attempted to integrate environmental education into the K-12 curricula in Montana by encouraging relationships between teachers, government agencies, conservation groups, and private industry. Also, the Crown of the Continent Environmental Education Consortium (COCEEC)
has been formed to encourage and support coordination and cooperation among individuals, organizations, and agencies which educate about humans and the natural resources, promote a sense of community, provide balanced educational leadership, and encourage the development and dissemination of educational information throughout the northern rocky mountain ecosystem.

The creation of these organizations can be viewed as an indication of increasing commitment to quality environmental education in Montana. Additionally, Montana’s state teaching certificate standards now require environmental science coursework, thus enabling new teachers to gain a greater understanding of the issues that effect Montana’s ecosystems. Given the current status of environmental education in Montana, it has the potential to gain momentum throughout the state and eventually receive the state support that it needs in order to be a part of every student's education.
Environmental education requires an understanding of concepts in the disciplines of math, social science, art, and to a large extent science. Until recently, there has been little cohesiveness in the national science education efforts, making it difficult to integrate environmental education into a standard curriculum. Given the emphasis being placed on the incorporation of environmental education into the formal education system, the history of science education reform and national education standards are relevant to the potential of integrating environmental education into any science curriculum. This chapter provides an overview of science education and the National Science Education Standards (NSES) and points out where environmental education can fit within the current science education framework.

Science Education Reform

A Historical Perspective

Science, in general, refers to a wide range of research fields which each have their own language, conceptual base, and investigating procedures (Hurd, 1993). Early science instruction in the United States tended to be knowledge-oriented with particular emphasis on the scientific methods. Throughout this century, major changes in science education have occurred
in response to various historical and social circumstances. One notable episode which had significant effects on the way American's perceived science education was the launching of Sputnik by the Russians in 1957. Such a startling advancement by a powerful competitor in the world marketplace forced American's to acknowledge that our science curricula and instruction were not keeping up with the rapid changes in science and technology (Markinowski, 1991). Immediately, the United States sought to reform science education. As a result of this threat, science education in the 1960's focused on professional training and the development of new curriculum material. One of the most important objectives of curriculum change at this time was to increase the number of individuals pursuing careers in science to fill the "science manpower shortage" (Bybee, 1993).

Even with the early ideas of science education reform in place, research was showing that student performance on mathematics and science tests were declining and American students were being outperformed on a number of different international assessments in the 1970's (Pratt, 1998). Heightening these concerns was a recognition that enrollments and attitudes towards science were also declining.

**A Nation at Risk**

In 1983, the National Commission on Excellence in Education published a startling report which was aptly titled *A Nation at Risk*. This report pointed to American students declining test scores, poorly prepared high school graduates, and continued low enrollment in science and math as
indicators of an education system that was failing to educate its students adequately. Specifically, the report warned of a generation of scientifically and technologically illiterate Americans and a growing gap between the scientific and technological elite and a scientifically uninformed citizenry. (Bybee, 1993). Since that report was published, there have been over 300 other reports that all say that the United States has not been educating its children in science and mathematics (DeBuhr, 1995). As a result of all of these reports, there was a call for reconsideration and reform of our education system.

Goals 2000

One of the outcomes of the report Nation at Risk was a strong push to reestablish the American science education reform movement. In 1989, President George Bush and the nation's governors met in Charlottesville, Virginia for a rare national education summit. At the summit, this bipartisan group agreed to a set of six national education goals which was sent to Congress for debate and released to the public in 1991 as America 2000: An Educational Strategy (Bybee, 1993). This comprehensive, long-term plan entailed moving every community in America toward a set of national education goals which are based on the premise that "every child can learn and that education is a lifelong process" (National Education Goals Report, 1993).

Of the six broad goals set by Goals 2000, a few of them directly impacted the science education agenda. Specifically, the third goal pledged that by the year 2000:
"American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter, including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so that they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy" (National Education Goals Report, 1993).

Additionally, the fourth goal declared that U.S. students will be first in the world in science and mathematics achievement by the year 2000. The fifth goal states that every adult American will be literate and possess the knowledge and skills necessary to compete in a global economy and exercises the rights and responsibilities of citizenship.

The Bush administration's Goals 2000 plan spurred thousands of programs and projects to improve one aspect of the education system or another. Within the first year, half of the state governors and more than 2,000 communities agreed to support the proposals made in America 2000: An Educational Strategy (Bybee, 1993). Continuing this national agenda, the Clinton administrations introduced Goals 2000: Educate America Act which was passed into law in 1994 (Ravitch, 1995).

Many of the ideas behind Goals 2000 are based upon a change in educational approaches and goals as a form of educational reform. Current science educational reform encapsulates a number of different ideas. It moves away from the traditional chalk and lecture style of teaching to focus more attention on the learner (Olson, 1995). Science education reform is also directed at the curriculum and the knowledge that educators want students to learn. Instead of focusing on basic skills and superficially covering a
multitude of topics, science education reform emphasizes higher order thinking skills, like problem solving and a connection to the world beyond the classroom. Most importantly, science educational reform emphasizes scientific and technological literacy as the major purpose of K-12 science education for all students, not just those destined for careers in science (Bybee, 1993).

**Finding Environmental Education in Science Educational Reform**

In 1991, both David Kearns, the former U.S. Department of Education deputy secretary and William Reilley, an EPA administrator publicly commented on how environmental education can serve as part of the America 2000 reform effort (Marcinkowski, 1991). Environmental education encapsulates a number of different approaches that are encouraged by the current science educational reform movement. The environment can and does serve as an important societal and relevant educational context for learning science, mathematics and other subjects. Additionally, environmental education supports the processes of identifying, resolving, and preventing environmental problems by informing students about natural systems and their interdependence with the environment. Finally, it exposes students to a learning style which can effectively and efficiently facilitate conceptual learning and develop process skills such as critical thinking and problem solving (Cantrell and Barron, 1991).
National Science Education Standards

Based on the *America 2000: Educational Strategy* and its assertion that students should be able to demonstrate competency in various subjects, many actors in America's education system came to believe that national standards and assessments would provide accurate information about student performance and raise the quality of education. The first set of national standards was introduced by the field of mathematics at the end of 1989.

By the early 1990's, the National Science Teachers Association (NSTA) and several different scientific societies set out to develop their own innovative science standards that would reform science education and set some overall goals for the field (National Research Council, 1996). After almost six years of effort from thousands of experts in the field of science education, the National Research Council published the National Science Education Standards (NSES) in 1996. These standards were designed to encourage state and local school personnel to develop policies that bring coordination, consistency, and coherence to the improvement of science education while moving towards a scientifically literate society (National Research Council, 1996).

The NSES defines scientific literacy as "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (National Research Council, 1996). More specifically, the standards proclaim that a scientifically literate person can:
“ask, find, or determine answers to questions derived from curiosity about everyday life, as well as describe, explain, and predict natural phenomena, read articles about science in popular press, and identify scientific issues underlying national and local designs while expressing positions that are scientifically and technologically informed” (National Research Council, 1996).

By striving for every student in the United States to be scientifically literate, according to this definition, the standards aim to make tremendous strides in science education reform.

In order for scientific literacy to be achieved, the report concludes that students need to actually “do science” (National Research Council, 1996). Additionally, the standards demand that the learners see science as it connects to the real world, in terms of problem identification and solving, with a concept base and hands-on experience. Most importantly, the standards assert that science education should foster a higher level of critical thinking.

Components of NSES

The NSES are intended to provide a map for science education reform so that scientific literacy can be achieved throughout the nation. Instead of focusing on knowing scientific facts and information, they stress understanding scientific concepts and developing abilities of inquiry. They also emphasize integrating all aspects of science content and learning into the context of inquiry, technology, science and personal and social perspectives, and history and nature of science (National Research Council, 1996). Among other things, the standards encourage activities that investigate and analyze
science questions instead of activities that demonstrate and verify science content.

The NSES are organized into six different areas: Standards for Science Teaching, Standards for Professional Development for Teachers of Science, Standards for Assessment in Science Education, Standards for Science Content, Standards for Science Education Programs, and Standards for Science Education Systems (Table 2).

Table 2

<table>
<thead>
<tr>
<th>Science Teaching Standards</th>
<th>Professional Development</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Inquiry-based</td>
<td>• Continued learning of science through the methods of inquiry</td>
<td>• Four components of assessment</td>
</tr>
<tr>
<td>• Guide and facilitate learning</td>
<td>• Involves integrated learning of content, learning, pedagogy, and students</td>
<td>• Assessment consistent with decisions they are designed</td>
</tr>
<tr>
<td>• Engage in ongoing assessment</td>
<td>• Promote a life long learning approach</td>
<td>• Achievement and opportunity must be assessed</td>
</tr>
<tr>
<td>• Create learning environments with extended time, appropriate space, and resources</td>
<td>• Programs must be coherent and integrated</td>
<td>• Data collection is matched to students decisions and actions</td>
</tr>
<tr>
<td>• Create community of learners reflecting rigor of scientific inquiry and attitudes</td>
<td>• Participate in ongoing program planning</td>
<td>• Must be fair</td>
</tr>
<tr>
<td>• Participate in ongoing program planning</td>
<td></td>
<td>• Inferences made about student achievement are sound</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Science Content</th>
<th>Program Standards</th>
<th>System Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Unifying Concepts and Processes</td>
<td>• All elements of K-12 programs much follow NSES</td>
<td>• Policies match standards and are flexible to local circumstances</td>
</tr>
<tr>
<td>• Science as Inquiry</td>
<td>• All students must develop interest, subject must be relevant, inquiry based, and connected to other subjects</td>
<td>• Coordinate within and across agencies, institution, and organizations</td>
</tr>
<tr>
<td>• Physical Science</td>
<td>• Coordinated with Math</td>
<td>• Sustained over time</td>
</tr>
<tr>
<td>• Life Science</td>
<td>• Students have access to resources</td>
<td>• Must be equitable</td>
</tr>
<tr>
<td>• Earth and Space Science</td>
<td>• All students have equitable access to opportunities</td>
<td>• Policy instruments must be reviewed</td>
</tr>
<tr>
<td>• Science and Technology</td>
<td>• School support of teachers</td>
<td>• Provide reforms time</td>
</tr>
<tr>
<td>• Science in Personal and Social Perspectives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• History and Nature of Science</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Each of the six broad standards is defined by specific goals. In order for the vision of science education that is described in the NSES to be attained, all six standards are supposed to be implemented together (National Research Council, 1996).

Science Content Standards

The Science Content Standards are of particular importance to educators. These standards outline what students should know, understand, and be able to do in the natural sciences over the course of a K-12 education (National Research Council, 1996). They are divided into eight categories: Unifying Concepts and Processes in Science, Science as Inquiry, Physical Science, Life Science, Earth and Space Science, Science and Technology, Science in Personal and Social Perspective, and History and Nature of Science (Table 3).

Table 3

An Example of NSES Content Standards- Grades 9-12

<table>
<thead>
<tr>
<th>Grades 9-12</th>
<th>Unifying Concepts</th>
<th>Science as Inquiry</th>
<th>Physical Science</th>
<th>Life Science</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>* Systems, order and organization</td>
<td>* Abilities necessary to do scientific inquiry</td>
<td>* Structure of atoms</td>
<td>* The cell</td>
</tr>
<tr>
<td></td>
<td>* Evidence, models, and explanation</td>
<td>* Understandings about scientific inquiry</td>
<td>* Structure and properties of matter</td>
<td>* Molecular basis of heredity</td>
</tr>
<tr>
<td></td>
<td>* Change, constancy, and measurement</td>
<td></td>
<td>* Chemical reactions</td>
<td>* Biological evolution</td>
</tr>
<tr>
<td></td>
<td>* Evolution and equilibrium</td>
<td></td>
<td>* Motions and forces</td>
<td>* Interdependence</td>
</tr>
<tr>
<td></td>
<td>* Form and function</td>
<td></td>
<td>* Conservation of energy and increase in disorder</td>
<td>* Matter, energy, and organization in living systems</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Earth and Space Science</th>
<th>Science and Technology</th>
<th>Science in Personal and Social Perspectives</th>
<th>History and Nature of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades 9-12</td>
<td>* Energy in the earth system</td>
<td>* Abilities of technological design</td>
<td>* Science as a human endeavor</td>
</tr>
<tr>
<td></td>
<td>* Geochemical cycles</td>
<td>* Understanding about science and technology</td>
<td>* Nature of scientific knowledge</td>
</tr>
<tr>
<td></td>
<td>* Origin and evolution of the earth system</td>
<td></td>
<td>* Historical perspectives</td>
</tr>
<tr>
<td></td>
<td>* Origin and evolution of the universe</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The content standards address what students should know by the end of fourth, eighth, and twelfth grades. Each standard is then broken down into broad areas of content followed by an illustrative discussion of outcomes. While these standards do not prescribe a specific curriculum, they do describe what it should include.

Finding Environmental Education in the NSES

Because of the way that the content standards define scientific literacy, they call for more than learning in traditional subject matter like earth, life, and physical sciences. In particular, the NSES standards state that an important purpose of science education is "to give students a means to understand and act on personal and social issues" (National Resource Council, 1996). Although the term environmental education is not referred to specifically, the standards include the environment as a component of science content that all students should know. Therefore, the standards recognize the importance of teaching students about the environment and environmental studies.

Most of the content that refers to environmental topics is found in the Science and Personal and Social Perspectives category within the content standards of the NSES (Table 4).
### Table 4
Environmental Content within the NSES Content Standards

<table>
<thead>
<tr>
<th>Grades K-4</th>
<th>Science in Personal and Social Perspectives</th>
</tr>
</thead>
</table>
| • Personal health  
• Characteristics and changes in populations  
• Types of resources  
• Changes in environments  
• Science and technology in local challenges |

<table>
<thead>
<tr>
<th>Grades 5-8</th>
<th>Science in Personal and Social Perspectives</th>
</tr>
</thead>
</table>
| • Personal health  
• Populations, resources, and environments  
• Natural hazards  
• Risks and benefits  
• Science and technology in society |

<table>
<thead>
<tr>
<th>Grades 9-12</th>
<th>Science in Personal and Social Perspectives</th>
</tr>
</thead>
</table>
| • Personal and community health  
• Population growth  
• Natural resources  
• Environmental quality  
• Natural and human-induced hazards  
• Science and technology in local, national, and global challenges |

By the end of fourth grade, the content goals within the Science and Personal and Social Perspectives category revolve around initial understanding of various environmental issues such as scarcity of resources, pollution, and overcrowding.

By the end of eighth grade, the standards recommend that student learning expand within this category to include environmental concepts and their interrelationships. These standards maintain that middle school students should be able to conceptually understand the idea of ecological crisis and grasp large and abstract issues like acid rain or ozone depletion. Also, the standards state that teachers should be sure to challenge popular misconceptions about environmental issues.
By the time students graduate from high school, they should have an understanding of more formal environmental concepts including: population growth, natural resources, environmental quality, and natural and human-induced hazards. Specifically, they should recognize the connection between populations and competition for resources, the relationship between human consumption and the limits of the earth's resources, the factors that influence environmental quality, and the natural and human activities that affect the earth's systems.

Based on the generally understood objectives of the field of environmental education, these standards appear to fall short of offering students a comprehensive environmental education experience. The NSES do specifically address furthering students' knowledge and awareness of environmental issues and encourage students to become active participants in making local and global change, but they never address how to teachers can promote participation (Brown, 1997). Also, the standards do not address how students can acquire the skills to solve environmental issues or clarify their own personal values toward the issues.

Even though the NSES do not model comprehensive environmental education, the experts involved with the writing the standards acknowledge that learning about the environment is important and they open the door for student learning in the environmental context (National Resource Council, 1996). Therefore, educators could easily supplement these standards with
environmental education in order to foster a positive learning experience for students.

**Parallels between NSES and Environmental Education Guidelines**

Because scientific understanding is such an important part of environmental education, the *Excellence in Environmental Education Guidelines for Learning (K-12)* focus a number of their learner goals on science content and processes, specifically modeling the NSES. When comparing both documents it is apparent that the environmental education guidelines could be utilized in order to accomplish almost half of the NSES science content standards (refer to Appendix C for a comparison of the Learner Goals of NSES and Excellence in Environmental Education Guidelines).

Both the NSES and the environmental education guidelines use the term "literacy" to describe the understanding and lifelong skills which learners need in order to achieve a personally fulfilling and responsible life (Cantrell and Barron, 1991). Accordingly, the NSES and the environmental education guidelines emphasize similar content areas and a number of their learner goals mimic each other.

A common theme in both documents relates to the abilities that are necessary for students to do scientific inquiry. The NSES refer to this content area as Science as Inquiry while the guidelines refer to it as Questioning and Analyzing Skills. In both cases, there is an emphasis on students ability to ask questions, plan and conduct investigations, employ technology to
improve investigations, analyze alternative explanations, and communicate procedures. Both documents have similar inquiry goals for the learner.

Within the Knowledge of Environmental Processes and Systems strand of the environmental education guidelines, a number of the content goals parallel the Physical Science, Earth and Space Science, and Life Science content areas within the NSES. Specifically, more than half of the learner goals in these content areas of the NSES could be fulfilled by using the environmental education guidelines.

Finally, both documents address science as it relates to the environment and society. The Environment and Society strand in the environmental education guidelines maintains similar goals as the Science in Personal and Social Perspectives theme in the NSES. Both address resources, environmental quality, and humans ability to change the environment. Within the environmental education guidelines, this theme is woven into the entire document, but highlighted in the Environment and Society strand, whereas, the NSES focus on the environment and society only in the Science in Personal and Social Perspectives strand.

Although the environmental education guidelines emphasize an interdisciplinary approach to learning about the environment, science educators could easily justify teaching environmental issues as the guidelines suggest because of their strong commitment to scientific understanding. Furthermore, the guidelines can facilitate science education reform efforts.
CHAPTER THREE:
The MCPS Science Curriculum Review Process

In order for local school districts to keep pace with current science educational reform efforts, it is important for them to evaluate and revise their K-12 science curriculums regularly. Given the previously mentioned characterization of environmental education and its strong relationship with science education, I placed myself on the local curriculum review committee in order to help MCPS integrate environmental education into the districts new science curriculum. This chapter includes a description of the MCPS science curriculum review process and an overview of the role that I played in it.

MCPS Science Curriculum Committee

Each year, the MCPS system evaluates a different disciplines' curriculum. If a schedule is maintained, each subject is scheduled for review every six years. In the spring 1998, the MCPS system began the year-long process of reviewing their K-12 science curriculum, thirteen years since it had gone through a previous formal review (McKean, personal communication, September 22, 1998).

The underlying goal of the MCPS science curriculum review process is to develop a K-12 unified science curriculum which gives children the best education based on the finest available resources. Some of the parameters to
the project include developing an integrated K-12 curriculum which is standards-based, incorporating a form of assessment for the curriculum, and basing the curriculum on the mission and goals of the district's Board of Education.

**Membership**

The science curriculum committee is led by Bob McKean, the county's executive director of curriculum. His role is to coordinate the entire committees effort, provide resources, act as a liaison between the committee and the MCPS Board of Education, and maintain the integrity of the review process.

The full committee is primarily made up of teachers because of their expertise in the field. Accordingly, there are 50 teachers representing all of the schools and grade levels in the district as well as a group of 15 parents, students, and community members who serve in one capacity or another on the full committee. The full committee is charged with developing a philosophical approach for the curriculum, serving as a clearinghouse for recommendations, and providing input to the different sub-committees.

The steering committee, which includes 13 area teachers, provides specific direction for the overall curriculum review process. The members develop agendas for the full committee meetings and act as a sounding board for other committee members and district teachers. Additionally, they serve to problem solve specific issues as they arise.
Table 5 provides an overview of the originally proposed timeline for the steps in the curriculum development process:

Table 5

<table>
<thead>
<tr>
<th>Activities</th>
<th>Time Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Development of Intellectual Capital</td>
<td>Spring &amp; Summer—Prior to Year 1</td>
</tr>
<tr>
<td>A. Gather and review information 1. Literature 2. Assessment Data 3. Curriculum Models 4. Old Curriculums</td>
<td>Fall—Year 1</td>
</tr>
<tr>
<td>B. Other needs assessment</td>
<td></td>
</tr>
<tr>
<td>II. Develop a general philosophical approach</td>
<td>Fall—Year 1</td>
</tr>
<tr>
<td>A. Comparison of what best minds in field recommend vis-à-vis where we are</td>
<td></td>
</tr>
<tr>
<td>B. Decide what we should do that we are not doing</td>
<td></td>
</tr>
<tr>
<td>C. Agree on model for document development</td>
<td></td>
</tr>
<tr>
<td>III. Document Development</td>
<td>Winter &amp; Spring—Year 1</td>
</tr>
<tr>
<td>A. Write standards, benchmarks &amp; competencies</td>
<td></td>
</tr>
<tr>
<td>B. Decide what we should do that we are not doing</td>
<td></td>
</tr>
<tr>
<td>C. Begin assessment development</td>
<td></td>
</tr>
<tr>
<td>IV. Materials Review</td>
<td>Winter &amp; Spring—Year 1</td>
</tr>
<tr>
<td>V. Complete Document and Submit to C &amp; I Committee</td>
<td>Spring &amp; Summer—Year 1</td>
</tr>
<tr>
<td>VI. Complete Materials Review and Submit to C &amp; I Committee</td>
<td>Spring—Year 1</td>
</tr>
<tr>
<td>VII. Staff Development</td>
<td>Summer—Year 1, 2 and 3</td>
</tr>
<tr>
<td>VIII. Implement Curriculum</td>
<td>Fall—Year 2</td>
</tr>
<tr>
<td>IX. Complete Assessment</td>
<td>Year 2</td>
</tr>
<tr>
<td>X. Assess Curriculum</td>
<td>Years 2 &amp; 3</td>
</tr>
</tbody>
</table>

The proposed timeline ensures that the committee accomplishes the science curriculum review process by the fall of 1999. Because the MCPS Board of Education authorized money in its budget to purchase new science
material for the 1999-2000 school year, it is important for the committee to request all of the funds that are necessary to carry out their proposed curriculum by the spring of 1999. If the committee does not make their requests to the Board of Education by the end of the spring, access to these funds will be thwarted. If the timeline is followed, the science curriculum implementation, staff development and assessment will begin in the summer and fall of 1999.
An Overview of Events

Full committee meetings were held on a monthly basis throughout the fall and early winter of the 1998-1999 academic year. The first full committee meeting took place in September of 1998. This meeting served to familiarize the science committee participants with each other and the curriculum review process, while also establishing common ground from which everyone could work.

In October, Professors Fletcher Brown and Lisa Blank, from the University of Montana's School of Education, provided committee members with an overview of curriculum trends in science. This meeting provided teachers with a summary of the National Assessment of Education Progress (NAEP) in science and the Third International Math and Science Study (TIMSS) tests' results and described how Montana students compared to the rest of the nation on them.

In November, the agenda for the full committee meeting was scheduled so that participants would begin defining the district's standards and benchmarks, the scope and sequence of science offerings, and the philosophy that would drive the design of the new curriculum. The overriding question for this meeting was whether the committee was in
agreement regarding the districts use of the NSES as their science curriculum framework.¹

Although the Montana state science standards were not yet available for review, it was anticipated that the state standards would be aligned with the NSES. The steering committee recommended that the district follow the NSES because they provide a common language for the curriculum.

Because a number of committee members felt that they needed to review the NSES before making a decision about adhering to these standards, McKean agreed to provide them with a voluntary workshop on the standards. Accordingly, the full committee spent time discussing the district's overall science philosophy and much of the November agenda was pushed up to the December meeting.

Early in December, the steering committee came up with a draft philosophy of the district's science curriculum. The first paragraph was taken directly from the NSES, while the second paragraph included a few changes:

"Scientific literacy is important for all students. Increased scientific literacy will offer increased personal fulfillment and excitement, is important for collective decision making about shared resources, enhances the capability of students to hold meaningful and productive jobs, enhances students' ability to think logically and creatively, and helps us as a society to remain globally competitive.

To ensure scientific literacy, this curriculum includes strong content with a clearly defined, standards based scope and sequence that includes the "unifying concepts" of the NSES. It is

¹ Recently, many states and local school districts have made efforts to align their standards with those that are nationally recognized. By doing so, more students are expected to measure up to standards of academic achievement that are as high as any in the world (Tucker and Codding, 1998). Although the national standards are voluntary, incentives such as increased federal funding exist to encourage state and local school districts to adopt these standards.
further based upon the belief that in order for students to develop deep scientific understanding and skills, they must participate in appropriate scientific problem solving. The curriculum is designed to be integrated, where appropriate, and includes a variety of assessment techniques” (MCPSa, 1998)

This statement was reviewed and approved by the full committee at the December meeting. Also, at the December meeting there was a final movement to adopt the NSES as a basis for standards in the district. This motion was approved by the full committee.

Once agreement was reached to follow the NSES, the full committee was divided into smaller sub-groups in order to focus on the grade-specific tasks at hand. Elementary, middle, and high school committee members were separated to work on their different agendas.

**High School Agenda**

The high school sub-committee first met in mid-January. The overall agenda for this meeting was “to gather input regarding the high school component of what students should know and be able to do in science by the time they graduate from high school” (MCPSb, 1999). Specifically, committee members needed to decide how they could ensure that the high school students within the district would be taught the science content that NSES recommend they learn by twelfth grade within the current framework of the local high schools.

The first part of the meeting provided committee members with an outline of some background information regarding the overall purpose and goals of the science curriculum committee and its direction. Specifically, Bob
McKean provided committee members with an overview of the NSES, a draft of the new Montana science standards, and a very preliminary draft of the MCPS science standards which the steering committee had recently developed (Table 6).

Table 6

*Draft--MCPS Science Standards--Draft*

**Standard #1: Science as inquiry**
Students will combine process and scientific knowledge as they use scientific reasoning and critical thinking to develop their understanding of science.

**Standard #2: Unifying concepts of science**
Students will demonstrate an understanding that systems, models, changes, evolution, innovation design and form and function are the unifying concepts of science.

**Standard #3: Physical science**
Students will demonstrate knowledge of properties, forms, patterns, changes, and interactions of physical and chemical systems.

**Standard #4: Life Science**
Students demonstrate knowledge of characteristics, structures and function of life systems, the process and diversity of life, and how living organisms interact with each other and their environment.

**Standard #5: Earth and space science**
Students demonstrate knowledge of the composition, structures, processes and interactions of the earth's systems and other objects in space.

**Standard #6: Humans and science**
Students demonstrate knowledge of human health, understanding of the history and development of science and informed decision-making concerning human impact on the environments.

These draft district standards were a consolidated version of the eight content standards of NSES. The steering committee agreed that technology is integral to the entire science curriculum, so they embedded it into the entire district curriculum instead of including it as a separate standard as the NSES have done. Additionally, two of the NSES, Science in Personal and Social
Perspectives and History and Nature of Science, were combined to become the district's sixth standard, Humans and Science.

At this meeting, McKean also addressed the new TerraNova test which will be administered to all MCPS students beginning in the spring of 1999. He pointed out that the test is written with the NSES as a spine for the science evaluation section. In other words, this new version of the CTBS test is directly aligned with the NSES, making it even more important that teachers address all of the NSES content.

Following this overview, the participants of the meeting broke up into three smaller groups to discuss their opinions about the current model for teaching high school science. They also addressed the problems associated with meeting all of the NSES goals given the current two-year science requirement at all of the district high schools.

At the end of the meeting, committee members concluded that because so many of high school students currently take three years of science, there was not a need to extend the two-year science requirement. Additionally, committee members agreed that infusing the necessary physical science content into the Earth Science and Biology classes would be an ideal way to ensure that all students be exposed to the information that is demanded by the NSES. Accordingly, each high school within the district would need to reinforce their Earth Science and Biology requirements. Committee members also agreed that students need stronger exposure to earth, life, and physical science in middle school. Finally, it was mentioned that the focus of this
committees discussion had revolved around only three of the six proposed district standards. In such a way, Inquiry, Unifying Concepts, and Humans and Science were not addressed, even though the district acknowledges their importance and national assessments will include these standards.

In early February, the high school sub-committee met again to determine specifically how teachers could meet the NSES within the two-year science requirement at district high schools. At this meeting, the high school science teachers concluded that they would be able to meet the earth and space, life, and physical science requirements within the current framework of an Earth Science and Biology class. Again, little discussion revolved around methods for meeting the other three proposed district standards.

By March, high school teachers were able to write up benchmarks for grade 12 and screen materials that they were interested in using. In April, the high school committee wrote course descriptions that are consistent with the proposed guidelines and by the end of May, Committee members had determine what material should to use in each the high school science classes.

**Middle School Agenda**

The middle school sub-committee met at the end of January with an agenda set to gather input regarding middle school science curriculum scope and sequence and material selection criteria (MCPSc, 1999). The steering committee decided that the choice of curriculum material was likely to dictate whether or not the middle school educators would use an integrated or
discipline-centered approach to teaching science content. Accordingly, material selection was a pressing concern.

Bob McKean began the meeting with the same general overview of national, state, and draft district standards for science that he gave to the high school sub-committee a few weeks earlier. The committee then broke into small groups to discuss the elements that should be in the criteria to script and select the middle school science material. Additionally, one group of committee members set out to discuss the meaning of inquiry in science.

Several concerns were raised at this meeting. First, high school teachers worried that students were coming to the high school lacking basic process skills like, measuring and graphing. They emphasized that these skills, in terms of how to do science and perform science, are more important to have before high school than the specific content. Middle school teachers discussed the difficulty of using inquiry as a teaching method within a 45-50 minute class structure and their fear that by accommodating inquiry they would have to give up breadth of content. Finally, committee members worried that some middle school teachers, particularly in the outlying feeder schools, might be uncomfortable teaching science content and the committee emphasized the need for professional development within the new curriculum.

By March, the middle school committee began screening curriculum material and completed a draft of the grade 8 benchmarks and complete grade-level competencies were written by the end of April. After much
discussion, it was decided that seventh and eighth grade science would be
taught through a discipline center approach, while sixth grade science content
would be integrated. Based on the best available curriculum material, sixth
grade students would be taught an integrated life, earth, and physical science
course, seventh grade students would be taught predominately life science
content, and eighth grade students learning would focused around physical
science content. Although middle school science content seems to revolve
around only three of the six recognized content areas, the standards do
address all content areas and claim that each will be taught, to some extent or
another, throughout middle school. Accordingly, Science as Inquiry,
Unifying Concepts of Science, and Humans and Science will be addressed
throughout sixth through eighth grades.

**Elementary School Agenda**

The elementary school committee members met in the middle of
February to analyze the current district science curriculum and determine
which units have been working the best. As with the high school and middle
school sub-committees, Bob McKean provided the elementary teachers with
an overview of federal, state, and draft district standards.

Because the elementary school committee felt overwhelmed with the
amount of content that they are responsible to teach in order to prepare
students for the fourth grade benchmarks, it was decided that the members
would be divided into two further sub-committees: grades K-2 teachers and
grades 3-5 teachers. This way, each sub-committee could focus on more
specific guidelines for student learning. Accordingly, the committee decided that benchmarks would be created for grade 2, as well as grade 4.

At the K-2 committee meeting, teachers agreed that all science standards should be taught at each grade level. Also, they decided to teach health as part of the science curriculum for approximately one quarter's worth of time. Additionally, they emphasized that science should compliment reading, communication arts, and math.

At the sub-committee meeting for the grade 3-5, teachers highlighted the need to continue teaching science skills as well as to integrate science into reading lessons. They also discussed the option of teaching health as part of science in cases where the content overlaps. Additionally, they emphasized the importance of tying science and math together at this learning stage. At the end of this meeting, several committee members asked for more information about the developmental learning stages of K-5 students in order to decide what should be taught at each level.

Throughout the spring, the elementary sub-committees screened curriculum material and attended vendor presentations by publishing companies. By the beginning of March, these committees had written up standards for grade 2 and 4. By the end of the spring, both committees selected curriculum material and completed grade-level competencies.

Outcomes

Because the science learner goals for students vary so much throughout their education, each sub-committee on the MCPS science
curriculum committee has had a different role in the review process. While the elementary school teachers have been extremely concerned about fitting science content into their already full curriculum which involves teaching students the basics skills of reading, writing, and arithmetic, the middle school teachers have focused their attention on whether or not they should integrate the science content throughout a students 6-8 grade experience, or whether they should divide the content into distinct disciplines that would be taught at separate grade levels. The high school teachers have addressed the issue of teaching all the NSES content within the framework of two single discipline classes.

A draft of the MCPS Standards and Benchmarks for Science was presented to the full committee at the end of March (refer to Appendix D to review a copy of this document). Although the document has not been finalized, the committee decided to base the science materials selection criteria upon these standards and benchmarks and use them for the development of grade-level competencies and high school course descriptions.

At the end of May, the full science committee recommended to the Board of Education that MCPS Science Curriculum be accepted as a working draft until the document is completed in the fall and that the Board adopt the agreed upon materials. Even though the K-8 grade-level competencies had not been completed and some last minute agreement needed to be reached on some material selection, Bob planned to put a draft of the finished standards
and benchmarks in front of the Board of Education on May 25th. A presentation of both the curriculum and materials list together is important in order to ensure that the proposed programs are fully funded and material is purchased before the end of the fiscal year (McKean, personal communication April, 1, 1999).

Once the Board approves the new science curriculum, the document will still need to go through a final editing process. If all goes according to plan, the final adoption of the curriculum is anticipated for August, 1999. At that time, material will have been purchased and the first stages of professional development should be in place so that the new curriculum can be implemented in September.
My Role in the Curriculum Review Process

I became involved with the MCPS curriculum review process in the spring of 1998. As an environmental educator and an Environmental Studies graduate student at the University of Montana, I have become increasingly interested in the role that the environment can play in the education of MCPS students. While natural resources and the environment are central to the lives of Missoula area residents, I noticed that there have not previously been any efforts to integrate environmental learning into the local public schools. Because of the pivotal role that science plays in educating people about the environment, it seemed appropriate to try to incorporate environmental education into the MCPS's new science curriculum.

Bob McKean granted me permission to be a member of the full science curriculum committee in the fall of 1998. Consequently, I attended curriculum committee meetings throughout the 1998-1999 academic year as a community representative. I sat in on these meetings in order to observe the curriculum review process and gain a better understanding of exactly how environmental education could be incorporated into the new curriculum.

Once the committee came out with a draft of the MCPS Science Standards and Benchmarks in mid-March, I was able to determine where environmental learning might play a role in the curriculum. Upon review, it was apparent that learning about the environment is imbedded in the
curriculum. Specifically, district Standard #3: Humans and Science addresses environmental issues such as population, natural resources, and hazards.

In response to the districts draft standards and benchmarks, I submitted a short executive summary of my professional paper, including recommendations regarding the integration of environmental education into the science curriculum to the steering committee (refer to Appendix E for a copy of this document). Additionally, I provided committee members with a guide to local organizations which offer environmental education programs and a guide to local resource centers which provide environmental education material that encourage student learning about the environment through the sciences (refer to Appendix F and G for these guides). In doing so, I hope that teachers will be more likely to use the environment as a context for learning science content and that the new science curriculum will include a more comprehensive approach to addressing environmental issues (refer to Appendix H for detailed reflections about my role in the curriculum review process).
CHAPTER FOUR:

Conclusions

Based on the research that I have done on environmental education and its potential role in a science curriculum, I came up with a set of recommendations for the MCPS science curriculum steering committee to consider when finalizing their new curriculum (a copy of the executive summary and recommendations that I submitted to the committee is included in Appendix E). This chapter includes the specific recommendations that I made to the steering committee as well as the rationale behind them. Additionally, I have noted some examples of communities in the United States which have successfully brought environmental education into their science curriculum and can be used by MCPS as examples to help implement their own environmental education programs. The chapter ends with a summary of the process of integrating environmental education into a science curriculum.

Recommendations and Consideration

I commend the science curriculum committee for including environmental issues in the new MCPS standards. By teaching about the environment, educators can promote effective and environmentally literate students, capable of participating democratically, making responsible
decisions, and understanding complex issues. The environment provides an ideal context for learning the scientific meaning of systems and interrelationships while also refining science skills such as observation, data collection, analysis, and formulating conclusions. Furthermore, integrating environmental issues into a science curriculum is an effective way to reach beyond basic content knowledge through student-centered learning, hands-on instruction, and relevant subject matter.

Recommendation #1:

While the MCPS draft science standards specifically address furthering students' knowledge and awareness of environmental issues and encourage students to develop decision-making skills concerning human impacts on the environment, they fail to address how students can acquire these skills, clarify their own personal values toward the issues, or participate to resolve environmental issues effectively. Because, effective solutions to our environmental problems depend on a citizenry that is aware of the issues and equipped with the skills to solve them, the new science curriculum should include all of the components of a comprehensive environmental education program: not just awareness and knowledge, but values, skills, and participation, as well.

The proposed science curriculum states that students should "demonstrate knowledge of informed decision-making concerning human impact on the environments" and that an important purpose of science
education is to give students a means to “understand and act on personal and social issues” (MCPSd, 1999). Clearly, this document indicates that students should be capable of not only being aware and knowing about the environment, but they should also be taught the skills that are required to effectively participate in social change.

**Recommendation #2:**

Missoula teachers should be encouraged to use the NAAEE’s new *Excellence in Environmental Education- Guidelines for Learning (K-12)* in order to complement all science content.

This set of common guidelines is intended to help teachers develop balanced and scientifically accurate environmental education lessons while pointing the way towards using the environment as a means for meeting the standards set by the traditional disciplines. Because the guidelines represent a well rounded approach to educating students about the environment while addressing specific science content, science educators can easily utilize these guidelines to meet and even enhance the district science standards.

**Recommendation #3:**

In order to ensure that Standard #3 of the MCPS science standards is met, teachers will need to be provided with in-service training. By doing so, educators can be informed about updated knowledge, material, and curriculum ideas within the field of environmental education.
Without an understanding of environmental education, teachers are less likely to integrate environmental issues into their curriculum. Ham and Sewing (1988) reported that teachers' misgivings about their own competence to conduct environmental education programs are one of the leading barriers to incorporating environmental education into the traditional school system. Accordingly, in-service training can empower teachers to use environmental education in their science lessons.

Recommendation #4:

The MCPS science curriculum should incorporate text books and learning material which include content pertaining to environmental issues. These issues should be presented in a balanced and scientifically sound manner.

A number of different publishing companies do incorporate environmental education into the lessons of their science text books and efforts should be made to choose such materials. By integrating environmental issues into the science text students can understand the relevance that these problems have on scientific understanding and teachers are more likely to use it in their lessons.

Recommendation #5:

Environmental education material, such as *Project WILD* and *Project Learning Tree*, should be used to supplement science lessons, particularly in
the elementary and middle schools (a complete guide to local resources is in Appendix G).

Environmental Education curriculum materials have been developed by experts within the field and they reflect current throughout the science education reform movement. Their activities are easy to use and the hands-on, engaging nature is appealing to most students.

**Recommendation #6:**

The MCPS science curriculum should promote an understanding of the local environment. Natural resources and the environment are central to the lives of Missoula area residents, accordingly teachers should expand students awareness of these related issues without advocating a particular viewpoint or course of action. By understanding their local environment, learners can build a strong foundation of skills and knowledge to reach deeper into the conceptual understanding that scientific literacy demands. Additionally, this understanding can help students make responsible decisions about the environment in the future.

Children have an innate love of animals and curiosity about nature, so it is important to capitalize on this and engage children in real world, lasting learning (Leiberman and Hoody, 1998). The local environment is an engaging, concrete and relevant context for teaching science concepts. Students should be encouraged to explore local issues so that, as adults, they can be better equipped to act as responsible members of their communities.
By teaching about the environment in the environment, students can gain a more concrete understanding of the concepts through hands-on discovery. Environmental education enables students to refine the science process abilities which the MCPS science curriculum committee agrees are so important. Additionally, educating students about their local environment by informing them about natural systems and their interdependence with the environment encourages students to go through the process of identifying, resolving, and preventing environmental problems.

Field trips are not the only way that students can explore the local environment, there are numerous environmental activities that can be done both in the classroom and in the schoolyard (examples of such activities are available through resources listed in Appendices F and G).

Recommendation #7:

Teachers should be encouraged to expand student understanding of science content by taking advantage of local non-formal environmental education programs offered by the Montana Natural History Center, Missoula YMCA, University of Montana, Missoula Urban Demonstration Project, and various local land use agencies (refer to Appendix F for a detailed description of local programs in environmental education). Furthermore, the MCPS science curriculum should require each student in elementary and middle school to participate in a school sponsored outdoor science based educational program.
There are a plethora of different organizations which offer programs that can expand student understanding about science by incorporating environmental learning. Programs vary from brief classroom presentations to multi-day field courses. Many of these programs are offered to area schools for little or no cost.

By requiring that each student is exposed to some type of outdoor science program throughout their education's, MCPS can ensure that their students are given the opportunity to learn in an alternative setting. In such a way, students can make the connection between scientific content and real-world learning.
Case Studies

Several communities have successfully integrated environmental education into their science curriculum. This section includes an overview of one of the first studies that has been conducted on the educational efficacy of environmental based education, specifically within the context of the traditional disciplines that are taught in K-12 schools. Additionally, several school systems will be highlighted as models for the inclusion of environmental education within a science curriculum.

Closing the Gap

In 1996, the State Environmental Education Roundtable (SEER) designed a comprehensive study that systematically describes how 40 schools from across the United States have used the environment as an integrating context for learning in K-12 schools. In 1998, the results of this study were presented in a report known as Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning. The report describes how the environment can be used as a framework for interdisciplinary, collaborative, student-centered, hands-on, and engaged learning to transform curricula in the schools and significantly improve K-12 education in the U.S. (Leiberman and Hoody, 1998).

Specifically, the report addresses how the environment can be used as an integrating context for learning science. By doing so, students not only learn about science, but they explore the world around them and actually do
science. For example, instead of reading about water chemistry, students might collect rain water, follow it as it enters storm drains, and conduct experiments at the local wastewater treatment plant to discover how it changes along the way. By using the environment as a context for learning science, students can develop their knowledge of scientific methods as they apply critical thinking to real-world situations.

The SEER report found that when students learn about science within the context of their community and natural surroundings, they demonstrate greater proficiency in applying scientific skills to real world situations (Leiberman and Hoody, 1998). The report also found that when compared to traditionally educated peers, students that learn science with the environment as an integrating context can more effectively master scientific knowledge and skills and achieve a deeper understanding of scientific concept and processes. Specifically, the report found that these students tend to perform better on standardized measures of science achievement.

The SEER report also found that students who participated in environment-based programs tend to become more excited about learning science than their traditionally educated peers (Leiberman and Hoody, 1998). Additionally, they found that students of all ability levels can master scientific information more easily when they learn about science through this context.
Hollywood Elementary School, Saint Mary's County, Maryland: (Leiberman and Hoody, 1998)

Hollywood Elementary school turned their 72-acre campus into a living lab of nature trails, butterfly gardens, migrating bird habitat, and wetland transformation. These projects were aided by community volunteers and funded through various small grants from the Chesapeake Bay Trust. Each project engaged the children and provided unique opportunities to combine learning about science to a meaningful whole.

One way that Hollywood Elementary has integrated environmental education into their science curriculum is through a Smithsonian-sponsored study on migratory birds. The students learned about the threats to certain bird populations because of habitat loss and they decided to create new habitat on their school grounds. They identified likely planting areas and filled in the area with native underbrush. This student driven approach to real scientific inquiry empowered the students to make their own decisions on the direction of the project.

Another project at Hollywood Elementary involved second and third graders turning a drainage pond into a natural habitat. Students researched the types of plants and animals that could thrive in a little pond, drafted planting plans, calculated depths and distances for optimal grown, and recruited parents and local college students to help with the work. This project combined biology, botany, ecology, math, and language arts.

SEER found that the test scores for Hollywood Elementary students demonstrate that this real-world experience has helped them excel in science.
In 1997, 67 percent of the school's third graders achieved satisfactory assessment scores on the state's year-end performance assessment for all students, whereas the statewide average was 38 percent. At the fifth-grade level, 70 percent of the students performed in the satisfactory zone, as opposed to 46 percent statewide.

**Custer County, South Dakota:**
(Ruskey and Wilke, 1994)

The Custer County Environmental Education Cooperative (EECo) was established in order to justify field trips during a time of budget cuts. EEco is a consortium which involves the school district along with eight state and federal land use agencies. Working together, they have developed environmental education lessons which focus on the unique natural and cultural features of the Black Hills and the environmental problems that affect both. They specifically focus the K-12 curriculum around a strong field science component.

Prior to the EECo program, Custer County students were rarely exposed to the local parks and monuments. By creating a park-based curriculum centered around different environmental themes for specific grade-levels, the consortium was able to eliminate overlap between the outreach programs of different agencies and concentrate on creating a high quality experience for specific topics. Along with grade-specific curriculum guides, EECo included a teacher preparation component which served to enhance teacher knowledge.
and skills in environmental education, reduced the teaching load of agency staff, and empowered teachers to teach environmental education content.

Chariton Middle School: Chariton, Iowa:
(Leiberman and Hoody, 1998)

Teachers at Chariton's middle school have found a way to encourage students to examine the world around them, show initiative, and get involved in issues that affect them. By bringing the outside into the classroom and the classroom outdoors, students have been able to see real science with a real purpose. Teachers have invited local experts from natural resource industries to talk with students and take them on field trips for on-site learning in order to teach real world issues.

Additionally the school's science club has a five year contract with Iowa's Department of Natural resources and the Lucas County Soil and Water Conservation District to monitor water quality for Clariton's water system. Through this process, students have learned to think, ask their own questions, and develop their own conclusions.

Oak Ridge Elementary: Salt Lake City, UT:
(National Association for Conservation district, 1998)

Students at Oak Ridge Elementary School have shown others how they can garden with limited water resources and an increasing population. By landscaping a portion of their school grounds to create a nature trail with native plants, they are learning about water conservation and wildlife habitat
enhancement. Not only is the trail self-sustaining, but it supports and encourages the local ecosystem. Teachers have been using programs such as *Project Learning Tree, Project WET* and *Project WILD* to help integrate lessons about the Naturescaping into their curriculum.

Teachers have noticed that seeing and experiencing local plants and animals has made learning much more meaningful and fun for students. They also recognize that using the garden as an outdoor classroom can bring the wonder of natural discovery to students.

**Yellowstone River Watch: Billings, MT:**
(National Association for Conservation district, 1998)

Each fall and spring, students from 20 schools along the Yellowstone River in Montana sample the river for macro-invertebrates and conduct chemical and physical analyses to determine the river's water quality. Using the guides, *Save Our Streams* and *Project GREEN*, the program is helping teachers satisfy the ecology goals and outcomes of district science curriculum. Teachers report that this first-hand experience of dealing with water and conservation issues has given students the opportunity to apply what they learn in class to a field study experience.

**Ecology: Big Sky High School, Missoula, MT:**
(Stevens, personal communication February 24, 1999)

In the Spring of 1998, Andrea Stevens, an Earth Science teacher at Big Sky High School noticed that there was a niche for a class that would address environmental issues without being based on the woes of the planet. She
recognized that high school students were dying to do something that is both helpful and real, so she designed a course to satisfy this need.

In the Fall of 1998 students could enroll in a junior/senior level elective called Ecology. The course was designed to address a number of different community issues through a hands-on approach to learning. While studying a soil ecology unit, students work with a local organization called Garden City Harvest to grow food for local food banks. In a riparian ecology unit, students replant and monitor several riparian areas for the Montana Department of Fish, Wildlife and Parks. By working on important community projects, Ms. Stevens claims that students feel inspired to learn more and do more to help. After a day of replanting vegetation in a riparian area one student commented, “I feel so good about what I did at Bear Creek, I can’t wait to go back in 15 years and see how we’ve helped.”
Summary

A number of different communities have demonstrated that effective education efforts can have a profound effect on students understanding of environmental issues as well as the underlying scientific content. Environmental education can teach tomorrow’s leaders how to solve and prevent environmental problems that plague the earth today. Over the past 30 years, the field of environmental education has become an important mechanism through which citizens have learned to understand and react to the complex issues that stress the future of our planet. Through federal legislation and both public and private initiatives throughout the country, environmental education has formed the cohesiveness and support that it will need in order to serve as a vehicle for solving our environmental problems.

There is little doubt that the earth is currently faced with various environmental threats. The federal government and the general public all seem to agree that environmental education is an important and viable solution to the environmental problems that we face (U.S. Congress, 1990; Elam, 1991; Simmons, 1995). Research demonstrates that environmental education can provide an opportunity to strengthen the teaching of science because science is the basis for solving so many of the environmental challenges (U.S. EPA, 1996; Leiberman and Hoody, 1998). With such a broad spectrum of environmental issues, science education is essential for furthering the connections between real-world problems and the
development of significant science understanding. Furthermore, environmental education can expand the general public's scientific understanding so that we can work towards effective solutions to these problems. By making science relevant to students' lives, environmental education can help meet the needs of a wide range of learners and potentially attract more students to careers in the various fields of science.

Throughout this project, my hope has been that MCPS system's science curriculum committee adheres to my recommendations regarding the integration of environmental education into the new science curriculum. By using environmental education as the context for learning science, students will be exposed to the environmental issues that plague our planet and be able to make responsible decisions that will benefit the environment in the future.

On May 18th, my recommendations were presented at a steering committee meeting. Upon review, the steering committee commended my efforts and acknowledged that MCPS needs to devote more attention towards addressing environmental issues in our schools. They agreed that staff development in environmental science/education needs to be incorporated into future in-service training efforts and that they need to ask for additional field trip funds for science (a copy of the steering committees full response to my recommendations is available in Appendix H).

Ideally, all of the future MCPS curriculum review committees will also include environmental education within their curriculums. While
environmental education fits well in a science curriculum, it is also an important component of social studies, geography, English, history, and mathematics content. By integrating environmental education into every subject, students can understand the interdisciplinary nature of the environmental problems that plague the earth while satisfying the standards set by all of the educational disciplines.

In order to ensure that environmental education becomes a part of all aspects of Missoula students K-12 education, the commitment of future curriculum committee members will be necessary. Fortunately, several disciplines have already recognized the importance of environmental education by including it in their national standards, therefore these national efforts can be used as models for future curriculum development in MCPS. Additionally, the NAAEE Project for Excellence in Environmental Education can be used to help future efforts to integrate environmental education into all of the different curriculum programs.

By taking an active role in the curriculum review process, I have come to understand how change can occur at the local level. Through bringing environmental education into the discussion of the local curriculum review process, I am hopeful that more teachers will become informed about the benefits of integrating environmental education into their science curriculum and all aspects of a students education. In such a way, more of Missoula’s children will be exposed to environmental learning and
understand that humans can live compatibly with nature and make informed decisions that consider future generations.
Appendix A: Summary of the NEEA of 1990

The National Environmental Education Act (S. 1076) was introduced to the Senate Committee on the Environment and Public Works on May 18, 1989 by Senator Chaffe. Representative George Miller introduced companion legislation (H.R. 3684) to the Committee on Education and Labor in the House of Representatives, on November 16, 1989.

The Senate passed a version of the bill by voice vote on July 18, 1990 while a similar bill was passed by the full House on September 28, 1990. Because the House and the Senate had passed different versions of the bill, the bills were referred to a joint conference committee. A unified version of the act, known as S. 3176, was approved by both bodies on October 26, 1990. On November 9, 1990 the measure was presented to President Bush. There were six general provisions of S. 3176 which were stated in Sections 4-9 of the Act.

First, the bill established an Office of Education within the Environmental Protection Agency (EPA). While it was argued that the Department of Education should be in charge of the act because of their expertise in the field of education and their role in the process of public education, the EPA was chosen to administer the act because they already had programs in environmental education underway, they had a regional infrastructure that was conducive to moving forward with the implementation, and they had the technical expertise to promote environmental education (U.S. Congress, 1990a). The Office of
Environmental Education was intended to develop and support programs that would improve public understanding of the natural environment, provide training programs for professionals, develop curricula, and manage grant and internship programs.

Second, the bill established a National Environmental Education Program which would be operated by a university or a consortium to coordinate the development and circulation of environmental education material and train professionals within the field. Because so much environmental education material already existed, this program was intended to centralize the existing information in order for educators to easily access and implement environmental education programs.

Third, a grants program was established through the Office of Environmental Education which promoted the development of environmental education programs. Twenty five percent of the grants were to be for $5,000 or less and no grant was to exceed $100,000. Most of this money was intended to provide seed money for teachers or organizations who were trying to get environmental education programs off of the ground.

Fourth, an environmental internship program was established to be run by the EPA in order to encourage college students to pursue careers that deal with environmental issues like environmental engineering or chemistry. Each year the EPA was to provide at least 150 college level internships.
Fifth, the Office of Environmental Education was to recognize excellence in environmental education by distributing a number of different national and regional awards to teachers, students and environmental education professionals each year.

Finally, both an advisory council which would be made up of environmental education experts and a Federal Task Force for Environmental Education which would include representatives from key federal agencies was established to advise the EPA in the implementation of the Act. The Department of Education was to be one of the key member of this Federal Task Force so that their expertise would be readily available to the EPA.

The act also included the formation of the National Environmental Education and Training Foundation. The foundations' purpose was to "encourage, accept, and administer private donations for environmental education activities as well as raise public consciousness about the need to protect the environment" (U.S. Congress, 1990d). The hope was that the foundation could raise enough private sector funds for environmental education so that the federal dollars for the programs could be phased out by the time the act needed to be reauthorized (U.S. Congress, 1990d).

As for funding, the final version of the bill authorized $12 million for the first two years of enactment, $13 million for the next year, and $14 million for the fourth and fifth years.
The new bill attempted to make some compromises between the House and Senate bill. The main provisions of the bill were similar to the Senate bill with a few exceptions. The revised NEEA authorized $12 million for the first two years of enactment, $13 million for the next year, and $14 million for the fourth and fifth years. The Trust Fund for Environmental Education was cut from the unified version and the Environmental Education and Training Foundation was implemented instead. Because Senate representatives worried that a privately funded foundation might not present environmental issues objectively, the final bill included prohibitions in the acceptance of gifts that would require an education program to represent a certain view which is favorable to the economic interest of the giver (U.S. Congress, 1990e). This included a clause that did not allow material which was financed by funders to contain logos or any other overt form of identification on the published material.

The NEEA was originally authorized for five years, so in the summer of 1996, Senator James Inhofe and Representative Scott Klug introduced the NEEA for reauthorization (S. 1873 and H.R. 3645 respectively). The reauthorization passed the Senate on August 2, 1996, but died in committee in the House at the end of the 104th Congress (Lefebvre, 1997).

Within its language, the amendments state that the act should:

support environmental education programs and material that characterize the environmental problem in a factual and objective way and that the act supports environmental education programs that point students and teachers toward constructive solutions to problems including those that foster conservation and economic goals (U. S. Congress, 1996a).

Inhofe argued that the Act needs to be articulated in such a way that the prejudices of teacher is not instilled in America’s children (U.S. Congress, 1996a). This request was intended to allow students to learn in an objective setting.

Among the proposed changes in the amendments were a shift in the percentage of small grants awarded under $5,000 or less from 25 percent to 15 percent. It also repealed authority for the internship and fellowship programs for the Office of Environmental Education because they seemed to overlap with other federal programs. Additionally, they would streamline the environmental awards program to only emphasize the President’s Environmental Youth Awards and eliminate all others. They would also
provide more flexibility for the National Environmental Education Advisory Council and Federal Task Force, so that they could have fewer members. Additionally, they would change the name of the National Environmental Education and Training Foundation to the National Environmental Learning Foundation, so as to better represent the goal and mission of the organization.

The bill also repeals a clause of the original act which prohibited logos and other means of identification on material donated to the Foundation for environmental education and training. Finally, the amendment sought reauthorization with a funding level of $10 million for each fiscal year, 1999-2004.
Appendix C: Parallels Between NSES and Excellence in Environmental Education Guidelines

<table>
<thead>
<tr>
<th>National Science Education Standards</th>
<th>Excellence in Environmental Education - Guidelines for the Learner (K-12)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science as Inquiry</strong></td>
<td><strong>Questioning and Analysis Skills</strong></td>
</tr>
<tr>
<td>• Identify questions that can be answered through scientific investigation</td>
<td>• Develop, focus and explain questions that help them learn about the environment and do environmental investigations</td>
</tr>
<tr>
<td>• Design and conduct a scientific investigation</td>
<td>• Design environmental investigations to answer their own questions</td>
</tr>
<tr>
<td>Use appropriate tools and techniques to gather analyze and interpret data</td>
<td>• Locate and collect reliable information about the environment using a variety of methods</td>
</tr>
<tr>
<td>• Think critically and logically to make the relationship between evidence and explanations</td>
<td>• Classify and order data and organize and display information in ways that help analysis/interpretation</td>
</tr>
<tr>
<td>• Recognize and analyze alternative explanations and predictions</td>
<td>• Judge the weaknesses and strengths of the information they are using</td>
</tr>
<tr>
<td>• Communicate scientific procedures and explanations</td>
<td>• Synthesize observations and finding into coherent explanations</td>
</tr>
<tr>
<td>• Use mathematics in all aspects of scientific inquiry</td>
<td>• Understand many of the uses and limits of models</td>
</tr>
<tr>
<td>• Understanding about scientific inquiry</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Science</th>
<th>The Earth as a Physical System:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Properties and changes of properties in matter</td>
<td>• Understand the properties of the substances that make up objects or materials found in the earth</td>
</tr>
<tr>
<td>• Motions and forces</td>
<td>• Grasp formal concepts related to energy in terms of energy transfer and transformation</td>
</tr>
<tr>
<td>• Transfer of energy</td>
<td>• Explore the origin of differences in physical patterns that shape the earth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Earth and Space Science</th>
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</thead>
<tbody>
<tr>
<td>• Structure of the earth system</td>
</tr>
<tr>
<td>• Earth’s history</td>
</tr>
<tr>
<td>• Earth in the solar system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Life Science</th>
<th>The Living Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Structure and function in living systems</td>
<td>• Basic understanding of the importance of genetic heritage</td>
</tr>
<tr>
<td>• Regulation and behavior</td>
<td>• Understand major kinds of interaction among organisms or populations of organisms</td>
</tr>
<tr>
<td>• Reproduction and heredity</td>
<td>• Understand that biotic communities are adapted to live in particular environments</td>
</tr>
<tr>
<td>• Populations and ecosystems</td>
<td></td>
</tr>
<tr>
<td>• Diversity and adaptations of organisms</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Science in Personal and Social Perspectives</th>
<th>Environment and Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Populations, resources, and environments</td>
<td>• Understand the uneven distribution of resources influences their use and perceived value</td>
</tr>
<tr>
<td>• Natural hazards</td>
<td></td>
</tr>
<tr>
<td>• Risks and benefits</td>
<td></td>
</tr>
<tr>
<td>• Science and technology in society</td>
<td></td>
</tr>
</tbody>
</table>
Missoula County Public Schools Standards and Benchmarks for Science  
March 25, 1999

Standard #1: Science as inquiry

Students will combine processes and scientific knowledge as they use scientific reasoning and critical thinking to develop their understanding of science.

Rationale: Science as inquiry is basic to science education and a controlling principle in the ultimate organization and selection of students' activities. The standards on inquiry highlight the ability to conduct inquiry and develop understanding about scientific inquiry.

<table>
<thead>
<tr>
<th>Benchmarks</th>
<th>End of Grade 2</th>
<th>End of Grade 4</th>
<th>End of Grade 8</th>
<th>Upon Graduation End of Grade 12</th>
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</thead>
<tbody>
<tr>
<td>1. Ask questions, find answers and compare the known and unknown.</td>
<td>1. Ask questions concerning objects, organisms, and events in the environment.</td>
<td>1. Identify questions and concepts that guide scientific investigations.</td>
<td>1. Identify questions and concepts that guide scientific investigations.</td>
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</tr>
<tr>
<td>2. Use different ways to investigate.</td>
<td>2. Plan and conduct an appropriate investigation.</td>
<td>2. Design and conduct scientific investigations, utilizing appropriate technology to acquire and analyze data.</td>
<td>2. Design and conduct scientific investigations, utilizing appropriate technology to acquire and analyze data.</td>
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<tr>
<td>3. Demonstrate use of instruments and other devices for measuring and observing scientific phenomena.</td>
<td>3. Choose and employ appropriate equipment and tools to gather and extend the senses.</td>
<td>3. Accurately use appropriate equipment and technology to measure (in SI units or as is otherwise appropriate) process and analyze data.</td>
<td>3. Accurately use appropriate equipment and technology to measure--in SI unit or as is otherwise appropriate--process and analyze data.</td>
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<tr>
<td>4. Collect and record data.</td>
<td>4. Organize and use data to construct a reasonable explanation.</td>
<td>4. Use evidence from the scientific investigation to develop descriptions, explanations, generalizations, predictions and models.</td>
<td>4. Formulate and revise scientific explanations and models based on scientific knowledge and evidence from investigations.</td>
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<tr>
<td>5. Communicate the results of investigations to others.</td>
<td>5. Reflect on and communicate investigations and explanations and make recommendations for further study.</td>
<td>5. Think critically and logically to develop and communicate the relationship between the variables of the scientific investigation.</td>
<td>5. Devise and analyze alternative explanations and models and use appropriate methods to defend a scientific argument.</td>
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</tbody>
</table>
**Standard #2: Unifying concepts of science**

Students will demonstrate an understanding that systems, models, changes, evolution, innovation design and form and function are the unifying concepts of science.

**Rationale:** Conceptual and procedural schemes unify science disciplines and provide students with powerful ideas to help them understand the natural world. Because of the underlying principles embodied in this standard, the understandings and abilities described here are repeated in the other content standards.

### Benchmarks

<table>
<thead>
<tr>
<th>End of Grade 2</th>
<th>End of Grade 4</th>
<th>End of Grade 8</th>
<th>Upon Graduation End of Grade 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify and apply appropriate scientific concepts and processes which include the following:</td>
<td>1. Identify, apply, compare and contrast appropriate scientific concepts and processes which include the following:</td>
<td>1. Identify, apply compare and contrast appropriate scientific concepts and processes which include the following:</td>
<td>1. Identify predictable events as a basis for explaining phenomena within a system through the use of models.</td>
</tr>
<tr>
<td>a. systems, order and organization.</td>
<td>a. systems, order and organization.</td>
<td>a. systems, order and organization.</td>
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</tr>
<tr>
<td>b. evidence, models and explanation.</td>
<td>b. evidence, models and explanation.</td>
<td>b. evidence, models and explanation.</td>
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<tr>
<td>c. change, constancy and measurement.</td>
<td>c. change, constancy and measurement.</td>
<td>c. change, constancy and measurement.</td>
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<tr>
<td>d. evolution and equilibrium.</td>
<td>d. evolution and equilibrium.</td>
<td>d. evolution and equilibrium.</td>
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<tr>
<td>e. form and function.</td>
<td>e. form and function.</td>
<td>e. form and function.</td>
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</table>

2. Use evidence to analyze interactions within systems in order to predict changes in natural cycles.

3. Distinguish between properties which are constant and those which interact within a systems to result in change.

4. Quantify system changes in observable and measurable units.
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<tr>
<th>End of Grade 2</th>
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<th>Upon Graduation End of Grade 12</th>
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<tbody>
<tr>
<td></td>
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<td></td>
<td>5. Account for the present form and function of objects through evolution.</td>
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<td>6. Describe how interacting units of matter tend toward equilibrium.</td>
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<td>7. Illustrate how form and function are complementary aspects of objects, organisms, and systems in the natural and designed world.</td>
</tr>
</tbody>
</table>
Standard #3: Humans and science

Students demonstrate knowledge of human health, understanding of the history and development of science and informed decision making concerning human impact on the environments.

Rationale: An important purpose of science education is to give students a means to understand and act on personal and social issues. The science in personal and social perspectives standards help students develop decision-making skills. In learning science, students need to understand that science reflects its history and is an ongoing, changing enterprise. The standards for the history and nature of science recommend the use of history in school science programs to clarify different aspects of scientific inquiry, the human aspects of science, and the role that science has played in the development of various cultures.

Benchmarks

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<th>End of Grade 4</th>
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</thead>
<tbody>
<tr>
<td>1. Investigate natural resources and environments.</td>
<td>1. Identify linkages among populations, resources and environments.</td>
<td>1. Analyze linkages among populations, resources and environments.</td>
<td>1. Explain why the Earth does not have unlimited resources, and describe the responsible use of those resources.</td>
</tr>
<tr>
<td>2. Investigate limits of natural resources and man's impact on future generations.</td>
<td>2. Describe how individual life decisions impact other people, the environment and future generations</td>
<td>2. Analyze the effects of the products, processes, technologies and inventions of a society on human health and the integrity of the environment.</td>
<td>2. Relate population dynamics to the limited carrying capacity of the earth and illustrate how technological changes affect that carrying capacity.</td>
</tr>
<tr>
<td>3. Demonstrate understandings of personal health and safety, and nutrition.</td>
<td>3. Describe individual responsibility for personal health and nutrition and how safety and security are basic human needs.</td>
<td>3. Identify major milestones in science that have changed the thinking of the time and explain that scientific knowledge is subject to change as new evidence is available.</td>
<td>3. Determine how individual life decisions impact other people, the environment, and future generations.</td>
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<td>4. Predict the result of human influences on the Earth's systems.</td>
<td>4. Document the existence of the natural and human-induced hazards and explain how they can be influenced by human activities.</td>
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<td>5. Identify major milestones in science that have changed human understanding and explain how new evidence affects scientific knowledge.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>6. Identify career opportunities that are available in science and science-related fields and explain why science is an integral part of society and human endeavor.</td>
</tr>
</tbody>
</table>
Standard #4: Physical science

Students demonstrate knowledge of properties, forms, patterns, changes and interactions of physical and chemical systems.

Rationale: By studying matter and energy in a variety of forms, students will be able to explain, interpret and predict changes and interactions in physical and chemical systems. Understanding of the dynamics of the physical world is the basis for informed decision making affecting life.

Benchmarks

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<th>End of Grade 4</th>
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</thead>
<tbody>
<tr>
<td>1. Identify and compare physical properties of objects—size, color, shape—by sorting, comparing, measuring and classifying.</td>
<td>1. Examine, describe, compare and classify objects based on physical properties using appropriate instruments and combine, separate and compare the different physical properties of and mixtures: e.g., salt and sand, iron filings and soil, oil and water.</td>
<td>1. Examine, describe, compare and classify matter based on common chemical and physical properties in a laboratory setting.</td>
<td>1. Comprehend that matter is made of atoms. Describe atomic structure, including subatomic particles, electron configuration, isotopes, and nuclear forces. Examine nuclear energy including fission and fusion.</td>
</tr>
<tr>
<td>2. Identify different forms of energy: e.g., light, heat and magnetism.</td>
<td>2. Comprehend that energy (light, heat, magnetic, electricity, and sound) is transferred in many ways: e.g., electricity in circuits can produce light, heat, sound and magnetic effects.</td>
<td>2. Explain that energy (light, heat, magnetic, electric, sound, chemical, nuclear and mechanical) is transferred in many ways.</td>
<td>2. Illustrate how energy can come in many forms (kinetic, potential, and electromagnetic), can transfer from one form to another and that within an ideal system remains constant.</td>
</tr>
<tr>
<td>3. Compare different forms of matter: solids, liquids and gasses.</td>
<td>3. Model and explain that matter exists as solids, liquids and gasses and can change from one form to another. Some common materials such as water can be changed from one state to another by heating and cooling.</td>
<td>3. Classify and measure quantities associated with energy forms necessary for changes in state from solids, liquids and gases.</td>
<td>3. Relate how chemical and physical properties of matter are functions of atomic structure, electron configuration, periodicity, and bonding arrangements; and differentiate between different forms of matter.</td>
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<td>4. Identify and describe mechanical systems: e.g., simple and complex machines.</td>
<td>4. Examine, describe, model and demonstrate that substances react chemically in characteristic ways with other substances to form new substances (compounds) with different chemical and physical properties, while conserving mass.</td>
<td>4. Describe interactions between matter and energy, including waves, heat and electricity.</td>
</tr>
<tr>
<td></td>
<td>5. Describe the position and motion of objects: e.g., changing the positions and motions of objects relating to push and pull.</td>
<td>5. Analyze the affect of multiple forces on movement, speed and direction of an object, and measure (in SI units) and graph the position, direction and speed of an object.</td>
<td>5. Understand that Newton's laws of motion describe interactions between matter and forces and differentiate between the types of forces: i.e., gravitation, electromagnetic, weak nuclear, and strong nuclear.</td>
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<tr>
<td></td>
<td>6. Examine, identify and measure (in SI units) the characteristic properties of the various types of energy in a natural and/or laboratory setting.</td>
<td>6. Describe various types of chemical reactions and the factors that affect reactions including time, temperature, concentration, shape and action of catalysts.</td>
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</tbody>
</table>
Standard #5: Life science

Students demonstrate knowledge of characteristics, structures and function of life systems; the process, continuity and diversity of life; and how living organisms interact with each other and their environment.

Rationale: Students gain a better understanding of the world around them if they study a variety of organisms, microscopic as well as macroscopic. Through the study of similarities and differences of organisms, students learn the importance of classification and the diversity of living organisms. The understanding of diversity helps students comprehend biological evolution and life’s natural processes (cycles, reproduction, growth and development). The study of cellular structure and function, the importance of DNA as the molecular basis of heredity, health and disease are important aspects of the study of life. The study of life systems provide students important information about how humans can have a critical impact on other organisms.

Benchmarks

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</thead>
<tbody>
<tr>
<td>1. Compare basic structures of plants and animals and their functions.</td>
<td>1. Identify basic structures and groups of plants and animals and their functions.</td>
<td>1. Compare structure and function of cells (plant, animal, bacteria).</td>
<td>1. Identify cell types along with the associated cell structures and functions that direct cellular activities, including photosynthesis, respiration, differentiation, and enzyme function.</td>
</tr>
<tr>
<td>2. Identify basic needs of plants and animals and their different environments/habitats.</td>
<td>2. Understand basic needs of organisms and the different environments/habitats that support them.</td>
<td>2. Explain how organisms and systems within organisms obtain and use energy resources to maintain life processes: i.e., growth, reproduction, response to stimuli, metabolism.</td>
<td>2. Explain how species evolve over time as a result of mutation driven variation interacting with the environment through natural selection. (Describe how this has resulted in biodiversity and subsequent classification systems.) biodiversity and biological classification.</td>
</tr>
<tr>
<td>End of Grade 2</td>
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<tr>
<td>3. Identify plant and animal life cycles.</td>
<td>3. Demonstrate knowledge of plants and animal life cycles and different environments that support different organisms.</td>
<td>3. Compare the relationships of food webs in a variety of local ecosystems.</td>
<td>3. Demonstrate how matter and energy flow through different levels of organization of living systems and describe how organisms maintain a dynamic equilibrium.</td>
</tr>
<tr>
<td>4. Group plants and animals according to observable characteristics.</td>
<td>4. Differentiate between inherited and learned/acquired characteristics, and identify parent/offspring resemblance.</td>
<td>4. Describe the differences in the reproductive process, using the principles of genetics, in a variety of plants and animals.</td>
<td>4. Describe the chemical and structural properties of DNA and explain how the genetic information is encoded and transmitted, and how this information controls the development and function of organisms.</td>
</tr>
<tr>
<td>5. Recognize the environmental effects on plants and animals.</td>
<td>5. Describe the effects of human interaction and environmental change on organisms caused by human and natural forces.</td>
<td>5. Recognize the basis for standard classification schemes by grouping plants and animals according to their characteristics: i.e., design and use.</td>
<td>5. Illustrate how the behavior of organisms operates through physiological systems allowing them to respond to stimuli in their environments, and how behaviors are adaptive to both the individual and the species.</td>
</tr>
<tr>
<td>6. Recognize growth, survival and reproduction of plants and animals as influenced by internal and external cues.</td>
<td>6. Explain the interdependent nature of biological systems in the environment and how they are affected by human interaction: e.g., life cycles, food webs, etc.</td>
<td>6. Explain the role of microorganisms in terrestrial and aquatic ecology, in the causation and transmission of disease and for environmental, medical and other purposes by man.</td>
<td></td>
</tr>
</tbody>
</table>
Standard #6: Earth and space science

Students demonstrate knowledge of the composition, structures, processes and interactions of the earth-space systems.

**Rationale:** By studying the Earth, its composition, history and the processes that shape it, students gain a better understanding of the planet on which they live. Knowledge of geochemical cycles—i.e., carbon cycle, rock cycle, water cycle, etc.—and the relationships among them enables the student to understand common processes and predict the impact of change. Understanding Earth-space systems will empower students to make informed decisions about their future.

**Benchmarks**

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<th>End of Grade 4</th>
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</thead>
<tbody>
<tr>
<td>1. Explore physical properties and changes in earth materials (rocks, water and soil).</td>
<td>1. Identify, describe and compare earth materials (rocks, soil, water and gases) their physical and chemical properties and use as resources.</td>
<td>1. Model and explain the internal structure of the earth.</td>
<td>1. Describe internal and external energy sources of the Earth, including convection in the mantle, within the atmosphere, and in the oceans.</td>
</tr>
<tr>
<td>2. Describe life and environmental changes over time.</td>
<td>2. Describe how fossils are used as evidence of life and environmental changes over time.</td>
<td>2. Explain scientific theories about the origin of the Earth and Solar system describing how fossils are used as evidence of life and environmental changes over time.</td>
<td>2. Describe the origin and evolution of the solar system and the Earth and use rock and fossil evidence to estimate geologic time.</td>
</tr>
<tr>
<td>3. Identify objects in the sky and describe their motion.</td>
<td>3. Describe the nature and properties of objects in the sky: i.e., clouds, sun, moon, stars, planets and other objects.</td>
<td>3. Describe the predictable motion of the earth, moon, and planets and the role of gravity as a force.</td>
<td>3. Explain the theories of the origin and evolution of the universe and celestial bodies including energy and element production in stars.</td>
</tr>
<tr>
<td>4. Identify seasonal weather changes.</td>
<td>4. Identify and measure daily and seasonal weather changes (temperature, wind direction and speed, precipitation, etc.) and explain that the temperature of the Earth is maintained by energy from the sun.</td>
<td>4. Describe the water cycle, the composition and structure of the atmosphere, and the impact of oceans on large scale weather patterns.</td>
<td>4. Analyze and predict how differences in heat transfer cause weather system development and how these systems are modified by Earth’s topography.</td>
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<tr>
<td>5. Describe processes that lead to slow and rapid changes on the surface of the Earth.</td>
<td>5. Describe the formation and composition of Earth's external features: i.e., plate tectonics, rock cycle and soils.</td>
<td>5. Explain and make predictions relating to ongoing Earth processes including, earthquakes, volcanoes, plate tectonics, erosion and weathering.</td>
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<td>6. Observe and describe daily and seasonal patterns of movement of the sun and moon: e.g., recognize that the observable shape of the moon changes from day to day in cycle.</td>
<td>6. Model the motion and tilt of Earth in relation to the sun, and explain the concept of day and night, seasons, year.</td>
<td>6. Identify geochemical cycles of Earth elements and how matter moves between chemical reservoirs.</td>
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<td>7. Identify the sun as the major source of energy for phenomena on Earth’s surface: e.g., growth of plants, wind and ocean currents, water cycle.</td>
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APPENDIX E: Executive Summary for MCPS Curriculum Steering Committee

MEMORANDUM

DATE: May 24, 1999
TO: MCPS Science Curriculum Steering Committee
FROM: Katy Meyer
RE: EE in the New Science Curriculum

Throughout the academic year, I have been involved in the MCPS science curriculum review process. Currently, I am a candidate for a Master's in Environmental Studies at the University of Montana and I am finishing a lengthy professional paper which includes recommendations regarding the integration of environmental education into MCPS system's new science curriculum. As a part of my research, I have determined where environmental education is in the National Science Education Standards (NSES), reviewed how the new Excellence in Environmental Education Guidelines* recommend promoting environmental education through science, and identified the advantages of using the environment as an integrated context for learning science content. Based on this research, I have come up with some recommendations for the science curriculum committee to consider.

Upon review of MCPS Draft Science Standards and Benchmarks, it is apparent that learning about the environment is imbedded in the curriculum. Specifically, Standard #3: Humans and Science addresses environmental issues such as population, natural resources, and hazards. The current document maintains that part of the rationale behind Standards #3 is "to give students a means to understand and act on personal and social issues [and] help [them] develop decision-making skills." Accordingly, the document incorporates environmental issues into eleven out of the sixteen benchmarks for learners (K-12) within this standard.

I commend the science curriculum committee for including environmental issues in the new MCPS standards. By teaching about the environment, educators can promote effective and environmentally literate students, capable of participating democratically, making responsible decisions, and understanding complex issues. The environment provides an ideal context for learning the scientific meaning of systems and interrelationships while also refining science skills such as observation, data collection, analysis, and formulating conclusions. Furthermore, integrating environmental issues into a science curriculum is an effective way to reach beyond basic content knowledge through student-centered learning, hands-on instruction, and relevant subject matter.

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1 These guidelines were published by the North American Association for Environmental Education (NAAEE) in March 1999.
Although these standards do not model a comprehensive environmental education experience based on the generally understood objectives of the field, they do acknowledge that learning about the environment is meaningful. Most importantly, the MCPS standards open the door for student learning in an environmental context. Therefore, educators can easily supplement these standards with environmental education in order to foster a positive learning experience for students.

RECOMMENDATIONS AND CONSIDERATIONS:

- While these standards specifically address furthering students' knowledge and awareness of environmental issues and encourage students to develop decision-making skills concerning human impacts on the environment, they fail to address how students can acquire these skills, clarify their own personal values toward the issues, or participate to resolve environmental issues effectively. Because, effective solutions to our environmental problems depend on a citizenry that is aware of the issues and equipped with the skills to solve them, the new science curriculum should include all of the components of a comprehensive environmental education program including awareness, knowledge, values, skills, and participation.

- Recently, the NAAEE published a set of common guidelines for the development of balanced and scientifically accurate environmental education instruction called *Excellence in Environmental Education- Guidelines for Learning (K-12)*. Like the NSES, these guidelines suggest expectations that are appropriate for learner performance and achievement at the end of fourth, eighth, and twelfth grades. They model effective and comprehensive environmental education programs and curricula while pointing the way towards using environmental education as a means for meeting the standards set by the traditional disciplines. Because scientific information is an integral part of environmental education, these guidelines specifically focus a number of their learner goals on science content, thereby modeling the NSES. Missoula teachers should be encouraged to make use of these guidelines.

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According to experts within the field of environmental education, education about the environment should include the following components: **awareness** of the environment and its associated problems, **knowledge** of ecosystem functions and humans role in this system, **attitudes** or values that guide a student's behavior towards preserving the environment, **skills** to identify and investigate environmental problems, and **participation** in positive actions toward the resolution of environmental issues (UNESCO, 1978; NASSP, 1988; Braus and Wood, 1995; and Weilbacher, 1995)

For a copy of the Excellence in Environmental Education- Guidelines for Learning (K-12) or more information contact: NAAEE at 410 Tarvin Road, Rock Spring, GA 30739; (706)764-2926; beager410@aol.com; or www.naeee.org.

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• In order to ensure that Standard #3 of the MCPS science standards are met, teachers will need to be provided with in-service training. Without an understanding of environmental education, teachers are less likely to integrate environmental issues into their curriculum. By introducing educators to updated information, material, and curriculum ideas within the field of environmental education, they will be more confident integrating environmental issues into their science lessons.

• The MCPS science curriculum should incorporate textbooks and learning material which include content pertaining to environmental issues. These issues should be presented in a balanced and scientifically sound manner.

• Environmental education material, such as Project WILD and Project Learning Tree, should be used to complement science lessons in MCPS elementary and middle schools.

• The MCPS science curriculum should promote an understanding of the local environment. Natural resources and the environment are central to the lives of Missoula area residents, accordingly teachers should expand students awareness of these related issues without advocating a particular viewpoint or course of action. By understanding their local environment, learners can build a strong foundation of skills and knowledge to reach deeper into the conceptual understanding that scientific literacy demands. Additionally, this understanding can help students make responsible decisions that may benefit the environment in the future.

• Teachers should be encouraged to expand student understanding of science content by taking advantage of local non-formal environmental education programs offered by the Montana Natural History Center, Missoula YMCA, University of Montana, Missoula Urban Demonstration Project, and various local land use agencies. Furthermore, the MCPS science curriculum should require that each student in either elementary or middle school participate in a school sponsored outdoor science based educational program.

If you are interested in learning more about the integration of environmental education into a science curriculum or have any questions about these recommendations, please do not hesitate to contact me. I would be happy to discuss any of my research in further detail. I can be reached by e-mail at <katy_meyer@yahoo.com> or by phone at 542-8232.

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4 A description of curriculum resources that Missoula teachers can use in order to integrate environmental education into their science curriculum will be available by early May.

5 A list of local organizations that offer programs which enhance learning about the environment will be available by early May.
Appendix F: Guide to Local Organizations that offer Environmental Education Programs

One of the easiest ways for teachers to integrate environmental education into their science curriculum is by tapping into local organizations which offer such programs for K-12 students. The following is a comprehensive list of local groups which offer environmental education lessons. Included in this guide is an overview of each organization's mission, a description of the lessons that they offer, and an indication of program fees. Each of these organizations has elected to be a part of this resource and they encourage teachers to take advantage of their services.

Bitterroot Ecological Awareness Resource

P.O. Box 2135
Hamilton, MT 59840
Phone: (406)375-9110
Contact: Jamie Ogden
Fee: free

The Bitterroot Ecological Awareness Resources (BEAR) offers field experiences for area students (K-12). The education director at BEAR can work with teachers to plan field trips around any number of different science themes that they are studying. BEAR has recruited volunteers who have expertise in a number of different fields including wildlife biology, botany, forestry, ornithology, and others. These volunteers teach interdisciplinary lessons to school groups through engaging, hands-on learning stations. Although BEAR does not have their own field site, they can plan excursions to any location within our National Forests. They also have a resource library which is available for teachers to use.

Blackfoot Challenge

P.O. Box 9237
Helena, MT 59604
Phone: (406)443-8577
Contact: Becky Garland
Fee: free

The Blackfoot Challenge is a grassroots group which has been organized to coordinate the management of the Blackfoot River, its tributaries, and adjacent lands. This group consists of private landowners, federal and state agency representatives, local government officials, and corporate landowners. They have sponsored a number of different projects which focus on water quality, aquatic habitat, noxious weeds, riparian areas, cumulative impacts, and species of special concern.
In coordination with Project Wet, the Blackfoot Challenge offer a week of watershed tours for the general public during the summer. These tours can provide educators with a solid background in water issues. Additionally, they have produced a video which can be used to introduce students to some of the players involved in the Blackfoot Challenge and spotlight a few of their successful projects. The Blackfoot Challenge is interested in providing more information sharing and educational outreach.

**BROWN BEAR RESOURCES**

222 N. Higgins Ave  
Missoula, MT 59802  
Phone (406)549-4896  
Contact: Kristie Scheel  

Brown Bear Resources (BBR) is a non-profit grizzly bear research and education organization in Missoula. They offer K-8 teachers a variety of supplemental interdisciplinary teaching materials about grizzlies and other Montana wildlife. Their "Traveling Grizzly Bear Trunk" teaches science and problem-solving skills, increases awareness of bears and other wildlife, and encourages hands-on understanding and communication. Included in the trunks are books, videos, a grizzly skull and hide, and an activity guide which covers topics such as: bear biology, distribution, current threats, and actions students can take. Background information, tips, and extension ideas for the teachers are also included.

BBR also offers in-class presentations and a full-day "Let's Be Fair to Bears" festival to interested schools. Through these programs wildlife biologists, ranch managers, storytellers, performing artists, and conservationists offer students a look at the diversity of perspectives surrounding wildlife issues in the state.

**CLARK FORK WATERSHED EDUCATION NETWORK**

1118 Creek Crossing Road  
Missoula, MT 59802  
Phone: (406)721-5805  
Contact: Debbie Fassnacht  

The Clark Fork Watershed Education Network (CFWEN) is a network of educators, researchers, local and regional agencies, and organizations who joined forces in 1997 in order to facilitate previously uncoordinated watershed activities. Their goal is to provide and coordinate training, equipment, volunteers, and support for local stream monitoring and education projects for K-12 students. CFWEN currently supports school
monitoring projects on Rattlesnake, Pattee, and Lolo creeks along with citizen monitoring throughout the middle Clark Fork watershed.

**CENTER FOR WILDLIFE INFORMATION**

P.O. Box 8289  
Missoula, MT 59807  
Phone: (406)523-7750  
Contact: Chuck Bartebaugh  

**Topics:** Wildlife  
**Grade Levels:** K-12  
**Fee:** free

The Center for Wildlife Information specializes in doing school programs and developing curricular material which teaches students (K-12) about overall stewardship of wildlife. Specifically, they focus on how students can avoid confrontations with bears, mountain lions, and rattlesnakes. The Center for Wildlife Information offers free videos, slide programs, and workshops to classes. Support material, such as posters and brochures are also available.

**CENTER FOR RESOURCEFUL BUILDING TECHNOLOGIES**

P.O. Box 100  
Missoula, MT 59806  
Phone: (406)549-7678  
Contact: Tracy Mumma  

**Topics:** Urban Development and Resources  
**Grade Levels:** K-12  
**Fee:** free-$10

The Center for Resourceful Building Technologies (CRBT) offers two educational resources which can be adapted to any grade (K-12). *Building our Children's Future* is a 15 unit curriculum which explores issues that relate to building technology, energy efficiency, and urban development. This book is available for $10. CRBT also has a traveling trunk which includes two slide shows, the *Building our Children's Future* curriculum, and various engaging teaching tools about resource efficient building and recycled building materials. Trunks are free and available for a two week loan period.

**FOREST DISCOVERY DAYS**

c/o Plum Creek  
140 North Russell  
Missoula, MT 59801  
Phone: (406)542-3263  
Contact: Tami Reschke  

**Topics:** Forestry and Wildlife  
**Grade Levels:** 5-12  
**Fee:** free

Each Spring, the Chamber of Forests Resource Committee offers an outreach program to Missoula area schools (grades 5-12) called Forest
Discovery Days. Teachers are invited to bring their students to a site in the Grant Creek area to explore responsible and sustainable forestry practices. The day-long program includes four education stations where students explore fire ecology, timber harvesting, wildlife biology, and timberstand improvement. The Chamber provides teachers with a curriculum that can be used prior to the field experience in order to enhance the students understanding of the issues.

Forest Discovery Days is a collaborative event sponsored by volunteers from Plum Creek, Stone Container, the University of Montana, the Forest Service, and other timber related organizations. This year, teachers can sign up for program that are offered between May 19th and the 21st. This program is free to MCPS classrooms and includes transportation for all participants.

GLACIER INSTITUTE

P.O. Box 7457
Kalispell, MT 59904
Phone: (406)755-1211
Contact: Chris Barth

Topics: Natural History and Ecology
Grade Levels: K-12
Fee: variable

The Glacier Institute serves students of all ages as an educational leader in the Crown of the Continent Ecosystem. Emphasizing hands-on, field-based experiences, the Institute’s courses, workshops, and special projects promote a balanced understanding of natural history and human interactions with the environment. It is their goal that the knowledge gained through this experiential learning process will enable participants to make informed decisions regarding the sustainability of healthy, functioning ecosystems and the appropriate role of humans within them.

The Glacier institute operates two facilities, the Glacier Park Field Camp, located just inside the west entrance of Glacier National Park and the Big Creek Outdoor Education Center, located in the North Fork Valley. Adult field seminars are offered at the Glacier Park Field Camp with OPI renewal units and college/university credit. These courses offer teachers an opportunity to gain a greater understanding of the natural and cultural history of Glacier and the surrounding regions.

The Big Creek Outdoor Education Center offers one to five-day outdoor education experiences for schools (K-12). These programs are offered for school groups during the spring (April- June) and fall (August- October). The curriculum for these programs are broken down into one to three hour classes which are designed to meet the science and math standards for Kalispell’s District 5 Schools and to fit the needs of individual school/program. Some of the topics offered include: Aquatic study, Orienteering, Fire Ecology, Botany, Team Building/Group Challenge Course, Geology, Wildlife, and Forest Ecology.
INTERNATIONAL WILDLIFE FILM FESTIVAL
27 Fort Missoula Road Missoula, MT 59804 Phone: (406)728-9380 Contact: Debbie Fassnacht

Topics: Wildlife Grade Levels: K-12 Fee: free

The International Wildlife Film Festival’s (IWFF) mission is to foster knowledge and understanding of wildlife and habitat through excellent and honest wildlife films. Because wildlife everywhere is increasingly threatened, they hope that their films help people understand and protect habitat and wildlife. Currently, IWFF is in the process of designing lesson plans and teaching guides that can be used by teachers in conjunction with specific titles and subjects from their film and video library. Their goal is to provide a context within which the students will see the films and be tuned in to learn more from them.

LEE METCALF NATIONAL WILDLIFE REFUGE
115 W Third Street Stevensville, MT 59870 Phone: (406)777-5552 ex. 203 Contact: Beth Underwood

Topics: Natural History Grade Levels: K-12 Fee: free

Lee Metcalf National Wildlife Refuge, located in the Bitterroot valley, offers local teachers a number of different training workshops and a comprehensive resource library. The site also has a field station education center, which area teachers may use for field trips that they design and carry out.

Recently, Lee Metcalf National Wildlife Refuge started a new program called Students Teaching Other Kids Ecological Dynamics (STOKED). This program provides high school students with the experience of teaching elementary students about the environment. Students from a local high school research a topic that they would be interested in teaching and meets with individual mentors who have experience in the field of their topic. They then design and teach their own lesson to local elementary students. Because of funding, this program is limited in the number of communities that it can involve. The education coordinator encourage other communities to adopt this program by using the guidelines that they have developed.
LUBRECHT LEARNING CENTER

30689 Hwy 200 E
Greenough, MT 59836
Phone: (406)244-5524
E-mail: patty@forestry.umt.edu
Contact: Patty Borarge

Topics: Forestry, Ecology, and Technology
Grade Levels: 3-12
Fee: $5-10 per student

The Lubrecht Learning Center offers one-day or multi-day outdoor education programs for grades 3-12 at the Lubrecht Experimental Forest. Programs are designed to engage students in critical thinking and reflection so that they can develop an understanding of ecosystem function, plant and animal adaptations, seasonal changes in the forest environment, impacts of human activity, unique bioregional characteristics, and the role of technology in science and society.

School groups are responsible for paying for their own bus transportation up to Lubrecht Forest and bringing sack lunches. There is a $5-$10 fee per student depending on the program and its length. Subsidized programs may be available. Please call for prepared meal costs and camping/cabin fees.

MISSOULA AREA RESOURCE CENTER

215 South Sixth West
Missoula, MT 59801
Phone: (406)728-2400 ext. 1075
E-mail: cabbott@mcps.k12.mt.us
Contact: Carolyn Abbott

Topics: Natural Resources, Wildlife, and Natural History
Grade Levels: K-12
Fee: free

The Missoula Area Resource Center (MARC) is a community resource clearinghouse which serves local teachers with guest speakers, field trips, and materials to supplement their lessons. Recently, MARC organized an environmental education speakers’ bureau which offers talks by local resource specialists including wildlife biologists, archeologist, foresters, and fisheries biology. Through this bureau, resource specialists can share their knowledge about nature with students.

MARC’s database has an endless list of speakers and experts who are willing to cater lessons to different grade levels. Carolyn Abbott, the Missoula Area Resource Coordinator can arrange a number of different programs based on teachers needs. All talks are 30-45 minutes long and are free unless otherwise notes. Available topics include: wildlife, natural and cultural history, and natural resources.
MISSOULA COUNTY CONSERVATION DISTRICT
5115 Hwy. 93 South
Missoula, MT 59801
Phone: (406)251-4826
Contact: Sadie Babcock

Topics: Water, Forestry, Weeds, and Ecology
Grade Levels: 5-12
Fee: free

Missoula Conservation District has been at the forefront of conservation education for the past several years. The district has developed two natural resource education curriculums and two educational videos that high school and grade school teachers can utilize.

The Montana Weed Project is an interdisciplinary environmental and weed education curriculum for grades 5-12. The curriculum includes a teacher manual with reading assignments, class discussion ideas, an instructional video, and interdisciplinary hands-on activities.

Additionally, the district has developed a Clark Fork Watershed Education curriculum which is designed to provide middle and high school teachers with the knowledge and enthusiasm to effectively teach students about the characteristics of watersheds. This curriculum teaches students how a stream, floodplain, and groundwater are interrelated and the ways that streams effect and are effected by human activities. Materials in this curriculum include a teachers manual, videos, readings, and illustrations. The district is currently conducting workshops to train teachers in the use of the curriculum and water quality monitoring techniques.

Finally, the district offers programs which highlight issues such as soils, forestry, weed, and grasses. Experts are available to cater to specific classes for grades 3-12.

MISSOULA FAMILY YMCA- OUTDOOR ENVIRONMENTAL EDUCATION PROGRAMS
3000 South Russel
Missoula, MT 59801
Phone: (406)721-9622
Contact: Porter Hammitt

Topics: Natural History and Ecology
Grade Levels: Middle School
Fee: free- $1 per student

The Missoula Family YMCA offers an outdoor environmental education program to middle school students and their teachers. Sixth-grade classes from three local public middle schools have traveled to Patte Canyon, one day each in the fall, winter, and spring for structured activities that include nature study, science discovery hikes, games, journaling, team-building initiatives, cross-country skiing, and a simulated public land-use hearing.

The YMCA program utilizes lessons adapted from established sources and programs, in a curriculum designed to instill greater understanding and appreciation of our natural surroundings in student participants. With
funding from the Environmental Protection Agency, transportation and instruction can be provided without a cost to local schools.

**MISSOULA COUNTY HEALTH DEPARTMENT**

301 West Alder  
Missoula, MT 59802  
Phone: (406)523-4755  
Contact: Shannon Theariult

**Topics:** Air Quality, Land-Use, and Transportation  
**Grade Levels:** K-12  
**Fee:** free

The Missoula County Health department offers multi-media air quality programs for grades K-12. Presenters are willing to tailor programs to the teachers needs. Presentations for younger students revolve around Missoula's air quality basics, while high school content expands to the specific causes of air pollution and the mechanism behind it. Other issues that the department will talk about are transportation, land-use planning and its impact on air quality, and outdoor burning.

**MISSOULA URBAN DEMONSTRATION PROJECT**

629 Phillips Street  
Missoula, MT 59802  
Phone: (406) 721-7513  
Contact: Michelle Walsh

**Topics:** Urban Ecology  
**Grade Levels:** K-12  
**Fee:** $5-50 per hour

The Missoula Urban Demonstration Project (MUD) is dedicated to working with people and the community to meet basic needs in less resource intensive ways. They offer two year-long nine lesson curriculums which address urban ecology issues for third and fourth graders. Both curriculums, Community Gardening and Imagining a City, provide students with a sense of empowerment by raising their awareness of and participation in local issues such as the long-term future of Missoula's neighborhoods and the role of community gardening in strengthening the ties between neighbors. Additionally, MUD offers one time lesson for all ages, such as paper making, composting with worms, spring planting, and cider pressing. These lessons can be taught in class or by field trip to MUD's headquarters. All lessons are taught by MUD staff and volunteers. The cost for the lessons is between $15 and $50 per hour on a sliding scale. MUD also has a free resource library which educators are welcome to use. This library has information about horticulture, sustainable living, self reliance, energy, curriculum ideas, and field guides.
MONTANA NATURAL HISTORY CENTER

Post Headquarters Bldg. T-2
Fort Missoula Road
Missoula, MT 59804
Phone: (406)327-0405
Contact: Anita Maxwell

Topics: Natural History, Water, and Ecology
Grade Levels: K-8
Fee: $2 per student

The Montana Natural History Center (MNHC) fosters understanding, appreciation, and conservation of natural systems through natural history education in the Rocky Mountain Region. Currently, they provide both field and classroom instruction, as well as teacher training workshops, a library of resource materials to area schools, and educational trunks.

Elementary school classes can participate in field trips to Mount Jumbo and the Bitterroot River frontage at Fort Missoula. During these programs students rotate through four stations which offer engaging, hand-on activities dealing with a variety of themes like birds, watersheds, biodiversity, and mammals. These trips cost $2 per student and include a journal and a classroom visit by MNHC staff, interns, and community volunteers.

Additionally, they offer other seasonal programs like the Clark Fork Water Festival which engages Missoula area sixth-graders in a day of water education activities and a Paleontology field day for elementary school classes.

Throughout the year, the MNHC also offers seasonal ecology workshops for K-8 teachers. These workshops are intended to give teachers the opportunity to learn about ecology and explore investigations for students to do in the schoolyard. Additionally, MNHC co-sponsors other teacher workshops throughout the year on topics like “The Clark Fork Watershed Kit”. OPI credits are available.

MONTANA PARTNERS IN ECOLOGY

Division of Biological Science
University of Montana
Missoula, MT 59812
Phone: (406)243-6016
web: http://biology.dbs.umt.edu/pie
Contact: Elaine Caton

Topics: Ecology
Grade Levels: K-12
Fee: free

Montana Partners In Ecology (PIE), formally known as the Eco-Partnerships Program, is a cooperative program of UM Division of Biological Sciences and the Montana Natural History Center. Montana PIE facilitates collaboration between K-12 teachers and local ecologists, providing teachers with a partner with expertise in scientific processes, local ecology, and natural history. Participating teachers plan investigations with their partner during the school year, and network with other teachers with similar interests. The program encourages true collaboration between research scientists and their
colleagues in the schools, as well as long-term support for teachers in the classroom. We are forming a network of teachers and ecologists with an interest in ecological education and in sharing ideas, information, and resources.

Montana PIE is funded by the National Science Foundation Postdoctoral Fellowship in Science, Mathematics, Engineering, and Technology Education.

**RAPTORS OF THE ROCKIES**

P.O. Box 131  
Clinton, MT 59825  
Phone: (406)728-0999  
Contact: Kate Davis

Topics: Wildlife  
Grade Levels: K-12  
Fee: $100 for two programs

Raptors of the Rockies is a non-profit organization which provides interactive educational programs about predatory birds for schools in Western Montana. The teaching team is made up of over a dozen live species of raptors, each with a unique story and personality. These live birds serve as invaluable tools in conveying the adaptations and strategies essential to predatory animals.

Discussions in the programs center on: tactics to locate, capture, and kill prey; structural specializations; breeding habits; and the individual ecological niches occupied by the various species represented. Also discussed is the essential role that predatory birds play in controlling insect and rodent pests, and their place in the food chain with the related hazards of environmental dangers such as pesticides. Finally, the conservation of birds and their habitats is stressed, including a survey of the laws protecting wild bird populations. The hope is to instill a sense of respect and admiration for these skilled hunters.

Raptors of the Rockies will present up to two programs to a school (K-12) for $100.

**ROCKY MOUNTAIN ELK FOUNDATION**

2291 W. Broadway  
Missoula, MT 59802  
Phone: (406) 523-4500  
Contact: Jason Hobson

Topics: Wildlife  
Grade Levels: K-12  
Fee: free

The Rocky Mountain Elk Foundation provides students and teachers with conservation material and a place for students to take a field trip. As leaders in the wildlife education field, they provide school groups with speakers and a place to see the animals that call elk country their home. Program offerings are available for any age group. Additionally, information
packets and magazines are available for teachers to use in order to supplement teaching activities.

TELLER WILDLIFE REFUGE

1292 Chaffin Lane
Corvalis, MT 59828
Phone: (406)961-3507
Contact: Amy Monteith

Topics: Natural History and Wildlife
Grade Levels: K-12
Fee: free

The Teller Wildlife Refuge provides an outdoor classroom and resources for schools and the communities to engage in hands-on learning about the natural world. Their education program facilitates learning experiences that enable students to make a connection to the natural world around them.

Teller offers a site for hands-on outdoor field trips at no cost to local school districts. Teller's education coordinator can assist teachers with these field trips, but their goal is to make field trip planning and implementation a collaborative process where the teachers carrying out their own field trips. In this way, Teller can empower teachers to design engaging outdoor learning experiences to complement and extend their classroom curriculum.

Additionally, Teller Wildlife Refuge offers a number of different teacher workshops. These are hands-on workshops where teachers participate directly in the field activities they will carry out with their own students. Examples of workshops include a watershed trunks, song birds, butterflies and bugs.

WESTERN MONTANA ECOSYSTEM MANAGEMENT LEARNING CENTER PROGRAM

School of Forestry
University of Montana
Missoula, MT 59812
Phone: (406)243-6655

Contact: Carolyn Durgin

Topics: Forestry and Natural Resources
Grade Levels: K-12
Fee: free

The Western Montana Ecosystem Management Learning Center Program is a cooperative, grassroots effort among researchers, managers, educators and students to explore the interactions between humans and the environment. Their mission is to provide new learning opportunities on the interactions of people with forest and range ecosystems, to promote cooperative ventures among land managers, researchers, university personnel, school teachers, and the public that demonstrate ecosystem
management principles, and to improve understanding of ways ecosystem dynamics and human interactions influence land use planning.

The Learning Center provides teachers with resources in ecosystem management education, a network of forest learning sites, cooperative relationships with other natural resource and environmental education programs, and scientific and managerial expertise. They are interested in helping educators develop ecosystem management problem-solving exercises for their students. They educate teachers via in-service workshops and which earn recertification credits.

Teachers are encouraged to visit the ecosystem management learning site. Each site focuses on a unique aspect of forest ecology and range management. They include: Pattee Canyon where students can learn about forest recreation, wildfire, and wildland/urban interface issues; Lick Creek Demonstration Forest, a place to study the influence of fire and timber harvesting on low elevation ponderosa pine ecosystem; Lubrecht Experimental Forest which demonstrates uneven-aged management, ponderosa pine silviculture, tree thinning treatments and small equipment harvesting techniques; Bandy Ranch which housed agricultural rangeland and forestry research, including cattle/elk interactions; Miller Creek Demonstration Forest where the effects of clear-cutting, broadcast burning and wildfires are demonstrated as well as vegetative succession and wildlife; The Coram Experimental Forest incorporates a designated research natural area focusing on western larch forest management techniques.
Appendix G: Guide to Curriculum Resources

The following section includes an overview of places where local educators can access environmental education resources that supplement science content. Because there are so many different environmental education resources available to teachers, specific titles are not included in this section. Teachers should search for curriculum guides based on their specific needs in the classroom using the following resources.

- The University of Montana’s Resource Center Education Material located in the School of Education building room 110 offers thousands of curriculum guides on specific subjects ranging from wildlife and endangered species to weeds and forest fires. These resources are catalogued in a user friendly database and available to any area teachers.

- Educational Resources Information Center (ERIC) is the world’s largest education-related database and can provide access to a wide variety of environmental education material. For information about using the ERIC system, contact a local library or (800)LET-ERIC. This clearinghouse regularly acquires materials related to environmental education and also produces resource materials of its own.

- Acorn Naturalist is a catalogue of resources for the trail and the classroom. Acorn is an independent bookseller and publisher that is committed to the field of environmental education. There are hundreds of publications which include innovative curricula, field guides, interpretive resources. To receive a copy of Acorn Naturalists, call (800)422-8886.

- MEEA and MNHC have an extensive environmental education loan library which members can access for free. Additionally, these organizations have compiled a list of traveling teaching trunks that are available in the Northern Rockies. This list includes a description of trunk contents, the intended grade levels, contact information about where to obtain the material, and a quick subject reference to trunks. This list includes over 100 trunks, boxes, or kits that address issues such as astronomy and space, natural resources, wildlife, and dinosaurs. Most trunks are available for the cost of shipping. A copy of this guide is available through the Gloria Weisgerber, Public and Government Relations, USDA Forest Service, Northern Region, P.O. Box 7669, Missoula, MT 59807, (406)329-3094.
Appendix H: Personal Reflections on the MCPS Science Curriculum Review Process

In the spring of 1998, I approached Bob McKean, the county curriculum coordinator, about becoming involved in the MCPS science curriculum review process. He explained that my involvement in the curriculum review process was welcome and that previous curriculum review processes have involved similar outside interest groups¹. He then explained the political nature of the curriculum process and the potential harm in pressing an advocacy position in education. Because the curriculum is ultimately approved by members of the Board of Education, who are elected public officials, effective change needs to be under the guise of a moderate stand. Accordingly, I agreed that my role was to see students learning about the environment, not cause a ruckus with elected officials.

I had decided early on in the process of designing my project that my main objective was to get MCPS districts' children learning about the environment, in the environment. While I would love to see a comprehensive environmental education program embedded in every students' K-12 education, from the beginning, I sensed that this would be unlikely given the contention associated with environmental issues in this area. Because environmental education fits so well with the goals of science education reform, I felt that integrating environmental learning into the

¹ The social studies curriculum review (1997-1998) involved Native American groups that wanted to make sure that Native Americans are appropriately represented, and local ministers expressed concern about past issues within the health curriculum.
MCPS district science curriculum would be a very reasonable and realistic aim for my project.

I presented Bob with a proposal for my professional paper in early September. He agreed that I could play a valuable role in the science curriculum review process and I began attending full committee meetings in the middle of September. Both Bob and I decided that I would be a community representative on the committee because I seem to represent a general interest of the community.

Throughout the fall, I played a very low key role on the curriculum review committee. I casually introduced myself and my project to various committee members, and familiarized myself with the science curriculum review process.

In early January, I approached Bob about introducing myself to the full committee. He recommended that I write a short memo to the full committee about my project which he would include in the meeting handouts at one of the next full committee meeting. I obliged and quickly sent Bob a brief memo. When I saw Bob at a subsequent sub-committee meeting, he acknowledged that he had received the memo and would include it the next full committee meetings' agenda. Unfortunately, I was unable to attend both the February and March full committee meetings, but I did receive the handouts from the meetings and neither one included my memo.
In January, Bob and I also discussed how I could present my final recommendations to the committee. He recommended that I write an executive summary which included an overview of my project and my recommendations. He noted that this summary should be short (2-3 pages) and clearly written, because most teachers would not take the time to review anything of length.

Once the committee came out with a draft of the MCPS *Science Standards and Benchmarks* in mid-March, I was able to determine exactly where environmental learning played a role in the curriculum. Upon review, it was apparent that learning about the environment is imbedded in the curriculum. Specifically, Standard #3: Humans and science addresses environmental issues such as population, natural resources, and hazards.

While I was pleased to see environmental issues addressed in the document, I am aware that environmental education, as it is defined by experts within the field, is not a component of this curriculum. Like the NSES, these standards do address awareness and knowledge, but there is limited focus on skills, values, and participation. Even so, the district standards acknowledge that students should learn about the environment in some way.

Upon reading the draft standards and benchmarks, my immediate hope was that the district would further facilitate environmental learning in science by increasing teacher in-service training in environmental education, encouraging student involvement in environmental issues, and encouraging
teachers to take advantage of local outreach programs which incorporate environmental learning. Ideally, I hoped that the new science curriculum would mandate that each student participate in an experiential education experience at least three times throughout her K-12 education.

I submitted an executive summary of my project with recommendations regarding the integration of environmental education into the science curriculum to the steering committee in late April. By doing so, I hoped that the main decision-making body of the curriculum committee would adhere to my considerations and encourage area teachers to integrate environmental learning into their teaching repertoire.

On May 18th, my executive summary were addressed by the science curriculum steering committee. In response to my recommendations, the Bob McKean wrote a letter to me on behalf of the steering committee. The committee acknowledged that MCPS could improve how they address environmental issues, that they should include in-service training in environmental education/science, and they should allocate additional fund for science education field trips (a copy of this letter is included in Appendix I).

On May 20th, a copy of my executive summary and recommendations was presented to the full committee. Eventually, I would like to make this executive summary and copies of my professional paper available to any teacher in the district who is interested in learning more about
environmental education and the role that it can play in a science curriculum.

I have learned a great deal through my involvement in the MCPS science curriculum review process. While I am uncertain about the overarching effect that my project has had on area schools, it is my hope that educators will learn more about environmental education and consider the recommendations that I have included in Chapter Four.

Admittedly, my project and role in the curriculum review process are not without flaw. If I were to turn back time and do this all over again, I might consider a different strategy. I regret that I was not poised and ready with my project from the inception of the curriculum review process. Because I was a full time student in the fall with various responsibilities, I did not put forth enough effort in the beginning of the process. Specifically, I wish I had introduced my project to the full committee much earlier. By doing so, committee members could have been thinking along the lines of environmental education earlier in the process. I also would have been more involved in the different sub-committee meetings. I felt that I fell short of committing myself to all the different committees. Ideally, it would have been helpful to have an individual on each of the different sub-committees- high school, middle school, and elementary school- so that efforts could be concentrated to the needs of each committee.

Because Bob McKean is an extremely busy individual, I found it difficult to coordinate my ideas with his timing. This proved to be a struggle.
for both of us throughout the process. In many ways, I regret not asserting myself enough. Even so, Bob did his best to respond to my questions and needs when he could and he provided me with invaluable advice throughout the process. Fortunately, my presence on the committee was noticed by some members and I was able to network at the sub-committee meetings.

I encourage people to get involved with the curriculum review process in their local school system. Teachers and committee members need outsiders input and seem to appreciate thoughtful insight in the process.
Appendix I: Letter from MCPS Science Steering Committee to Katy Meyer

May 18, 1999

Katy Meyer

Dear Ms. Meyer:

On behalf of the Missoula County Public Schools (MCPS) Science Steering Committee, thank you for your memorandum of April 19, 1999 regarding environmental education in the new MCPS Science Curriculum. The committee appreciates your acknowledgment of our efforts to address this issue and believes that you make some valid points. The committee commends you for taking the time to bring your comments to its attention. During the course of our discussion the following points were raised.

1. There is a long history of teaching environmental science in MCPS and in other area schools. At one point, for example, every grade six MCPS student attended an outdoor education program at Camp Paxson for several days. Unfortunately that program was reduced some time ago for budgetary reasons. Environmental science is taught in many ways through a variety of science classes and grade levels in MCPS and other Missoula County Curriculum Consortium (MCCC) districts currently. Too many examples emerged in discussion to recite here. Additional environmental science will be taught as a result of the standards and benchmarks developed in this curriculum. However, the Steering Committee believes that district-wide coherence in the way we approach the issue could be improved. Consequently, the Steering Committee will recommend to the full Science Committee that a meeting(s) be devoted to discussing this issue further be scheduled during the 1999-2000 school year.

2. Staff development will be an ongoing element of the MCPS science program. Environmental science/education will be incorporated in our staff development as appropriate.

3. In order to take better advantage of opportunities to learn from our local environment, which is rich with opportunities, there is a need for increasing our field trip funds. The Science Steering Committee will ask that the full committee make additional field trip funds for science a recommendation to the Board.
4. The Science Steering Committee agreed that environmental education includes more than science. Other subject area teachers need to consider how issues of environment are related to their subject. For example, the social issues related to environmental decisions fit well into social studies.

5. There was much discussion regarding the relationship between environmental awareness and action. Most MCPS environmental science is taught at the awareness level, though a number of examples emerged from the committee relating to action. Service learning was one venue that has been used in connection with this issue. Concern was expressed that there were issues in the area of “environmental action” vis-a-vis “environmental awareness” that needed to be carefully considered by teachers to ensure that educational activities are appropriate in the public school setting.

6. Chris Kuschel, MCCC Consultant, pointed to the fact that there may be additional opportunities for environmental science being taught through an NSF grant being proposed through parties at the University of Montana.

A number of other individual thoughts were expressed which demonstrated committee interest in continuing to attend to the issue of environmental education. Again, on behalf of the Science Steering Committee and MCPS, thank you for your thoughtful observations and comments. You have provided us with additional impetus to improve our curriculum.

Respectfully,

Robert A. McKean
Executive Director of Curriculum
Literature Reviewed


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