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Environmental awareness of Waterville Junior High School students

Jenna Morrison
Colby College

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Environmental Awareness of Waterville Junior High School Students

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Environmental Studies Program
Colby College
Waterville, Maine
May 12, 2006

A thesis submitted to the faculty of the Environmental Studies Program in partial fulfillment of the graduation requirements for the Degree of Bachelor of Arts with honors in Environmental Studies

F. Russell Cole, Principal Mentor
Karen A. Barnhardt, Reader
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ABSTRACT

An environmental awareness survey was designed to assess the influences of gender and grade level on the relationships among outdoor experience, environmental knowledge, and environmental behavior at Waterville Junior High School, Waterville, ME. Environmental awareness indicates a fundamental understanding of the natural world, which is essential for developing future sustainable development. The foundation and acquisition of environmental knowledge of Waterville Junior High School students was determined using the multiple-choice survey. A total of 125 sixth graders and 136 eighth graders were surveyed. 61% of sixth graders and 73% of eighth graders indicated that their most common source of environmental information was school, television, and outdoor activities. While only 55% of adult Americans can pass a similar environmental knowledge test, 22% of sixth graders and 46% of eighth graders answered more than half the environmental knowledge questions correctly. A positive correlation was found among outdoor experience, environmental concern, and pro-environmental behavior. Mean scores on environmental knowledge survey questions were significantly higher for sixth grade boys than girls and mean scores on questions indicating pro-environmental concern were significantly higher for sixth grade girls than boys. There are several theories to explain this gender gap including gender biased teaching techniques and the more subtle culture socializations that steer girls away from science and technology. The survey exemplifies an encouraging trend in terms of acquisition of environmental knowledge by junior high students as compared to adults. Gender discrepancies in environmental knowledge and environmental concern due to cultural socialization need to be considered when designing environmental curricula and teaching strategies.
INTRODUCTION

E.O. Wilson coined the term "biophilia" to describe an innate human connection to nature (Wilson 1984). Wilson (1984) describes humans as literally kin to other organisms and the continuity of life as dependent on our tolerance of other organisms. Children are born with a sense of relatedness to their environment and nature (Phenice and Griffore 2003). Nature has been defined broadly as the material world and all its objects and phenomena (Louv 2005). "For children nature comes in many forms. A newborn calf, a pet that lives and dies, a worn path through the woods, a fort nested in stinging nettles, a damp mysterious edge of a vacant lot. Whatever shape nature takes it offers each child an older larger world separated from parents" (Louv 2005). However, this sentiment does not last for many children. Through the process of socialization, adolescents often begin to feel more separate from the natural environment (Phenice and Griffore 2003). This process has led humans needlessly to destroy habitats, threaten animals and plants with extinction, and deplete natural resources. What pedagogy is appropriate to explain a transformation from an innate connection to nature to one of abuse and misuse?

Through our abuse of the environment, we also disproportionately endanger or place at risk certain populations of people. These populations tend to be more vulnerable due to their socioeconomic position, their gender, their race, their political status, their age, and their health (i.e., the poor, the working classes, communities of color, migrant workers, and the ill). Environmental justice is a movement against these abuses and is considered a civil rights and a human rights issue (Bullard 2005). The principles of environmental justice are to affirm the sacredness of Mother Earth, ecological unity and
the interdependence of all species, and the right to be free from ecological destruction (WE ACT 2003). Under the tenants of environmental justice, no group of people should bear a disproportional share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or public programs or policies (Bullard 2005). In terms of children, the United Nations recognizes a child’s right to play as a fundamental human right and access to parks and recreation is a basic component of community health (Garcia and Flores 2005). Though the principles of environmental justice seem infallible, numerous studies have documented that poverty and pollution are intricately linked and in the United States, people of color are disproportionately affected by environmental hazards in their homes, neighborhoods, and workplaces (Bullard 2005). Ecofeminism as a theoretical discipline and activist movement seeks to respond to this circumstance.

Ecofeminism is primarily concerned with simultaneous oppression of what Karen Warren (2000) terms the “twin dominations” —the domination of nature and the domination of women. Patriarchy is considered to be one form of domination and is described as the masculine perspectives, values, and attitudes and the assumption that this perspective is the norm (Neuwirth 1996). The theory of patriarchy asserts that males are superior to females and their surrounding environment. This perspective has influenced the development of modern science, which believes the world is at man’s disposal (Neuwirth 1996). Neuwirth (1996) argues that women’s identities have not been established through their superiority to the natural world, but instead women have often been identified with nature. According to patriarchal theory, men typically do not consider themselves a part of nature and often consider themselves superior to nature.
Griffin (1978) argues that there is an essential connection between women and nature; patriarchy subordinates both women and nature. Traditionally, the descriptions of nature and humans in nature have been gendered (Griffin 1978). Griffin (1978) describes that men and animals correspond just as women and plants correspond, for women develop more placidly, like plants. Patriarchy has subordinated women and nature, which has led to both political and physical abuse.

Ecofeminism is the counter system of thought to male domination of nature. Ecofeminism as a term was coined in 1974 to represent women's potential for bringing about an ecological revolution to ensure human survival on the planet (Merchant 1990). Ecofeminists, which include men and women, have the common goal of restoring the natural environment and quality of life for people and other living inhabitants of the planet. According to the tenets of ecofeminism, an imbalanced male perspective dominates the present worldview (Neuwirth 1996). This has contributed to our present environmental crisis of climate change and biodiversity loss because the feminine and the natural have usually been associated with each other and both have been mistreated (Smith 1992). The future of our environment depends on a willingness to deepen humans' experience of communion with nature, which can only be accomplished by being in the natural world (Spretnak 1990). Our society is now facing crises in agriculture, education, pollution, and global change of the environment. Ecofeminists argue that faith in technological progress has left humans ecologically lost due to a lack of grounding in the natural world (Spretnak 1990). Ecofeminist theory assumes that humans and the future of the global environment are entangled by the patriarchal pedagogy of the domination of nature and women (Neuwirth 1996).
Ecofeminists disagree in whether the connection between women and nature is essential or socialized. For the purpose of this paper, the ecofeminist theory that renounces the socialized constructions of the feminization of nature and the naturalization of women is most useful. The tenets of biophilia, environmental justice, patriarchy and ecofeminism set an important theoretical context for this paper. How do ecofeminist theories of the genderization of nature and roles of males and females in relation to nature play out today? When do children lose their sense of connectedness to nature and the environment? How does gender influence the relationships among spending time outdoors, gaining environmental knowledge, exhibiting environmental concern, and participating in pro-environmental behavior? What contributes to the essential qualities of environmental stewardship necessary for future generations so that humans' existence on this planet persists? I hoped to address these questions by creating and conducting an environmental awareness survey designed to assess the influences of gender and grade level of Waterville Junior High School students on the relationships among outdoor experience, environmental knowledge, environmental concern, and environmental behavior.
BACKGROUND

Environmental Education

80% of Americans base their environmental knowledge on incorrect or outdated environmental myths and just 12% of Americans can pass a basic energy awareness quiz (NEETF 2005). Even though 95% of the US public and 96% of parents support environmental education in schools, after 35 years the environment is still not a core component of schools' curricula (NEETF 2005). As Americans are being increasingly challenged with environmental problems, a 2005 study of environmental literacy in America found surprising results in terms of incorrect beliefs about the environment (NEETF 2005). For example, 120 million Americans think spray cans still have CFCs in them even though CFCs were banned in 1978 and 130 million believe that hydropower is America's top energy source, when it accounts for just 10% of the total (NEETF 2005).

Environmental education is a supplemental topic to core curriculum subjects in more than half of public schools- typically too little material is actually presented and it is often poorly sequenced so that environmental learning does not effectively accumulate (NEETF 2005). Environmental education is more accessible to private rather than public schools because private schools have more freedom in their accreditation process and often more money available for experiential education opportunities. Public school curricula are bound by state standards and public funding, neither of which are focused on environmental issues. Environmental education needs to be integrated into public school curricula more extensively to help dispel existing myths and reconnect children with nature.
Environmental education has been defined as "the process which develops knowledge, understanding, attitudes, and the formation of personal responsibility with regard to man's relationship with his socio-cultural and biophysical surroundings" (Richmond 1976). A more broad definition asserts that all education is environmental education and by what is included or excluded, students are taught that they are part or apart from the natural world (Orr 1994). Orr (1994) suggests that no student should graduate from an educational institution without a basic understanding of things like ecology, carrying capacity, end-use analysis, limits of technology, sustainable agriculture and forestry, and environmental ethics. A more holistic approach to environmental education is ecological education, which can be defined as "an education combining liberal arts study, work, and service with a strong commitment to environmental responsibility and experiential opportunities for international and cross-cultural understanding in a setting that promotes wisdom, spiritual growth, and contribution to the common good" (Warren Wilson College 2006). The definitions of environmental education range from a scientific understanding of the natural world to a more holistic and systems-thinking view of education.

Despite differences in definition, the overarching goal of environmental education is environmental literacy. Environmental literacy is the cognitive and affective understanding of the environment that lead individuals toward environmental responsible behaviors, or actions directed toward the remediation of environmental problems (EETAP 2002). Environmental education provides the fundamental background for younger generations to avoid or mitigate past environmental mistakes. Education about the natural world is essential because children's experiences are significant precursors for
adult environmental activism (Louv 2005). In a world increasingly plagued by environmental problems, environmental education is central to achieving future sustainable development and maintaining an ecologically healthy planet.

Children receive many benefits from experiential and environmental education. The State Education and Environmental Roundtable worked with 150 schools in sixteen states for ten years, identifying model environment-based programs, and examining how the students fared on standardized tests (Louv 2005). The report documented that environment-based education produced student gains in social studies, science, language arts, and math; improved standardized test scores and grade-point averages; and developed skills in problem-solving, critical thinking, and decision-making. Environmental education helps to create learning experiences that extend beyond the boundaries of the classroom and root themselves in the broader environment (Smith 1992).

Adults support environmental education in schools for several reasons. It contributes to better understanding of environmental issues, developing character through building respect for the people and places around them. Environmental education encourages children to get involved with community service volunteer work and enhances science learning (NEETF 2005). The environment is the leading subject for middle school service projects because of a combination of short-term, tangible projects, physical outdoor work, and variety of opportunities (NEETF 2005). Environmentally-based community service projects have a positive impact on student motivation, attitudes toward education, disciplinary problems, and building self-esteem, especially during the junior high and high school years (Sobel 1996). One example of an environmental and
experiential-based school is the Helen M. King Middle School in Portland, Maine. The Helen M. King Middle School struggled with discipline problems, poor attendance, negative attitudes, non-existent parental participation, and low academic performance (NEETF 2005). The school decided to reform its curriculum in 1993 to be based on environmental learning. Despite increases in the school’s low-income populations, the school’s performance on the Maine Educational Assessment tests improved in all areas: reading, math, science, health, social studies, and arts. In addition, the environmental curriculum led to 50% fewer discipline problems, improved student attendance, and student and parental engagement in school activities (NEETF 2005). Environmental education enhances academic achievement and character development because it helps students draw connections among school subjects and build respect for the people and places around them.

Nature and Local Sense of Place

One of the essential components of environmental education and fostering environmentally responsible citizens is hands-on-experience and being in nature (Sobel 1996). Today elementary-age children are more aware of the global threats to the environment than children in the past but their physical contact with nature is fading (Louv 2005). This fact has lead to a “nature deficit disorder” in which alienation from nature is causing physical and developmental effects, among them: diminished use of the senses, attention difficulties, and higher rates of physical and emotional illness (including childhood obesity, attention deficit disorder, depression, and anxiety) (Louv 2005). Being in nature can be seen as an antidote. Nature inspires creativity by demanding
visualization, full use of the senses, and integrates informal play with formal learning (Louv 2005). A room with a view of nature can help protect children against stress. Natural areas around a child's home seem to be a significant factor in the psychological well-being of children in rural areas (Louv 2005). Benefits from being in nature include greater physical health, deeper sense of spirit, a sense of play, and a greater awareness of surroundings (Louv 2005).

Direct interaction with natural habitats has been identified as one of the main influences leading to responsible environmental behavior in adults and children (Sobel 1996, EETAP 2002). The George Soule School in South Freeport, Maine provides an excellent example of how interactions with the natural world foster environmental stewardship among elementary school students (Sobel 1996). This charter school owns an area of forest that children are allowed to play in during recess. In the forest, the students designed an elaborate community where natural materials were exchanged and used to build forts. The teachers ensured the autonomy of this play activity, which fostered the students' sense of ownership and commitment to nature and empowerment through nature. Interestingly, in 1990 a group of 8-11 year olds from the same school started an environmental group called "CAKE" after learning about Global Warming. The group conducted a roadside survey of waste in Freeport and found that half of the waste was styrofoam containers. The students decided to petition the Freeport town council to ban styrofoam containers from a local McDonald's restaurant. After a several-year legal battle, the Freeport McDonalds became the first restaurant in Maine to eliminate its trademark styrofoam containers, which later became a national trend. The use of wilderness areas for recess predates CAKE and illustrates how fostering a
connection to the earth can help raise awareness in children that enables activism (e.g. the styrofoam protest) to take place (Sobel 1996).

Sobel (1996) warns “in our zest for making children aware and responsible for the world’s problems, we often cut out children from their roots.” Students seem to be losing their local sense of place because they are increasingly relying on electronic media (Sobel 1996). Students often know less about local wildlife and environmental issues and more about global issues such as rainforest deforestation (Cardeiro and Sayler 1994; Sobel 1996). This is especially a problem for children growing up in cities who do not have access to wilderness areas (Cardeiro and Sayler 1994). Electronic media has also advanced the disconnect between children and the natural world. Whether or not students feel like they are a part of nature relates to E.O. Wilson’s concept of “biophilia,” which he defined as an innate affinity that humans have for the natural world (Wilson 1984). Unfortunately, students are becoming disconnected from their local forests and wildlife, where they could take conservation action. They are instead overwhelmed by complex global issues that often leave them feeling helpless. In addition, teachers often assume children know about the local organisms and ecosystems, but they often do not (Louv 2005). Place based education, increases students’ sense of stewardship and environmental consciousness and adds to their sense of attachment to place (Louv 2005). Understanding and observing local environments and surroundings can help build a strong foundation of environmental sensitivity, environmental knowledge, and outdoor skills (Sobel 1996).
Environmental Knowledge and Behavior

By looking at environmentalists, we can speculate what fosters environmental behavior in adults. As children, most environmentalists had opportunities to be in the natural world and had a responsible adult who modeled how to behave within the natural world (Sobel 1996). Learning about the interrelationships between wildlife and humans can cultivate an appreciation and understanding of wildlife resources so as to foster wise stewardship (EETAP 2002). A higher level of environmental knowledge correlates significantly with a higher degree of pro-environmental behavior in adults (NEETF 2005). As overall environmental knowledge increases, the likelihood of participating in some environmental activities also increases. Most environmental education programs and activities are focused on promoting environmental awareness in young children in preschool and elementary school (Musser and Diamond 1999). However, little is known about the consequences of those activities for children's attitudes and behaviors (Musser and Diamond 1999). Some studies have found the relationship between environmental knowledge and environmental behavior to be weak in children but strong in adults (Kuhlemeier et al. 1999, NEETF 2005). For example, environmentally knowledgeable adults are found to be 50% more likely to recycle and 31% more likely to conserve water (NEETF 2005). For children, environmental behavior is most heavily influenced by environmentally relevant activities in the home (Musser and Diamond 1999). Junior high students are at a crucial stage between developing their own identity and still being influenced by their parents, so either environmental knowledge or home experience may have a greater influence on their behavior.
Gender, Age, and the Environment

There are gendered differences in environmental perceptions, environmental knowledge, and behavior. Women tend to support the environment over the economy (e.g., supporting additional environmental regulation) (NEETF 2005). Many studies have shown that males of all ages have greater environmental knowledge than females and that females of all ages exhibit more pro-environmental behaviors than males (Chan 1996, Riechard and Peterson 1998, EETAP 2000, NEETF 2005). Traditionally, gender may be an influential factor in gaining environmental knowledge in school because males tend to take more science classes than females. Females also may receive less attention in class than males (EETAP 2000). In addition, many fathers bond with their sons over outdoor activities such as hunting and fishing, which may cause boys to value outdoor experience and environmental knowledge more than girls (Cardeiro and Sayler 1994). More recently, it had been hypothesized that the main difference between men and women from an educational perspective is their involvement in science and technology (NEETF 2005). Also several studies have shown that school-age girls exhibit more pro-environmental practices and perceive a greater threat from environmental problems than boys (Chan 1996, Riechard and Peterson 1998, EETAP 2000, NEETF 2005). Females may have a socialized connection to nature because they are taught to be nurturing and foster relationships between people and their surroundings. It is very likely that gender plays a significant role in influencing students' environmental perceptions and awareness.

Environmental curricula need to provide opportunities for students to think and act locally at younger ages (Sobel 1996). Sobel (1996) recommends "no tragedies", such as climate change and rainforest deforestation, before fourth grade as global and complex
environmental issues are beyond young children's geographical and conceptual scopes. Ethical concerns and ecological appreciation increase during the junior high years, making this time appropriate for social action projects (Smith 1992; Sobel 1996). It is important to focus on local problems where children can have a real impact. Appropriate junior high activities include managing school recycling programs and helping to pass school/town environmental ordinances. Within the middle school years, one survey found that sixth graders feel more connected to nature and more engaged by science than eighth graders (Seever 1991). Grade level probably influences students' degree of environmental concern.

Surveying Environmental Awareness at Waterville Junior High School

In order to design effective environmental curricula and improve environmental education programs, it is important to know the foundation of student environmental knowledge and their attitudes about the environment. Many studies have used environmental knowledge and perception surveys to gage environmental awareness in children and adults (Richmond 1976, Seever 1991, Reichard and Peterson 1998, Simpson 1998, Musser and Diamond 1999, Mertig 2005, and NEETF 2005). Surveys are an important technique to assess the status of environmental knowledge and attitudes and can be used at later times to provide an indication of the effectiveness of new environmental education programs (Richmond 1976). The purpose of this investigation is to conduct an environmental awareness survey of sixth and eighth grade students at Waterville Junior High. I hope that the survey results provide a valuable assessment for the school and the community that helps to evaluate environmental knowledge and the
influences of pro-environmental behavior in junior high students. This analysis could help educators understand what students really think about environmental issues, which is a critical step toward providing students with materials to meet their intellectual and emotional needs (Simpson 1998).

There are four themes to the survey: outdoor experience, environmental knowledge, environmental concern, and environmental behavior. These themes were analyzed in terms of their relationships to each other and the influences of grade and gender. These themes were chosen because they are common topics in the environmental education literature and are recognized as factors that contribute to enhanced environmental stewardship and awareness (NEETF 2005). The first theme was outdoor experience, which was defined as time spent outdoors, participation in a variety of outdoor activities, and comfort in natural places. The second theme was environmental knowledge; questions were designed to test students' knowledge about environmental topics such as energy, biodiversity, pollution, and natural resource use. The third theme was concern for the environment, which was evaluated by opinion questions such as desire to learn about environmental issues and degree of concern about specific environmental problems. The fourth theme was environmental behavior, which was defined as actions that exhibit pro-environmental behavior such as recycling, conserving electricity, and water conservation. My literature review suggests that there will be correlations between themes, which will be influenced by grade and gender.

59% of national middle schools teach about the environment in their curriculum (NEETF 2005). The most common topics are recycling and waste management. Currently enrolled at Waterville Junior High School (WJH) are 129 sixth graders, 136
seventh graders, and 171 eighth graders. At WJH, very few environmental topics are integrated into the already compressed curriculum, which is based on the Maine Education Assessment (MEA). The MEA does not specifically address environmental topics; there is only a vague mention in the objectives for science and technology to "understanding the connections between industry, natural resources, population, and economic development" (Hyde 2005). Physical science is covered in the sixth grade, which includes chemistry, motion, and a unit on energy (renewable and nonrenewable sources). Seventh graders focus on life science, which includes ecology, nutrient cycling, and cell composition and function. Earth and space science is covered in the eighth grade, including geology and plate tectonics. Ricia Hyde, an eighth grade science teacher, also includes a lesson about atmospheric changes in her earth science curriculum, which discusses greenhouse gases and ozone layer depletion. However, this is her individual choice as a teacher and only one day is spent on these topics.
METHODS

Survey Design

A 50 question, multiple-choice survey was created with many questions modified from already published surveys (Appendix A). Each question was carefully selected or created to contribute to the themes of the environmental awareness being studied (i.e. outdoor experience, environmental knowledge, environmental concern, and environmental behavior). Wording of questions selected from other surveys was modified to include appropriate vocabulary for 11 to 14 year old students. Questions 4, 19, and 27 were modified from an environmental knowledge survey (Richmond 1976); 12, 13, and 14 from an environmental curriculum evaluation (Seever 1991); 16, 17, 18, 20, 21, 23, 24, 25, and 32 from an adult environmental knowledge test (NEETF 2005); 28, 29, 33, and 35 from an environmental perceptions survey (Simpson 1998); 31 from an environmental awareness survey (Mertig 2005); 36 from an environmental risk perceptions survey (Riechard and Peterson 1998); and 37, 38, 39, 40, 41, 43, 44, 45, and 49 from a pro-environmental activities participation survey (Musser and Diamond 1999; Appendix A). The remaining questions were created based on topics of interest from the literature: questions 5, 6, 7, 8, 9, 10, 42, and 48 contributed to the outdoor experience category; 15, 22, 26, 30, 34, and 47 evaluated local knowledge and environmental concern; 46 and 50 evaluated consumption views, and 11 addressed students' views of environmentalists. Questions 7 and 8 only listed outdoor activities that allow a participant to view nature and possibly develop an appreciation for wilderness areas. The survey was designed in five parts. Part One consisted of demographic questions such as grade, age, and gender. Part Two- Five addressed the four themes of the survey: Part
Two- environmental background or outdoor experience questions, Part Three- environmental knowledge questions, Part Four- environmental perceptions and concern questions, and Part Five- environmental behaviors (Appendix A).

The survey was reviewed and critiqued by Russ Cole (Environmental Studies Program Director and Thesis Adviser), Kirstin Edelglass (Program Director of Canoe Expedition for Maine Girls- Chewonki Foundation and Ecological Education Program Designer), and Karen Barnhardt (Education and Human Development Professor). The Waterville Junior High Principal Peter Thiboutot, Counselor Alice Hammond, and Science Department Lead Teacher Ricia Hyde all read, critiqued, and ultimately approved the survey (Appendix B). Sixth grade science teachers Jen Goff (approximately 60 students) and Chris Spear (approximately 60 students) and eighth grade science teachers Ricia Hyde (approximately 90 students) and Sabina Tosch (approximately 80 students) agreed to let their students participate in the survey. The teachers reviewed the survey and made suggestions to make sure that the wording of the questions was age appropriate. They also explained how the survey would connect to their curricula and how it might be received by their students.

Survey Implementation

After the survey questions were finalized, the experimental design and survey were submitted and approved by the Colby Institutional Review Board for the use of human subjects. In accordance with Waterville Junior High’s survey policy, a passive parental consent letter was mailed to the home of every sixth and eighth grade participant (Appendix C). The letter was drafted with the help of Waterville Junior High Counselor,
Alice Hammond, who had used this type of letter in the past for other school-wide surveys. The letter explained the non-sensitive and anonymous nature of the survey and asked parents or guardians to call the school if they wanted to view a copy of the survey or prevent their child's participation. Letters were sent to all sixth and eighth grade participants. Letters were not sent to the homes of special needs children, who were not going to be taking the survey. The letters were post marked approximately two weeks before the survey was given. No parents called the school to refuse their child's participation in the survey.

The survey was given over two days to both grades. Nine eighth grade classes taught by Mrs. Hyde or Mrs. Tosch took the survey on 21 and 22 March 2006. Six sixth grade classes taught by Ms. Goff or Mr. Spear took the survey on 4 and 5 April 2006. Before the survey was distributed either the teacher or I read the following directions:

"In class today and tomorrow, you will be participating in an anonymous environmental awareness survey. Your parents or guardian have been notified about your participation in this project. I would like to highly encourage you to take part in this survey but it is your choice to participate. If you are confused about any directions please raise your hand. Please write your name on the small yellow post-it note on top of the survey. Tomorrow you will be given the same survey back and the second half of the survey to complete. After you finish the survey tomorrow, please rip the post-it note off and staple the two parts of the survey together. Colby students will present the results of the survey and
a lesson about environmental issues in a few weeks. Thanks for your participation."

As noted in the directions above, the survey was divided into two sections and each section was distributed on consecutive days. The post-it-note with the student's name was necessary to make sure that students could compile both sections of the survey together on the second day. After the students finished the survey, they ripped off the post-it-note themselves to make sure the survey remained anonymous.

The survey took the sixth grade students 20 to 30 minutes to complete each day and the eighth grade students about 15 to 20 minutes each day. The teachers were allowed to further explain directions and answer individual student's questions if the students were having difficulty understanding any of the vocabulary (caution was taken in the knowledge section to not lead the students to the correct answer). The eighth graders had very few questions and seemed to understand the survey. I was present when the first few eighth grade classes took the survey, but since it was going smoothly, I left and allowed the teachers to administer the survey for the other three classes. The sixth graders needed a little more help understanding the directions of the survey, especially the statement choice behavior section. Since Ms. Goff and Mr. Spear teach science at the same time, either I or another Colby student plus the teacher were present for all classes taking the survey. We also offered "reading" groups for students who wanted the survey read aloud to them and this was either done by the teachers, teacher's aids, or Colby students, while I remained available for questions.

For each question, the percent of each response was calculated for sixth grade girls and boys and eighth grade girls and boys (Appendix D). Nonparametric statistics were
used to analyze the data. Responses to each question were analyzed in terms of grade and gender using the Kolmogorov-Smirnov test (Abacus Concepts 1996). Responses for each question were ranked and summed per student for the theme analysis of outdoor experience, environmental knowledge, environmental concern, and environmental behavior (Appendix E). The correlations between themes were analyzed using the Spearman Rank Correlation test (Abacus Concepts 1996). The influences of grade and gender on the themes were analyzed using the Mann-Whitney Rank test (Abacus Concepts 1996).
RESULTS

There were 125 sixth graders surveyed (54% female and 45% male) ranging in age from 11 to 12 years old and 136 eighth graders (49% female and 50% male) ranging in age from 13 to 14 years old. The gender information for 1% of the students in each grade is missing because several students did not complete the first part of the survey due to absence from class on the first day of the survey.

Sources of Environmental Knowledge

The students responded that their most common sources of environmental knowledge were school, television and movies, and outdoor activities. There was a significant difference between the sources of environment knowledge for sixth graders and eighth graders at Waterville Junior High School (Kolmogorov-Smirnov Test, N=483, p= 0.005). Eighth graders principally rely on school and media for environmental information while sixth graders rely more on school and outdoor activities (Figure 1). The sources of environmental knowledge did not significantly differ in terms of gender. Other studies have also shown major sources of environmental information to be school and television (Chan 1996).

Environmental Activism

Several questions addressed environmental activism and all student responses were combined because there were no significant gender or grade level differences. A large majority of Waterville Junior High School students (81%) reported to be willing to do more to protect the environment (question 31). When asked, what is the main reason that
Figure 1. Sources of environmental knowledge for sixth and eighth graders.
prevents you from participating in activities to help protect the environment: 34% of students responded that they don’t know what to do to help protect the environment, 31% do not have enough time or money, and 17% responded that they have not thought about helping to protect the environment. When adults were asked a similar question, 56% reported wanting to help and do more for the environment but they don't know how (NEETF 2005). Adults also identify lack of time and television as barriers to spending time outdoors (Louv 2005). Who should be responsible for making sure we have a healthy environment? 60% of students thought it should be a combination of industries, governments, environmental groups, and individual citizens and 19% of the students thought that just governments should be responsible. These results compare to a reported 47% of Americans who believe that large companies rather than individuals should take environmental action (NEETF 2005).

Several questions asked students about their perceptions of environmentalists and the concept of sustainable development. 43% of students consider environmentalists as people who are important protectors of wildlife and forests, which is an overall positive view. Approximately 30% of students responded, "don't know" to the question about sustainable development, indicating that this is a difficult conceptual topic for students at this age. 20% of students thought development should prioritize protecting ecosystems. 20% of students correctly assessed the concept of sustainable development as ensuring that people's needs (money and environmental) are met in the future. This result compares to 2/3 of adults who think that environmental protection and economic development can go hand in hand (NEETF 2005). However, sustainable development is probably too complex of a conceptual topic for junior high students to comprehend fully.
State of the Environment

Several questions addressed what students considered to be the current state of the environment. 10% of the Waterville Junior High School students surveyed believe the environment is in good shape but 3% think it is in such bad shape that nothing can be done about it. The majority of students (87%) had the fairly realistic view that the environment is in some trouble but humans can improve the situation. When asked to describe their future based on the current state of the environment, there were highly significant differences between the responses of girls and boys in the sixth grade (Kolmogorov-Smirnov Test, N=116, p=0.008) and girls and boys in the eighth grade (Kolmogorov-Smirnov Test, N=130, p=0.008; Figure 2). 43% of sixth grade girls reported that their future would be bright and hopeful but 44% of sixth grade boys believed it would be challenging. Between the sixth and eighth, there was a shift in views. A greater proportion of eighth grade boys (55%) believed that the future will be challenging, but 30% of the eighth grade girls reported a bright/hopeful future and only 30% a challenging future (Figure 2). Students' perceptions of the state of the environment are an important indicator of their potential motivation as environmental stewards.

Outdoor Experience

Questions 5, 6, 7, 8, 10, 42, 48, and 49 were designed to represent the theme of outdoor experience. The most common outdoor activities that sixth and eighth graders participated in during the past year included camping (10%), hiking/walking (12%), bicycling (12%), and swimming in lakes/ponds (11%) (question 7). Although many
students mentioned sports as an activity, it was not counted as an outdoor activity that would contribute to environmental awareness. Sixth graders participated in more outdoor activities in the past year than eighth graders: 16% of sixth graders listed a total of eight outdoor activities and 19% of eighth graders listed six activities.

![Bar chart showing percent of student responses based on grade and gender on their view of the future based on the current concerns about the environment. There was a highly significant difference between girls and boys in the sixth grade and girls and boys in the eighth grade.](image)

There was a significant difference between the types of activities that girls and boys want to participate in but have not had the opportunity to in the sixth grade (Kolmogorov-Smirnov Test, N=304, p=0.05) and eighth grade (Kolmogorov-Smirnov Test, N=282, p=0.04) (question 8). The greatest gender difference was observed with the desire to hunt: 19% of sixth grade boys and 15% of eighth grade boys wanted to have an opportunity to hunt while only 6% of sixth grade girls and 2% of eighth grade girls wanted to hunt.
Overall, Waterville Junior High School students have had many opportunities to participate in outdoor activities and desire to participate in more outdoor activities.

The outdoor experience questions were aimed at analyzing the quantity and quality (i.e., activities that foster an understanding and respect for nature) of time spent outdoors. Time spent outdoors did not significantly differ between girls and boys in the sixth grade but eighth grade boys spent significantly more time outside than eighth grade girls (Kolmogorov-Smirnov Test, N= 134, p=<0.0001) (question 5). 40% of eighth grade boys spend more than six hours outdoors during a typical school week as compared to 12% of girls (Table 1). At Waterville Junior High School, sixth graders and girls, in particular, spent more time with adults outdoors than eighth graders and boys (question 6). On a typical summer day, most sixth and eighth grade students usually play a sport outside (41%) or play in a forest, by a lake, or in a field (20%) (question 10). Playing outdoors in wilderness areas may foster an appreciation of nature while playing sports outside probably does not. Alternative summer activities include 16% of boys and only 6% of girls who like to play a sport or video games on a summer day and 13% of girls and 0% of boys who like to go to a shopping center. Approximately 60% of students, regardless of grade or gender, reported being very similar to a person who feels happy and relaxed outdoors (question 42). 46% of sixth grade girls strongly prefer to listen to nature rather than headphones as compared to 29% of boys (question 48). The eighth grade proportions switched in which 34% of boys strongly prefer to listen to nature as compared to only 21% of girls. 51% of sixth graders responded that they are very similar to a person who likes to look at animals and plants outside and play in the forest as compared to 28% of eighth graders (question 49). Waterville Junior High students
seems to have positive outdoor experiences which has important implications for their potential to be environmental stewards.

Table 1. Percent responses by grade and gender for time spent outdoors during a typical school week. There was a highly significant difference between eighth grade girls and boys.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Sixth Grade</th>
<th></th>
<th>Eighth Grade</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
<td>Boys</td>
</tr>
<tr>
<td>Less than 1 hour</td>
<td>20.9%</td>
<td>9.4%</td>
<td>33.3%</td>
<td>7.4%</td>
</tr>
<tr>
<td>1-5 hours</td>
<td>47.8%</td>
<td>37.7%</td>
<td>54.6%</td>
<td>52.9%</td>
</tr>
<tr>
<td>6-10 hours</td>
<td>17.9%</td>
<td>28.3%</td>
<td>7.6%</td>
<td>25.0%</td>
</tr>
<tr>
<td>More than 10 hours</td>
<td>13.4%</td>
<td>24.5%</td>
<td>4.6%</td>
<td>14.7%</td>
</tr>
</tbody>
</table>

Environmental Knowledge

Questions 16-27 were designed to investigate the theme of environmental knowledge. Most of the results can be related to the Waterville Junior High curriculum or the rural community setting of Waterville. A significantly higher percent of eighth graders answered environmental knowledge questions correctly as compared to the sixth graders (Table 2). However, a higher percentage of sixth graders correctly answered energy questions as compared to eighth graders, including how most of electricity in the U.S. is generated (Kolmogorov-Smirnov Test, N= 131, p= 0.03) and naming a renewable resource. The question that was most often correctly answered was about local wildlife (79% of sixth graders and 89% of eighth graders). Approximately half of all students correctly answered that their water comes from a nearby lake (Table 2). 50% of sixth and eighth grade students reported that they knew a fair amount about animals and plants found in the Waterville Area. 42% of the students reported knowing about a combination of global, national, and local environmental issues while 19% of the students reported knowing the most about global environmental issues, 15% reported national
environmental issues, and 24% reported local environmental issues. These results contrast the findings of a study of sixth grade students in the Pacific Northwest in which students had greater knowledge about highly publicized regional and global environmental issues than they did about local wildlife issues (Cardeiro and Sayler 1994). The majority of students did not know that surface water carrying dirt and pollutants from yards, streets, and farms is the most common cause of pollution in streams, rivers, and oceans (Table 2). This degree of local environmental awareness reflects the upbringing of most Waterville Junior High School children in their rural Maine community.

Table 2. The percent of correct environmental knowledge answers by grade. One asterisk indicates a statistically significant difference between sixth and eighth grade \((p<0.05)\) and two asterisks indicates a highly significant difference \((p<0.001)\).

<table>
<thead>
<tr>
<th>Question Topic</th>
<th>6th Grade</th>
<th>8th Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Wildlife</td>
<td>78.7</td>
<td>88.8</td>
</tr>
<tr>
<td>Supply of Fossil Fuels</td>
<td>69.7</td>
<td>73.1</td>
</tr>
<tr>
<td>Renewable Resources</td>
<td>60.7</td>
<td>51.5</td>
</tr>
<tr>
<td>Biodegradability</td>
<td>51.6</td>
<td>74.6**</td>
</tr>
<tr>
<td>Animal Extinction</td>
<td>51.6</td>
<td>63.4*</td>
</tr>
<tr>
<td>Drinking Water Source</td>
<td>45.9</td>
<td>54.5</td>
</tr>
<tr>
<td>Energy Generation</td>
<td>45.1*</td>
<td>27.6</td>
</tr>
<tr>
<td>Garbage Storage</td>
<td>33.6</td>
<td>55.2**</td>
</tr>
<tr>
<td>Wetlands' Benefit</td>
<td>25.4</td>
<td>53.7**</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>20.5</td>
<td>50.0**</td>
</tr>
<tr>
<td>Ozone Layer</td>
<td>19.7</td>
<td>59.0**</td>
</tr>
<tr>
<td>Water Pollution</td>
<td>9.0</td>
<td>22.4</td>
</tr>
</tbody>
</table>

No student answered all 12 knowledge questions correctly, but three boys and two girls in the eighth grade and two boys and one girl in the sixth grade answered 10 or 11 questions correct. Most students did not correctly answer at least half of the questions, but this was a difficult test in which eight of the twelve questions are similar to a NEETF knowledge test given to adults (Figure 3). 22% of the sixth grade and 46% of the eighth
grade answered more than half the questions correctly. On the comparable NEETF test, only 55% of adults correctly answered half of the questions (NEETF 2005). So perhaps today's school children are on their way to being more environmentally knowledgeable than their parents.

<table>
<thead>
<tr>
<th></th>
<th>&lt;3</th>
<th>4 to 6</th>
<th>6 to 8</th>
<th>&gt;8</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th Grade</td>
<td>2%</td>
<td>37%</td>
<td>41%</td>
<td>20%</td>
</tr>
<tr>
<td>8th Grade</td>
<td>5%</td>
<td>17%</td>
<td>37%</td>
<td>41%</td>
</tr>
</tbody>
</table>

Figure 3. Percent of correctly answered environmental knowledge questions out of twelve by sixth and eighth graders.

For sixth graders, there was a trend for a higher percent of boys answering each environmental knowledge question correctly as compared to girls (Figure 4). However, significantly more boys (67%) than girls (40%) were able to correctly name a biodegradable material (Kolmogorov-Smirnov Test, N=121, p=0.03). For eighth graders, a higher percent of girls answered four out of twelve questions correctly and a higher percent of boys answered eight out of twelve questions correctly (Figure 5). This shows
an important transition in degree of environmental knowledge as influenced by gender between sixth and eighth graders.

**Environmental Concern**

Questions 14, 30, 38, 43, 46, 47, and 50, which included topics such as desire to learn about the environment, concern about pollution, and concern about animal rights, were designed to represent the theme of environmental concern. Sixth graders and girls, in particular, tended to show greater environmental concern than eighth graders and boys, which fits national trends of females caring more about environmental issues (NEETF 2005). Of sixth graders, significantly more girls 52% like learning about the environment a great deal compared to 11% of boys (Kolmogorov-Smirnov Test, N= 121, p<0.0001) (Table 3). However, there was less difference in the responses of eighth grade girls and boys (Table 3). This indicates that with increasing age, there are less measurable gender differences in degree of environmental concern. 82% of adults claim to be interested in the environment as compared to just 55% of children (NEETF 2005). 75% of children say they are interested in nature and animals, indicating that children don’t necessarily associate environmental topics with nature and animals (NEETF 2005). There was not a significant difference between grades when students were asked how much they learned about the environment in school this year. This result contradicts other studies, which have found that sixth graders report learning more about science than eighth graders in that year in school (Seever 1991).
Figure 4. Percent of correct answers to each environmental knowledge question for sixth grade girls and boys. One asterisk indicates a statistically significant difference (p<0.05).

Figure 5. Percent of correct answers to each environmental knowledge question for eighth grade girls and boys.
Table 3. Percent responses by grade and gender to the question do you like learning about nature and the environment. There was a highly significant difference between sixth grade girls and boys.

<table>
<thead>
<tr>
<th>Responses</th>
<th>Sixth Grade</th>
<th>Eighth Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls</td>
<td>Boys</td>
</tr>
<tr>
<td>A great deal</td>
<td>52.2%</td>
<td>11.0%</td>
</tr>
<tr>
<td>A fair amount</td>
<td>26.9%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Not very much</td>
<td>14.9%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Not at all</td>
<td>4.5%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Unsure</td>
<td>1.5%</td>
<td>5.6%</td>
</tr>
</tbody>
</table>

Environmental concern represents how much students care about environmental issues and therefore, the likelihood they will act on behalf of the environment. Most students agree with the belief that plants and animals have as much right as humans to exist and are concerned about rainforest destruction, though a higher proportion of sixth graders and girls reported to be strongly agreeing with the statements (question 38 and 43). 36% of students reported that they were somewhat concerned about pollution in Maine lakes and the rate of tree harvesting in Maine (question 30). Sixth graders and girls in particular tended to be more mindful of reducing personal consumption (question 46).

There were few significant gender differences in terms of perception of environmental risk. Sixth grade girls thought that a decrease in food supply was significantly more risky than sixth grade boys (Kolmogorov-Smirnov, N=116, p=0.02). These results contradict the findings of the Riechard and Peterson (1998) survey on which this question was based. Riechard and Peterson (1998) found female students had significantly higher perception of risk scores than male students. Also, Riechard and Peterson (1998) found water and air pollution were perceived to pose the highest risk, which they attributed to higher media coverage of these issues. This study found no
significant differences between the risk ranks for each environmental problem. The only problem that was judged as proportionally less risky was population growth. This is because population growth is not a primary concern in Maine and students do not seem to be thinking beyond their state in terms of global sustainable development.

Environmental Behavior

Questions 9, 31, 37, 39, 40, 41, 44, and 45 were designed to investigate the theme of environmental behavior. More sixth graders (41.8%) reported recycling bottles, cans, or newspapers at home than compared to eighth graders (29.9%). 39.1% of sixth grade girls and 18.9% of sixth grade boys reported being very willing to do more to protect the environment. There was a similar trend for eighth grade girls and boys but less of a gender difference for recycling and willingness to protect the environment. In general, girls showed greater pro-environmental behavior and opinions on general topics such as water conservation, animal rights, and rainforest concern (Figure 6). Other surveys have also shown that females tend to score higher on environmental awareness and environmental behavior and in general, show greater support for environmental education and regulations than males (NEETF 2005). One of the greatest gender differences is female preference to limit hunting, which is consistent with fewer females hunting as an outdoor activity. In general, students did not strongly support limiting consumption as an environmental behavior. Another study of middle school student's attitudes also found a perceived importance of the benefits of modern consumer goods rather than reducing consumption (Chan 1996). In this study, only 37.9% of sixth grade girls and 14.9% of sixth grade boys strongly believe that they should only buy things they need. This
response reflects the general patterns of over consumption in the US. When the responses on the environmental behavior questions were totaled for both grades, a greater proportion of girls (90%) showed medium to high ranges of pro-environmental behavior scores as compared to boys (79%) (Figure 7).

![Bar Chart]

Figure 6. Percent of girls and boys showing high pro-environmental behavior or concern. Sixth and eighth grade responses combined.

There was no correlation between environmental knowledge and environmental behavior for all the students (Table 4) and other studies agree that this association thought to be strong in adults is weak in children (NEETF 2005). Musser and Diamond (1999) found that children's environmental behaviors are correlated with the degree to which children participate in environmentally relevant activities at home. This idea was tested by combining scores from whether students recycle at home (question 9) and how much
time they spend outdoors with a parent or other adults (question 6), and examining the correlation with total environmental behavior theme scores. The correlation was significant for all students and highly significant for sixth grade boys (Spearman Rank Correlation, N= 48, p=0.0008). This result has important implications for how and from whom children learn to be environmental conscious citizens.

<table>
<thead>
<tr>
<th>Low (Scores 13-20)</th>
<th>Medium (Scores 21-27)</th>
<th>High (Scores 28-34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 7. Range for scores of girls and boys for environment behavior theme questions. Sixth and eighth grade responses combined.

Connecting Outdoor Experience, Environmental Knowledge, Concern, and Behavior

The total score for each subset of questions, outdoor experience, environmental knowledge, environmental concern, and environmental behavior were summed and the means for each category were compared for possible correlations (Appendix E). Outdoor experience was not significantly correlated with environmental knowledge, which indicates that not all outdoor activities foster greater knowledge about the environment.
However, outdoor experience was correlated with environmental concern and environmental behavior regardless of grade or gender (Table 4). Other studies have also identified direct interaction with natural habitats as one of the main influences leading to responsible environmental behavior in adults and children (Sobel 1996). NEETF (2005) has found that 70-80% of outdoor program participants experience more positive attitudes toward the environment. Outdoor experience was significantly correlated with environmental concern and behavior themes when they were combined regardless of grade and gender.

Table 4. The correlations among themes of outdoor experience, environmental knowledge, environmental concern, and environment behavior. One asterisk indicates a statistically significant correlation (p<0.05) and two asterisks indicate a highly significant correlation (p<0.001) according to the Spearman Rank Correlation test.

<table>
<thead>
<tr>
<th>Theme Relationship</th>
<th>Sixth Grade</th>
<th>Eighth Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls (N=57)</td>
<td>Boys (N=48)</td>
</tr>
<tr>
<td>Outdoor fosters Knowledge</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Outdoor fosters Concern</td>
<td>0.0245*</td>
<td>0.0002**</td>
</tr>
<tr>
<td>Outdoor fosters Behavior</td>
<td>0.0008**</td>
<td>0.0471*</td>
</tr>
<tr>
<td>Knowledge fosters Concern</td>
<td>0.0276*</td>
<td>0.0290*</td>
</tr>
<tr>
<td>Knowledge fosters Behavior</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Concern fosters Behavior</td>
<td>0.0001**</td>
<td>0.004</td>
</tr>
</tbody>
</table>
In adults, environmental knowledge is highly correlated with pro-environmental behavior but the pattern is not consistent (NEETF 2005). Environmental knowledge was correlated with environmental concern for sixth grade girls and boys and eighth grade boys, but not eighth grade girls (Table 4). One study found that the relationship between environmental knowledge and environmental attitudes to be very weak (Kuhlemeyer et al. 1999). Environmental concern was significantly correlated with environmental behavior (Table 4). A study of children's environmental attitudes also found a relationship between children's attitudes and their participation in environmentally relevant activities (Musser and Diamond 1999). Another study of middle school students also showed a strong positive and significant relationship between environmental attitudes and students' willingness to participate in various pro-environmental behaviors (Chan 1996).

Differences in terms of grade and gender of the mean scores of outdoor experience, environmental knowledge, environmental concern, and environmental behavior were observed. The total scores for outdoor experience and environmental behavior were not significantly dependent on gender. The mean environmental knowledge scores were significantly higher for sixth grade boys (26.8±1.7) than sixth grade girls (20.7±1.4) (Mann-Whitney Rank Test, N= 105, p=0.01; Figure 8). The mean environmental concern scores were significantly higher for sixth grade girls (23.3±0.6) as compared to sixth grade boys (21.3±0.5) (Mann-Whitney Rank Test, N= 105, p=0.007; Figure 8). Also when mean environmental concern and behavior scores were combined, sixth grade girls had significantly higher scores than sixth grade boys (Mann-Whitney Rank Test, N= 105, p=0.006). The mean outdoor experience scores were significantly higher for eighth grade boys (18.1±0.5) than eighth grade girls (16.4±0.4) (Mann-Whitney Rank Test,
N=121, p=0.01; Figure 9). Though not significant, the mean scores of sixth grade girls for environmental concern (23.3±0.6) and environmental behavior (26.3±0.6) were higher as compared to scores of eighth grade girls for environmental concern (21.7±0.6) and environmental behavior (25.1±0.5) (Figure 8 and 9). The mean scores for environmental concern and environmental behavior for boys were very similar between sixth and eighth graders (Figure 8 and 9). These results conflict with other studies of gender and age influences on environmental knowledge and awareness. One study of adults found a significant relationship between level of environmental knowledge and gender, but no significant relationship between expressed attitudes toward the environmental and gender (Richmond 1976). A study of ninth graders in Maryland found males scored higher on environmental knowledge but females scored higher on environmental awareness and environmental behavior (Haddon-NEETF 1995). A study of preschool-age children found that pro-environmental attitudes increase with age (Musser and Diamond 1999), which conflicts with this study's finding that environmental concern and environmental behavior decrease from sixth to eighth grade girls.
Figure 8. The mean theme scores (± SE) for sixth grade girls and boys. One asterisk indicates a statistically significant correlation (p < 0.05) and two asterisks indicate a highly significant correlation (p < 0.001).

Figure 9. The mean theme scores (± SE) for eighth grade girls and boys. One asterisk indicates a statistically significant correlation (p < 0.05).
DISCUSSION

Sources of Environmental Knowledge

The sources of the students' environmental knowledge were influenced by grade level, which can be attributed to more time spent outdoors, school, and media. A greater percentage of sixth graders reported outdoor activities as a source of environmental knowledge as compared to eighth graders. The sixth graders also participated in more outdoor activities in the past year, spent more time outdoors than eighth graders, and enjoy viewing plants and animals outside to a greater degree than eighth graders. The sixth graders have less homework and more leisure time than eighth graders. Sixth graders reported spending more time outside with adults, which may indicate greater opportunities for outdoor and environmental education. In contrast, the eighth graders rely more heavily on television and movies for environmental knowledge. The sixth graders are learning through immediate experiential knowledge versus eighth graders who are learning through secondary mediated knowledge. The National Environmental Education and Training Foundation (2005) reports that children get more environmental information (83%) from the media than any other source. For most adults, the media is the only steady source of environmental information. Most media provides opportunities for learning superficial information about the environment, but does not provide in-depth education (NEETF 2005). Educators need an understanding of how to provide meaningful environmental education even when the media is sometimes oversimplifying and misinterpreting environmental problems (NEETF 2005).
State of the Environment

As children grow older, they gain environmental knowledge and a more accurate sense of the challenges of environmental problems facing society. Sixth and eighth grade girls in this survey had more optimistic views of the future than sixth and eighth grade boys. It is difficult to discern whether the boys thought that the future would be challenging as something to be excited about or an obstacle. One explanation for the gendered differences of perceptions is how girls and boys typically view nature in general. An investigation of elementary age girls' and boys' stories about the natural world found that girls generally described stories on connection and sharing a reciprocal relationship with nature (Neuwirth 1996). In contrast, boys generally described feelings of anxiety or fear associated with nature. This male sense of anxiety with nature might explain the boys' view of the future as challenging while the female sense of a reciprocal relationship with nature might explain the girls' more positive view about the future. However, in general this question may have been ambiguous because it defines the future in too broad of terms that are open to different interpretation. Students might have interpreted challenging as fun and exciting or difficult and demanding; these interpretations have very different implications of how students view the future of the environment.

Environmental Knowledge

Overall, the majority of students only answered half of the 12 environmental knowledge questions correctly. This performance could be a result of the degree of question difficulty. Eight of the 12 questions were modified from an adult environmental
knowledge test (NEETF 2005). However, similar percentages of eighth graders and adults answered more than half the questions correctly. This survey suggests that environmental knowledge in general is low but is improving with younger generations. The environmental knowledge results show students are retaining environmental knowledge but for a limited amount of time. This is probably because environmental topics are not continually addressed in the curriculum and similarly to national environmental problems, environmental learning does not accumulate (NEETF 2005). A greater percent of sixth graders correctly answered energy questions compared to eighth graders. This result is probably because energy and renewable and nonrenewable energy sources are major components of the sixth grade science curriculum. Overall, the eighth graders did show greater environmental knowledge than the sixth grade. This is probably due to two more years of science courses and more exposure to media.

In general, Waterville students showed a higher degree of local knowledge compared to national averages which show a decline in local knowledge due to media fostering a disconnect between students and their local environment (Sobel 1996). The greater degree of local knowledge found in this study can probably be attributed to the fact that they live in rural communities in Maine, a state dominated by wilderness areas. Rural students also may have more knowledge of wildlife issues because of more frequent contact with wildlife, opportunities to be outside, or exposure to hunting and fishing (Cardeiro and Sayler 1994). In addition, there was low comprehension of the topic of sustainable development. These results suggest that more education about sustainable development is needed because it is an essential concept to address our future social, economic, and biological needs (Smith 1992). Bringing non-school volunteers into the
classroom helps to diminish the boundary between school and its broader context (Smith 1992). For example, an organic farmer as a guest speaker might be able to give students a tangible understanding of sustainable food production and how it is important to their community. Rural schools in Maine should especially take advantage of this opportunity because there are many people with local hunting and craft making experience. Even though sustainable development is a difficult conceptual topic, it can be made more applicable to students through demonstrating the connection between their local community and a broader global context.

Influences of Environmental Behavior

Overall, the majority of students at Waterville Junior High recognized that the environment is in trouble, expressed concern about environmental issues, and were willing to participate in pro-environmental activities. Other studies have also shown that lack of environmental knowledge did not seem to prevent students from caring and acting on behalf of the environment (Kuhlemeier et al. 1999). As children's behaviors are influenced by activities in the home, their views on environmental activism probably reflect those of their parents. This study found a highly significant relationship between environmental concern and environmental behavior, regardless of grade or gender. There was also a correlation between recycling at home and spending time outside with adults as contributing to pro-environmental behavior. Children learn from direct experience and from observing others. Participation with adults in activities such as recycling or nature walks provides children with the opportunity for observation and direct experience (Musser and Diamond 1999). Even without explicitly stating their values, parents and
other adults are conveying messages to children through their own environmentally sensitive practices.

For both adults and children, the main reported barriers to environmental action are lack of knowledge about what to do and lack of time (Louy 2005). However, it is improbable that sixth and eighth graders actually do not have enough time to participate in environmental activities because they still have more leisure time than high school students or adults. Therefore, these sentiments are probably a reflection of the views their parents have shown at home. Students' perspectives also reflect the dominant U.S. perspectives about environmental issues. The majority of students reported that they hear environmentalists described as important protectors of wildlife and forests, which reflects a positive view. Students did not favor reducing the things they buy as an environmental behavior. This is reflective of over consumption practices in the U.S. and is ingrained in schools as few teachers publicly question the commonly shared assumptions about unlimited growth and expanding individual opportunities (Smith 1992). It is also increasingly assumed that individuals are responsible for themselves alone and not for the communities in which they live (Smith 1992). This disconnect needs to be addressed in public education and can be accomplished by a community perspective in experiential learning.

Gender Gap

Overall, boys had greater outdoor experience and environmental knowledge than girls. Girls showed greater environmental concern and environmental behavior than boys. These trends have been repeated in many surveys (Chan 1996, Riechard and
Peterson 1998, EETAP 2000, NEETF 2005). This gender pattern follows national trends of males performing better on environmental knowledge tests and female showing greater awareness. There are several arguments to explain this gender gap including the pedagogical gap that treats girls and boys differently in science classes, gender bias in teaching techniques, the perceived lack of female role models in science fields, and the more subtle culture socializations that steer girls away from science and technology.

Studies suggest that girls and boys often experience qualitatively different educational situations, especially in science and math fields (Greenfield 1997; EETAP 2000). The gender differences in environmental knowledge are most often attributed to male dominance in science and technology fields. While girls are taking as many science courses as boys, boys still take more advanced courses and are more likely to take all three core science courses—biology, chemistry, and physics in high school (AAWU 1998). Also, girls have fewer role models in computer games and are less likely to use computers outside of school (AAWU 1998). A new gap is emerging as computer science becomes the new "boys club." In addition, several socialized gender differences and teaching techniques affect the participation of girls in science class at all grade levels. Experiences outside the science classroom can reinforce the gender gap as certain experiences provide skills useful in science. Such activities include playing with science-related hobbies and exploration toys or games are more often associated with boys than with girls (Greenfield 1996). Women are assumed to be more intuitive and rely more on feelings while men tend to base their decisions on fact and science (EETAP 2000). Females are socialized to be less assertive and may receive less attention in class. These socialized experiences can give boys a wider experiential background to draw upon for
science problem solving in school (Greenfield 1996). This stereotyping over time can be
detrimental to female self-esteem and confidence when considering their involvement in
science.

The observed gender differences in environmental knowledge might have several
explanations. In Maine, this finding might be explained by the fact that outdoorsmen are
held in high regard and boys might have more opportunities and be encouraged to spend
time outdoors doing activities such as hunting and fishing than girls (Cardeiro and Sayler
1994). The survey results did show that more boys desire to participate in hunting than
girls. Boys might be more motivated or have more opportunities to gain environmental
knowledge through outdoor experiences. Another explanation might lie in the
environmental knowledge questions themselves. Environmental knowledge questions are
focused more on recalling facts and girls tend to be more interested and better at
processing the connections among things (Belenky et al. 1986). Perhaps discrete facts
do not engage girls in the same way that environment topics overall or the connections
between people and the planet do (Belenky et al. 1986). Girls are socialized from a
young age to think about such relationships and this may explain their greater
environmental concern. For example, a higher percentage of eighth grade girls correctly
defined the concept of biodiversity than eighth grade boys. Biodiversity is the
relationship between diverse habitats and their associated assemblages of organisms. In
my opinion, the socialization of gender through culture is the main cause for these
differences instead of an inherent nature in girls to care about environmental issues more
than boys.
The data showed that outdoor experience was significantly correlated with environmental concern for all students. The scores for environmental concern and environmental behavior decreased from the sixth grade to the eighth grade. This change is probably due in part to the decrease in time spent outdoors. Girls in this study showed significantly greater environmental concern as compared to boys. A study which investigated the reasons for gender differences in terms of environmental concern found that when surveys measure environmental attitudes in ways that trigger risk perceptions, women will score higher in concern than men (Bord and O'Connor 1997). For example, in surveys involving nuclear power or radioactive waste, women show more concern than men, but in surveys of general environmental concern, women do not exhibit greater concern than men (Bord and O'Connor 1997). Question 36 specifically addressed the perception of environmental risk and did not identify many significant gender differences. However, sixth grade girls had a significantly higher risk perception of decrease in food supply than boys, which is an issue that directly affects humans. Other gender differences were not observed because the environmental problems listed on question 36 were specific, though not as specific as nuclear waste (as in the Bord and O'Connor study) and were not necessarily linked to health issues. Also, the one to five scale used in this study, might have been too narrow to show gender differences.

Several researchers have found that girls have a tendency toward intimacy with others and the world around them while boys have a tendency toward autonomy, separation, and distance from the world around them (Neuwirth 1996). On one hand, girls often describe feelings of connectedness and reciprocal relationships with nature, which may reflect an innate biophilia (Wilson 1984). On the other hand, boys are socialized to see nature as
something to be conquered and used for human exploitation, such as providing materials for building boats and forts (Neuwirth 1996). Girls may have an ethic of care for nature and the environment, which manifests as greater environmental concern while boys see nature as providing resources for human use.

There are a variety of myths and assumptions associated with gender but there are also real differences as shown by this study, which should be considered in the design of environmental education programs. Several gender issues could be addressed with careful planning of pedagogical approaches and lesson plan strategies. First, teachers and counselors should encourage girls to enroll in math and science classes at the challenging AP or honors level (AAWU 1998). Second, educational equality for all students must be viewed as essential to educators and teaching schools must recognize gender, race, and class biases in teaching techniques (AAWU 1998). Third, lesson plans and activities need to be based on learning situation on an individual basis, rather than by gender (EETAP 2000). Studies have shown that gender differences are more characteristic of whole-class rather than small-group activities, because teachers generally devote more attention to boys than to girls in whole-class discussions (Greenfield 1996). Teachers should design class activities to allow all students to learn and feel comfortable when participating. Fourth, when asking questions, teachers should try to ask questions that do not involve spontaneous responses, which may favor male students (EETAP 2000). A mix of spontaneous answers and those that require more thought allow for boys' and girls' strengths to be recognized. By redesigning the ways in which teachers approach environmental education, they can be sure to avoid stereotypes and assumptions about gender.
Critique and Suggestions for Further Research

Intuitively, greater environmental knowledge should be correlated with more outdoor experience and greater environmental knowledge should lead to pro-environmental behavior. However, this survey did not find significant correlations. Other surveys have also found that the relationships between environmental knowledge and environmental attitudes or environmental behavior are very weak (Kuhlemeier et al. 1999). It is possible that environmentally responsible behavior is difficult to measure properly by a questionnaire. Also, we should not be too optimistic about the correspondence between what people say and what they really do (Kuhlemeier et al. 1999). In addition, part of the problem may be in the correlation model itself because it may be too simplistic and nonlinear. There may be correlations among environmental knowledge, environmental attitudes, and environmental behaviors, but there are other factors such as understanding of and skill in using environmental action strategies, as a better predictor of environmental stewardship (NEETF 2005).

This study produced several suggestions for further research. First, interviews with students as focus groups to help determine the reasons behind their responses. Second, the survey should be retaken when the current sixth grade is in eighth grade to see if environmental knowledge continues to accumulate. It would be interesting to see if their environmental knowledge is greater than the current eighth grade because of greater media and school coverage of environmental knowledge. The survey could also be used to evaluate the effectiveness of any environmental education programs aimed at fostering environmental knowledge and environmentally responsible behavior. It would have been
interesting if I could have taught a week-long overview of environmental issues to sixth and eighth grade students at Waterville Junior High School. Then, I could have students take the survey and analyze how their environmental knowledge and degree of concern changed (Appendix G). Third, to help find a further explanation of gender differences, it would have been beneficial to investigate the socialization of girls and boys in education and the sciences. In general, surveys are useful because they identify interesting trends, however they typically fail to provide explanations for these trends. This project provoked additional questions such as do children understand that the choices they make which increase their “ecological footprint” and what alternative choices are possible to decrease their footprint? Researching questions like this move beyond environmental education to the roots of ecological education. This survey also lends itself to more research to explain the educational and environmental implications of the results.

_Fostering Environmental Awareness_

Since one of my goals for this thesis was to increase environmental awareness, I thought it was important to share the survey results with the students. The students were genuinely interested in the results obtained and as one teacher noted, they take many surveys but never has someone come back to share the results with them. I also had the students participate in an environmental activity called Renew-A-Bean to represent nonrenewable and renewable energy consumption in the U.S. and the pressures of population growth (Appendix F). 92% of beans in a bag were one color representing nonrenewable resources and 8% of the beans were another color representing renewable. Students filled in data sheets, first by removing ten beans for each trial until the bag only
had renewable beans left. Then, accumulating amounts of five more beans and ten more beans removed from each trial (Appendix F). Renewable beans could always be replaced back in the bag but nonrenewable beans could not. Before beginning each experiment, students would predict how many trials or years their resources would last. The students really enjoyed this activity and some students wanted to stay after class to finish it. The students understood and could explain the implications of increasing populations using resources at a faster rate and how the over-reliance on nonrenewable energy in the US is unsustainable.

Throughout the lesson, students seemed eager to learn about environmental issues and environmental topics and it was clear that they were completely engaged by the hands-on lesson. Students' interests in environmental issues demonstrated the need to firmly integrate environmental and experiential education into the curricula, which is not limited to science classes, at Waterville Junior High School. As part of this project, I also developed a two-week unit curriculum that could serve as a model for an introduction to environmental studies at Waterville Junior High School (Appendix G). The unit rationale is to increase students' awareness about global and local environmental issues and promote participation in environmental protection and conservation. The unit plan includes background content for all the lessons, detailed instructional activities on air pollution, water conservation, renewable and nonrenewable energy, recycling, and biodiversity, and suggested evaluation techniques (Appendix G). The unit plan uses experiential lessons, takes a multidisciplinary approach, and includes group as well as individual projects. The materials for the unit plan are inexpensive. The unit plan
contributes to the learning standards set forth by the MEAs and could easily be integrated into the Waterville Junior High School curriculum.
RECOMMENDATIONS

The following is a list of recommendations suggesting how teachers and parents can foster environmental awareness in their students and children:

• Outdoor experiences in wilderness areas foster environmental concern. Even field trips around the schoolyard are beneficial.

• Girls need more outdoor experiences and hands-on science lessons and boys need more experiences with group participation and fostering relationships.

• Participation with adults in activities such as recycling or nature walks provide children with the opportunity for direct environmental experience.

• Educational institutions need to model sustainability by encouraging social action projects and collective and community based learning: think globally, act locally. This is an important opportunity in Maine as there are many sources of local environmental knowledge such as hunters and craftspeople.

• Teachers need to be aware of gender biases in their teaching techniques.

• Socialized gender differences affect the acquisition of environmental knowledge and environmental concern and should be considered in teaching techniques.

• Age and developmentally appropriate environmental topics should guide the creation of environmental curricula.

• Environmental education should be integrated across disciplines in the Waterville Junior High School because students are interested in the environment and nature and are willing to do more to protect the environment.
  • Sixth grade material should involve local environments and a physical presence in nature.
  • Eighth grade material can include internet projects on researching rainforest deforestation or analyzing community recycling programs.
  • Topics such as threats to biodiversity could be included in seventh grade ecology curriculum and the influences of climate change on earth’s atmosphere in eighth grade earth process curriculum.

• Surveys are a useful tool to evaluate environmental awareness and assess the effectiveness of environmental education curricula.

• Improving environmental awareness is essential as educators prepare students for the local and global environmental challenges of the future.
SUMMARY

Despite the fact that the Waterville Junior High School curriculum does not specifically address environmental issues, the sixth grade and eighth grade students have a comprehension of environmental topics. Their environmental knowledge increases with age and is comparatively ahead of many adults in America. The survey proved to be a useful tool to gauge current environmental awareness and it can be used at later times to provide a means of assessment of the effectiveness of new environmental education program. One of the principle objectives of this study was to determine if environmental education and environmental knowledge "pays off" in terms of encouraging measurable environmental stewardship. This study found outdoor experience, rather than environmental knowledge was the greater predictor of environmental awareness and environmental behavior in Waterville Junior High students. Nature experiences are key factors in fostering environmental stewardship. Girls and boys need to have outdoor, experiential, and community based educational opportunities to become more environmental aware citizens.

In the sixth grade, boys showed greater environmental knowledge and girls showed great environmental concern. The greater ethic of environmental concern that girls seem to have might be attributed to an innate connection to nature. However, many ecofeminists warn against feminizing nature and naturalizing women. These gender differences may be explained by socialized gender differences such as gender biased teaching techniques, the perceived lack of female role models in science fields, and the more subtle culture socializations such as toys that steer girls away from science and technology. The results of this study suggest that girls need more outdoor experiences
and hands-on science lessons and boys need more experiences with group participation and fostering relationships. Also gender differences were more pronounced for sixth graders than eighth graders. Therefore, gender and grade level differences should be considered when designing environmental curricula and teaching strategies.

87% of students recognized that the environment is in trouble, but there is something we can do about it. 81% of students are willing to do more to protect the environment. These results again show that students are interested in environmental issues. The results of major sources of environmental knowledge have important implications for environmental education curricula. Sixth grade material will be more engaging if it involves local environments and a physical presence in nature. Eighth grade material can include internet projects such as researching rainforest deforestation or analyzing community recycling programs. These geographic and conceptual foci are suggested because eight to eleven year olds should focus locally and twelve to fifteen year olds should focus on social action projects connecting humans and nature. Age and developmentally appropriate environmental education are extremely important issues to consider.

The Waterville Junior High School could easily integrate environmental topics into the curriculum and still complying with the goals set by the MEAs. Topics such as threats to biodiversity could be included in seventh grade ecology curriculum and the influences of climate change on earth's atmosphere in eighth grade earth process curriculum. Included in this report is a suggested unit plan covering a general overview of environmental issues that could be used in the curriculum at Waterville Junior High School (Appendix G). The unit will increase students understanding of the connection
between the environmental and people, including issues of environmental justice and conservation actions that they can take in relation to the environmental topics covered. The survey results show that students are very interested in the environment and understand the need to address environmental problems. This demonstrated interest and thirst for knowledge should be met by the curriculum at Waterville Junior High School.

Evaluating environmental knowledge and analyzing what inspires students to become environmentally aware citizens are crucial research areas for fostering future environmental sustainability. Since the United Nations recognizes a child’s right to play as a fundamental human right, access to parks and recreation is an essential component of environmental justice. Issues of environmental justice are also a great way to demonstrate the connection between the environmental and people as well as inspire students to participate in social action projects. This study recognizes this need and recommends further research on how gender and culture influence outdoor experiences, the acquisition of environmental knowledge, degree of environmental concern, and participation in pro-environmental behaviors. This work should also include increasing the general public’s understanding of environmental justice and working towards the fair treatment of all people and the environment. It is apparent that the educational and environmental experiences of students are cultured and gendered, therefore, educators must be conscious of how to identify and avoid bias in teaching techniques. In addition, this project recommends the integration of environmental and experiential education into the Waterville Junior High School curriculum. This curricular change should be done across disciplines so it is not merely the responsibility of science classes. All subjects can benefit from integrating environmental topics, as tangible subjects that engage
students. The quote above the doors of the Waterville Junior High School reads "Through These Doors Go the Leaders of Tomorrow." Improving environmental education and awareness is essential as educators prepare students for the local and global environmental challenges of the future.
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LITERATURE CITED


APPENDIX A. Environmental Awareness Survey

Environmental Awareness Survey
Environmental Studies Program, Colby College
March-April 2006

Day One of Survey

This survey is about you and what you think about the environment. Please be as honest as possible. Please only write your name on the post-it note. You will have one class period to finish this section of the survey and you will be given the second half of the survey tomorrow.

Part I. These questions are about you. Please circle the answer that best describes you.

1. What grade are you in? 6th 7th 8th
2. How old are you? 11 12 13 14 15
3. What is your gender? Female Male

Part II. These questions ask you about your environmental background.

4. Pick two of the following that best describe the ways in which you have learned the most about the environment:
   a) school
   b) newspaper
   c) TV/ movies
   d) internet
   e) personal reading (magazines, books)
   f) talking with parents
   g) talking with friends or other people
   h) radio
   i) outdoor activities
   j) other: ____________________________

5. On average, how much time do you spend outdoors during a typical school week?
   a) less than 1 hour
   b) 1-5 hours
   c) 6-10 hours
   d) more than 10 hours

6. How often do you spend time outdoors with a parent or other adults?
   a) very frequently
   b) frequently
   c) occasionally
   d) infrequently
   e) never

7. Circle all of the following outdoor activities that you have participated in during the past year:
   a) fishing
   b) gardening
   c) boating
   d) hunting
   e) camping
   f) hiking/ walking
   g) snowmobiling
   h) horseback riding
   i) climbing
   j) skiing
   k) ice skating on lakes/ponds
   l) bicycling
   m) swimming in lakes/ponds
   n) other: ____________________________

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8. Circle all of the following outdoor activities that you want to participate in but have not had the opportunity to do so:
   a) fishing  
   b) gardening  
   c) boating  
   d) hunting  
   e) camping  
   f) hiking/walking  
   g) snowmobiling  
   h) horseback riding  
   i) climbing  
   j) skiing  
   k) ice skating on lakes/ponds  
   l) bicycling  
   m) swimming in lakes/ponds  
   n) other: __________________

9. In your home, how often do you sort bottles, cans, or newspapers to be recycled?
   a) always  
   b) very frequently  
   c) occasionally  
   d) infrequently  
   e) never

10. What do you usually do on a typical summer day?
    a) play a sport outside  
    b) go to a shopping center  
    c) play in a forest, by a lake, or in a field  
    d) play video games or watch TV/movies  
    e) other: __________________

11. How do you hear others describe people who care about the environment?
    a) they are radical and don't tell the whole truth  
    b) they are important protectors of wildlife and forests  
    c) they care about animals more than people  
    d) they are scientists researching environmental problems  
    e) other: __________________

12. How much have you learned about the environment in school this year?
    a) a great deal  
    b) a fair amount  
    c) not very much  
    d) not at all  
    e) unsure

13. Have you gone on school field trips to outdoor places?
    a) a great deal  
    b) a fair amount  
    c) not very much  
    d) not at all  
    e) unsure

14. Do you like learning about nature and the environment?
    a) a great deal  
    b) a fair amount  
    c) not very much  
    d) not at all  
    e) unsure

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15. How much do you know about the local animals and plants in the Waterville area?
   a) a great deal
   b) a fair amount
   c) not very much
   d) not at all
   e) unsure

   Part III. These questions ask you about your environmental knowledge.

16. Which of the following is a renewable resource?
   a) iron ore
   b) coal
   c) oil
   d) trees
   e) don’t know

17. There are many different kinds of animals and plants, and they live in many different types of environments. What is the word used to describe this idea?
   a) multiplicity
   b) biodiversity
   c) development
   d) evolution
   e) don’t know

18. How is most of the electricity in the US generated?
   a) by burning oil, coal, and wood
   b) by nuclear power
   c) by solar energy
   d) by dams or hydroelectric power plants
   e) don’t know

19. Which of the following is not biodegradable (will not break down in nature)?
   a) glass
   b) bread
   c) wood
   d) leaves
   e) don’t know

20. Ozone forms a protective layer in the earth’s upper atmosphere. What does ozone protect us from?
   a) acid rain
   b) global warming
   c) sudden changes in temperature
   d) harmful, cancer-causing sunlight (ultraviolet radiation)
   e) don’t know
21. What is the primary benefit of wetlands?
   a) to help keep the number of unwanted plants and animals low
   b) to increase flooding
   c) to provide good sites for landfills
   d) to help clean the water before it enters lakes, streams, rivers, or oceans
   e) don’t know

22. Which of the following animals is not found in Maine?
   a) Snowshoe hare
   b) Buffalo
   c) Blue Jay
   d) Beaver
   e) don’t know

23. Where does most of the garbage in the United States end up?
   a) oceans
   b) recycling centers
   c) incinerators - a furnace that burns waste
   d) landfills
   e) don’t know

24. What is the most common cause of pollution in streams, rivers, and oceans?
   a) dumping of garbage by cities
   b) waste dumped by factories
   c) surface water carrying dirt and pollutants from yards, streets, and farms
   d) trash washed into the ocean from beaches
   e) don’t know

25. What is the most common reason that an animal species becomes extinct?
   a) its habitat is destroyed by humans
   b) pesticides kill them
   c) over-hunting or over-fishing
   d) climate changes affect them
   e) don’t know

26. Where does your drinking water come from?
   a) the ocean
   b) a nearby lake
   c) ice and snow from the Arctic
   d) nearby wetlands
   e) don’t know

27. There is an unlimited supply of energy from fossil fuels (coal and oil)
   a) true
   b) false
   e) don’t know

Day One of the survey is finished. Please make sure your name is on the post-it note and hand in the survey to your teacher.
Environmental Awareness Survey
Environmental Studies Program, Colby College
March-April 2006

Day Two of Survey

This survey is about you and what you think about the environment. Please be as honest as possible. You will have one class period to finish this section of the survey. When you are finished, please staple both sections of the survey together, rip off the post-it note, and hand in the survey to your teacher.

Part IV. These questions ask your opinion about the environment.

28. In the United States, the environment is overall:
   a) in good shape
   b) in some trouble but can be improved with a little effort
   c) in bad shape but a lot of effort might save it
   d) in such bad shape that little can be done about it

29. Who should be responsible for making sure we have a healthy environment?
   a) industries
   b) governments
   c) environmental groups
   d) individual citizens
   e) all of the above

30. How concerned are you about pollution in Maine lakes and the rate of tree harvesting in Maine forests?
   a) very concerned
   b) somewhat concerned
   c) a little concerned
   d) not concerned
   e) unsure

31. How willing are you to do more to help protect the environment?
   a) very willing
   b) somewhat willing
   c) not very willing
   d) unwilling
   e) unsure

32. What is the main reason that prevents you from participating in activities to help protect the environment?
   a) I do not have enough time or money
   b) I do not know what I can do help protect the environment
   c) I do not want to help protect the environment
   d) I have not thought about helping to protect the environment before
   e) I participate in activities to help protect the environment

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33. Given the current concerns about the environment, describe your future?
   a) bright and hopeful
   b) challenging
   c) depressing
   d) uncertain
   e) neutral - I don't think environmental problems will affect my life.

34. In which area do you know the most about environmental problems?
   a) global issues such as stopping rainforest deforestation
   b) national issues such as managing national parks and wildlife refuges
   c) local issues such as cleaning up polluted lakes and rivers and protecting habitats
   d) a combination of global, national, and local issues

35. As the human population increases, more natural resources (such as food, water, and shelter) and jobs are needed. This process is called development. Which of the following should be the main concern when development plans are being considered?
   a) providing the most jobs
   b) ensuring that people's needs (money and environmental) are met into the future
   c) protecting ecosystems and animal habitat
   d) using less natural resources
   e) don't know

36. For each problem, circle a number based on how risky you think the problem is to the environment.
   1 = not risky at all
   2 = a little risky
   3 = moderately risky
   4 = very risky
   5 = high risk - needs immediate attention

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Part V. These questions ask you about your behaviors. There are no right or wrong answers.

Directions: for each question, choose which group of people that you are most like or agree with (pick group 1 or group 2). Once you have picked a group, circle whether you are very similar or similar to that group described.

GROUP 1 | GROUP 2
---|---
37. Some people like to leave the water running when they brush their teeth. but Other people always turn the water off when brushing their teeth.  
Very Similar | Similar  
Very Similar | Similar
38. Some people think plants and animals have as much right as humans to exist. but Other people don’t think plants and animals are as important as humans.  
Very Similar | Similar  
Very Similar | Similar
39. Some people don’t like to pick up litter and throw it away. but Other people like to pick up litter and throw it away.  
Very Similar | Similar  
Very Similar | Similar
40. Some people think we should be able to hunt and kill all wild animals. but Other people think that some wild animals should not be hunted and need protection.  
Very Similar | Similar  
Very Similar | Similar
41. Some people turn the lights off when they leave a room. but Other people leave the lights on when they leave a room.  
Very Similar | Similar  
Very Similar | Similar
42. Some people feel happy and relaxed outdoors (by a lake, in the forest, or in a field). but Other people don’t feel comfortable when they are outside.  
Very Similar | Similar  
Very Similar | Similar
43. Some people are concerned about the rainforest destruction. but Other people aren’t concerned about the rainforest destruction.  
Very Similar | Similar  
Very Similar | Similar
44. Some people throw their bottles and cans in the trash. but Other people sort their bottles and cans and recycle them.  
Very Similar | Similar  
Very Similar | Similar
45. Some people use a lot of chemicals and fertilizers to keep their lawns green. Other people try to use fewer chemicals and fertilizers on their lawns.

Very Similar  Similar

Very Similar  Similar

46. Some people think they should be able to buy as many things as they want. Other people think they should just buy things that they need.

Very Similar  Similar

Very Similar  Similar

47. Some people think the remaining forestland in Maine should be preserved. Other people think forests in Maine can be managed and used for resources.

Very Similar  Similar

Very Similar  Similar

48. Some people like to listen to the sounds of nature when they are walking outside. Other people like to listen to their music with earphones when they are walking outside.

Very Similar  Similar

Very Similar  Similar

49. Some people like to look at animals and plants outside and play in the forest (build forts or gardens). Other people don’t like to look at animals and plants and play in the forest because they will get dirty.

Very Similar  Similar

Very Similar  Similar

50. Some people think that new technologies will be found to solve environmental problems so there is no need to conserve energy and resources. Other people think that using less materials and energy will help solve environmental problems.

Very Similar  Similar

Contact: Jenna Morrison (jrmorris@colby.edu)

March 2, 2006

To the Colby College Internal Review Board,

I am writing on behalf of Jenna Morrison. She has developed a program she hopes to present to some of our students. This program includes having these participating students complete an anonymous survey and a follow-up lesson. The topic of this program is environmental awareness.

Jenna is working closely with the science teachers here to draft a parent informational letter. This letter will be sent home to the parents of each student affected as well as to be included in our monthly school newsletter. This is a passive approach to parent permission in that the parents will be informed they have the right to keep their child out of this program. Parents are also offered the opportunity to see the survey questions prior to its administration.

Our school administration uses this passive parental approach on similar types of programs that are non-sensitive and confidential, such as Jenna’s. Feel free to contact me if I can be of further assistance.

Sincerely,

Alice H. Hammond
School Counselor
APPENDIX C. Letter of passive parent consent sent to each eighth grade participant. A similar letter was sent home to each sixth grade student, with just the date of the survey changed.

Waterville Junior High School
120 West River Road
Waterville ME 04901
(207) 873-2144
Fax (207) 873-5752
"Creating Inviting Schools"

Peter Thiboutot, Principal
Douglas McEwen, Assistant Principal

Donna Riggs, Guidance Counselor
Alice Hammond, Guidance Counselor

Dear Parent or Guardian of Waterville Junior High School Student,

I will be working with Jenna Morrison, a Colby College student, to conduct an environmental awareness survey of students at Waterville Junior High. The survey is part of her senior honors project to interpret what students know about the environment and their opinions about different environmental issues. The survey is non-sensitive and anonymous. In addition to the survey, Jenna will teach a lesson about environment issues and how students can make important choices such as how to save energy. I support this activity and believe it will provide students with a fun opportunity to think about the natural world. The survey will be conducted during the third week of March.

Your child's participation is completely voluntary. Each child will be given the option of skipping any question that he or she prefers not to answer. If you do not wish your child to participate, please contact the school guidance office. Your child will also have an opportunity to decide not to participate on the day the survey is conducted and an alternative activity will be assigned. If you would like to view the questions that will be asked, you may do so by contacting the school guidance office to schedule a time prior to the survey administration date.

Sincerely,

Ricia Hyde
Science Department Lead Teacher
rhyde@fc.wtlk12.me.us

This research study has been reviewed and approved by the Institutional Review Board for Human Subjects in Research at Colby College. For research-related problems or questions regarding subjects' rights, the Institutional Review Board may be contacted through Thane S. Pittman, Ph.D., IRB Chair, Roberts 334, 207-859-5557.
## APPENDIX D. Survey Data

Table 1. Percent of each response and total number of responses for each question of sixth grade females and males. Asterisk indicates a significant difference (p< 0.05) between male and female responses.

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APPENDIX D. Survey Data (continued)

Table 2. Percent of each response and total number of responses for each question of eighth grade females and males. Asterisk indicates a significant difference (p<0.05) between male and female responses.

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APPENDIX D. Survey Data (continued)
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APPENDIX E. Data Analysis

Questions that contributed to each survey theme and the assigned value of each response. Note that not all questions are listed because some were not relevant to the themes of outdoor experience, environmental knowledge, environmental concern, or environmental behavior. Pro-environmental responses received higher ranks and anti-environmental responses received lower ranks.

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APPENDIX F. Survey Results Lesson Plan Used at Waterville Junior High School

Objectives

- **Rationale:** To increase students’ awareness about global and local environmental issues and promote active participation in environmental protection and conservation.
- **Lesson goal:** To learn about the current status WJH students’ environmental experience, knowledge, and behavior and increase their understanding of the correlation between population growth and energy resources and how their actions can have an impact.
  - To understand the process of participating in an environmental awareness survey
  - To understand the basic results and implications of the survey

Content and Instructional Activities

- **Introduction (5 min)**
  - What do you think the environment is?
    - The environment is everything around us- where we live
    - We will be talking about mostly the natural living and non-living things on the Earth (air, water, trees, and animals outside)
  - Why is the environment important?
    - Benefits to humans: provides materials for food, shelter, medicines, services (plants carbon dioxide to oxygen, water purification in wetlands), visual value
    - Animals and plants have a right to exist
  - Lesson objectives (write on the board):
    - To understand the results of the survey
    - To learn about population growth and energy resources
    - To think about how you can conserve energy

- **Environmental Awareness Survey and Results (10 min)**
  - How scientific method was applied to design, conduct, and evaluate the survey
    - What are the steps of the scientific method?
    - Question, Research, Hypothesis, Experiment, Analyze Data, Conclusions
  - Question: How environmentally aware are WJH students and what factors contribute to their environmental awareness?
  - Research: Environmental Education and Benefits of Children in Nature
  - Hypothesis: There is a relationship between:
    - Outdoor activities - Environmental knowledge
    - Outdoor activities - Environmental behavior
    - Environmental knowledge - Environmental behavior
  - Experiment: Design and conduct survey
  - Results: See page summary of results- (see Environmental Studies Unit Plan- Lesson 5)
• Introduction to Population and Energy Issue + Activity (20 min.)
  o The US population size is increasing (see Environmental Studies Unit Plan-Lesson 5). The current 2006 US population is around 298 million and the world population is 6.5 billion. The US with less than 5% of the world’s population, consumes over 25% of the world’s resources.
    ▪ Increasing population size increases the demand on energy resources.
    ▪ Energy such as heat, light, electricity, or motion can be produced by renewable or nonrenewable resources. A nonrenewable resource is a natural resource that is not replaced as it is used (fossil fuels coal, oil, natural gas). A renewable resource is a resource that is naturally replaced in a relatively short time (solar power, wind power, hydroelectric power—dams, wood).
  o Does the US use more nonrenewable or renewable energy? Energy Consumption Graph (see Environmental Studies Unit Plan-Lesson 5)
    ▪ The US is facing an eventual depletion of nonrenewable resources—it depend on how quickly and how much we use energy.
• Renew-A-Bean Activity- Population growth is contributing to the depletion of nonrenewable resources (see Environmental Studies Unit Plan-Lesson 5)
  o Action: What can you do in your house to help conserve energy (save money and cut down on pollution? (turn off the lights, turn down the heat, use fans instead of AC, insulation, energy efficient appliances)
• Evaluation and Closure (2 min.)
  o Do you think you would have done better on the environmental knowledge section of the survey after today’s lesson?
  o How many people are more interested in environmental issues after today’s lesson?
  o How will your behavior change after today’s lesson?
  o Environmental issues are always in the news. Talk to your parents and teachers about environmental issues when you hear about them.

Materials:
• 10 bags with 100 (92, 8) two colors of beans, data sheets, handouts (see Environmental Studies Unit Plan-Lesson 5)
Appendix G. Proposed Environmental Studies Unit Plan

Unit Rationale

The goal of this unit is to increase students’ awareness about global and local environmental issues and promote active participation in environmental protection and conservation. The unit will involve evaluating environmental knowledge and analyzing what influences environmentally aware citizens, which are key components for fostering future environmental sustainability. The unit will use an experiential education and multidisciplinary approach. Environmental awareness is essential as educators prepare students for local and global environmental challenges of the future. This unit is designed for sixth graders and 42-minute periods. However, it can be modified for any middle school grade level.

Unit Objectives

Students will evaluate their environmental awareness through a survey about their outdoor experience, environmental knowledge, environmental concern, and environmental behavior. They will receive the results of the survey and interpret their classmates overall degree of environmental awareness. Students will gain an understanding of a variety of environmental topics including energy, biodiversity, air pollution, water as a resource, and recycling. Students will understand the connection between the environmental and people, including issues of environmental justice and conservation actions that they can take in relation to the environmental topics covered. The unit will conclude with another survey to evaluate environmental knowledge and concern. Students will compare how their knowledge and concern has changed from completing the unit in a writing and creative project.
Unit Content

Surveying Environmental Awareness

- Surveys are an important technique to assess the status of environmental knowledge and attitudes and can be used at later times to provide an indication of the effectiveness of new environmental education programs (Richmond 1976).
- Direct interaction with natural habitats has been identified as one of the main influences leading to responsible environmental behavior in adults and children (Sobel 1996, EETAP 2002).
  - Place based education, increases students’ sense of stewardship and environmental consciousness and adds to their sense of attachment to place (Louv 2005).
- By looking at environmentalists, we can determine what fosters environmental behavior in adults.
  - As children, most environmentalists had opportunities to be in the natural world and had a responsible adult who modeled how to behave within the natural world (Sobel 1996).
  - Learning about the interrelationships between wildlife and humans can cultivate an appreciation and understanding of wildlife resources so as to foster wise stewardship (EETAP 2002).
- Survey Themes
  - The first theme was outdoor experience, which was defined as time spent outdoors, participation in a variety of outdoor activities, and comfort in natural places.
  - The second theme was environmental knowledge; questions were designed to test students’ knowledge of environmental topics such as energy, biodiversity, pollution, and natural resources.
  - The third theme was concern for the environment, which was evaluated by opinion questions such as desire to learn about environmental issues and degree of concern about specific environmental problems.
  - The fourth theme was environmental behavior, which was defined as actions that exhibit pro-environmental behavior such as recycling, and conserving electricity or water.

Analyzing Environmental Awareness Survey Results

- Sources of Environmental Knowledge
  - The National Environmental Education and Training Foundation (2005) reports that children get more environmental information (83%) from the media than any other source.
    - For most adults, the media is the only steady source of environmental information.
    - Most media provides opportunities for learning superficial information about the environment, but does not provide in-depth education (NEETF 2005).
• Environmental Knowledge
  o Eight of the 12 questions were modified from an adult environmental knowledge test on which only 55% of adults correctly answered half of the questions (NEETF 2005).
  o Local vs. Global Knowledge
    • Students seem to be losing their local sense of place because they are increasingly relying on electronic media (Sobel 1996).
    • Students often know less about local wildlife and environmental issues and more about global issues such as rainforest deforestation (Cardeiro and Sayler 1994, Sobel 1996).
    • Rural students also may have more knowledge of wildlife issues because of more frequent contact with wildlife, opportunities to be outside or exposure to hunting and fishing (Cardeiro and Sayler 1994).

• Environmental Behaviors
  o Correlation between recycling at home and spending time outside with adults as contributing to pro-environmental behavior (Morrison 2006)
  o Children learn from direct experience and from observing others. Participation with adults in activities such as recycling or nature walks provides children with the opportunity for observation and direct experience (Musser and Diamond 1999).
  o The main reported barriers to environmental action are lack of knowledge about what to do and lack of time (Louv 2005).
  o Study of middle school student's attitudes also found a perceived importance of the benefits of modern consumer goods rather than reducing consumption (Chan 1996).
    ▪ This response reflects the general patterns of over consumption in the US.

• Correlating Themes
  o For suggestions on how to analyze and correlate themes see Morrison 2006.
  o A higher level of environmental knowledge correlates significantly with a higher degree of pro-environmental behavior in adults (NEETF 2005).
  o As overall environmental knowledge increases, the likelihood of participating in some environmental activities also increases.
    ▪ Some studies have found the relationship between environmental knowledge and environmental behavior to be weak in children but strong in adults (Kuhlemeier et al. 1999, NEETF 2005).
    ▪ For example, environmentally knowledgeable adults are found to be 50% more likely to recycle and 31% more likely to conserve water (NEETF 2005).
    ▪ For children, environmental behavior is most heavily influenced by environmentally relevant activities in the home (Musser and Diamond 1999).
  o Junior high students are at a crucial stage between developing their own identity and still being influenced by their parents so either knowledge or home experience may have a greater influence on their behavior.
    ▪ Morrison (2006) found outdoor experience, rather than environmental knowledge was the greater predictor of environmental awareness and behavior in Waterville Junior High students.
    ▪ Nature experiences are key factors in fostering environmental stewardship. Girls and boys need to have outdoor, experiential, and
community based educational opportunities in order become more environmental aware citizens.

Air Pollution

- The mixture of gases surrounding the Earth is called "atmosphere."
  - Pollutants are what make the air dirty and cause pollution. Air pollution is caused by emissions from cars, trucks, factories, power plants, paints and chemicals used by consumers and businesses.
- Two pollutants, ozone and particulate matter, make up most of the air pollution in this country.
  - Ozone can be good or bad. It all depends on where it is. Ozone is good when it is high up in our atmosphere. It protects us from sunburn. Ozone is bad when it is near the ground where we can breathe it in.
    - You can't see ozone in the air. Bad ozone is sometimes called smog. It is formed when chemicals coming out of cars and factories are cooked by the hot sun. Ozone is more of a problem in the summer.
    - It is not healthy to breathe harmful ozone, in fact, bad ozone can burn your lungs - just like sun can burn your skin. Other symptoms include coughing, wheezing, chest pain and headaches.
    - Check out DEP's Ozone Action video! Targeting children in grades 3-5, this short video uses the "Spy Kids" theme to teach students about the health effects of ground-level ozone and how to reduce air pollution.
  - Have you ever noticed a sunbeam with lots of little specks of dust floating in it? That is particulate matter. Some particles are so small that you can't even see them - these are the ones that can penetrate deep into your lungs.
    - Particulate matter is mostly dust and soot so small that it floats in the air. These particles come from anything being burned. Trucks and tractors, power plants, and wood-burning stoves make a lot of these small particles.
    - Soot and dust make the air look hazy. Many of the country's most scenic areas are affected by this man-made haze.
    - Some particles in the air are so small you can't see them. It is not good for you to breathe in too much of this tiny particulate matter. Particles in the air can make you cough. Particulate matter can also make it hard for you to take a deep breath and you might get more colds. If you already have asthma or problems with your heart, particulate matter could make you sick enough to go to the hospital.
    - To reduce exposure to particulate matter, don't play near streets with heavy traffic. Heavy traffic areas are highways and busy streets where there are a lot of cars, buses, and trucks.
- Although much of the pollution in our air comes from power plants, industrial sources, automobiles, and trucks, each one of us can do our own little part to make our air cleaner. We can all work together to make small, simple changes in our daily activities to help improve overall air quality and public health.
  - The DEP monitors air quality in many areas constantly! The DEP uses color to tell you about the quality of the air you are breathing - this is called the Air Quality Index. To see if the air quality in your area is monitored visit www.aqpartners.org
  - Indoor air quality can also affect your health.
There are many sources of indoor air pollution in any home. These include combustion sources such as oil, gas, kerosene, coal, wood and tobacco products; building materials and furnishings; products for household cleaning and maintenance, personal care or hobbies; central heating and cooling systems and humidification devices; and outdoor sources such as radon and pesticides.

For example, you can't see, smell or taste radon, but it is a gas that is harmful to your health. Radon can be found in buildings, such as homes, offices and schools. One way radon can get into buildings is by cracks in the basement, and if the ventilation is not good enough, radon levels can be harmful. Visit our section on Radon to learn more.

To learn more about other sources of indoor air pollution, visit the Environmental Protection Agency's website.

Water

- Water Cycle: Water has been used over and over and over for millions of years.
  - There is no telling where the water you brushed your teeth with today was 1,000 years ago or even 300 million years ago! It could have been part of a pool of water that a dinosaur drank from.
  - Water is used over and over or "recycled" through what is called the water cycle. The water cycle never stops, so it doesn't really have a starting point. (Diagram of Water Cycle, see Unit Instructional Activities Lesson 4)
    - When moisture in the atmosphere condenses and falls to the earth as snow or rain, we call it "precipitation." Some of the rain or snow will soak into the earth. That's what becomes groundwater. Groundwater is the water located under the surface of the earth.
    - The underground pockets where groundwater collects are called "aquifers". A lot of the water we drink and farmers use on their farm comes from aquifers. They can provide water for homes, farms or making electricity! The water that doesn't soak into the ground either "runs off" and joins creeks and rivers or oceans, or evaporates into the atmosphere.
    - Trees and plants use much of the precipitation to grow. They absorb the water through their roots and then release it back into the air as water vapor. This is called "transpiration." The groundwater the plants didn't use, flows through the earth until it comes back out to the surface to such places as springs, wells, creeks or lakes. Then it is the surface water, which flows to the ocean and also gradually evaporates back to the atmosphere.
  - A watershed is an area of land where all the water (surface and groundwater) flows to the lowest point — usually a stream, lake or river. (Diagram of Watershed Processes, see Unit Instructional Activities Lesson 4)
    - Imagine your bathtub is a watershed and the drain is a river. Any water that falls inside the tub (watershed) will eventually go down the drain (river) carrying dirt and soap with it. The high sides of the tub (like mountains and hills) keep the water from ending up on the floor (or in other watersheds).
    - What you can do to protect your watershed
      - Always pick up after your pet!

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• Be aware of how much water you use. Think of ways to conserve!
• Never throw trash on the ground. Make sure to put it in the trash, and remember to recycle when you can.
• Convince your parents to drive less. Try to plan trips to the store, school and gas station or other places in the same area so you waste less gas and time. The shorter the trip, the less air pollution.
• Ask your parents to wash the car in the yard, where suds can absorb into the soil, and water the grass all at the same time!
• Tell your parents to never use fertilizer or other items with chemicals especially before it rains. Use natural fertilizers like manure, mulch, or compost.
• Plant some trees or grass next to the stream in your watershed. These plants will help keep the dirt in place and out of the stream. They will also help catch some of the bad chemicals that can get washed into streams.

Drinking Water- Drinking water begins its journey to homes, schools and businesses from either a surface water source or a groundwater source.
  o Surface water sources are streams, rivers and lakes. They are on the surface of the land and are exposed to the air, rain and water flowing downhill from land near the source.
  o Groundwater is in the ground, not on top of it. We pull it up from wells drilled into the ground. Most groundwater comes from rain and melting snow soaking into the ground. Water fills the spaces between rocks and soils, making an “aquifer.”
  o About half of our nation’s drinking water comes from ground water. Most is supplied through public drinking water systems, though many families rely on their own wells.
  o Public drinking water systems pump water through an underground network of pipes to homes, schools and businesses. Big pipes deliver water to each neighborhood, and then the water is split into medium pipes for each street and into smaller pipes for each home, school or business.
  o Drinking water in a public water system is treated to make sure it is safe to drink before it enters all those pipes. Surface water treatment plants filter the water to remove particles of dirt, minerals, microorganisms and other stuff you wouldn’t want in your glass of water.
  o The water from public water systems using surface water or groundwater is then disinfected to kill dangerous germs. Chlorine is a chemical commonly used to disinfect water supplies.
  o Families that use their own drinking water wells have to make sure the water is clean and safe to drink.
  o Between 70 and 75 percent of the Earth’s surface is covered with water, but only 1 percent of all the world’s water can be used for drinking. Nearly 97 percent of the world’s water is salty or otherwise undrinkable. Another 2 percent is frozen in ice caps and glaciers, leaving only 1 percent to drink.
  o It is difficult and expensive for people to produce more fresh water to drink, so each one of us needs to conserve our precious resource.

Drinking Water- Global Rights
  o The General Comment on the right to water, adopted by the Covenant on Economic and Cultural Rights (CESCR) in November 2002, is a milestone in the history of human rights.
• For the first time water is explicitly recognized as a fundamental human right and the 145 countries which have ratified the International CESCR will now be compelled to progressively ensure that everyone has access to safe and secure drinking water, equitably without discrimination.
• The General Comment states that: "the human right to water entitles everyone to sufficient; affordable; physically accessible; safe and acceptable water for personal and domestic uses". It required governments to adopt national strategies and plans of action which will allow them to "move expeditiously and effectively towards the full realization of the right to water".

• Drinking Water - Supply and Sanitation
  o Estimations of yearly funding requirements for water supply and sanitation range between US$ 20 and 55 billion. In comparison, US$17 billion is yearly spent in USA and Europe on pet food; in Europe, US$105 billion is spent annually on alcoholic drinks.
  o 1.1 billion people lack access to improved water supply and 2.4 billion to improved sanitation.
    ▪ Those who lack adequate and affordable water supplies are the poorest in society.
    ▪ Despite the fact that promises have been made during the past 10 years and despite the fact that the right to water has been internationally recognized as a human right, one sixth of the world population is still without water and two fifths are without sanitation.
  o Global Sanitation (Map of Global, see Unit Instructional Activities - Lesson 4).
  o There are a large number of deaths, mostly of children, that are largely preventable through water/hygiene-related measures, as well as deaths from water-related vector-borne diseases.
    ▪ They result in millions of cases of ill-health every year and affect the physical, social and economic well-being of populations.
    ▪ Some 6,000 children die every day from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene.
  o In many countries throughout the world, schools for example have very poor sanitation environments.
    ▪ In such circumstances, schools become unsafe places where diseases are easily transmitted.
    ▪ About 40% of the world's 400 million school-age children are infected with intestinal worms, and diarrhea resulting from poor sanitation and hygiene is responsible for more than 2 million deaths per year.
    ▪ About 1 in 10 school-age African girls do not attend school during menstruation or drop out at puberty because of the lack of clean and private sanitation facilities in schools.
    ▪ The average distance that women in Africa and Asia walk to collect water is 6 km. The weight of water that women in Africa and Asia carry on their heads is the equivalent of your airport luggage allowance (20kg).
  o By 2050 at least one out of four people is likely to live in countries affected by chronic or recurrent shortages of freshwater.
    ▪ According to the World Water Development Report, the poorest countries in terms of water availability are Kuwait, Gaza Strip, and Bahamas.
• Drinking Water - Bottled Water
  o The world bottled water market represents an annual volume of 89 billion liters, and is estimated to be worth US$ 22 billion.
  o More than half (59%) of the bottled water drunk in the world is purified water, the remaining 41% being spring or mineral water.
    ▪ Poland Spring Bottled Water from Maine
    ▪ While bottled water originates from protected sources (75 percent from underground aquifers and springs), tap water comes mostly from rivers and lakes.
  o Changes in ways of life explain the increase in bottled water sales. Increasing urbanization, causing tap water quality to decline, can explain this situation.
    ▪ Increasing standards of living and greater use of cars enable people to bring home without pain a higher number of heavy and expensive bottled water: the price of bottled water is an average 500 to 1000 times higher than the one of tap water.
    ▪ Consumers think it tastes better than tap water (no chlorine taste), they perceive it as being safer and of better quality.
  o Global Bottled Water Consumption (Graph of Consumption, see Unit Instructional Activities - Lesson 4).

• Safety and Health
  ▪ Tap water may be contaminated by a range of chemical, microbial and physical hazards.
  ▪ However, some substances may prove more difficult to manage in bottled than in tap. This is because bottled water is stored for longer periods and at higher temperatures than water distributed in piped distribution systems. Some microorganisms that are of little or no public concern may grow to high levels.
  o Tap water is and should remain a public service meant to deliver good quality drinking water.

• What you can do to help?
  o The best way is to pay attention to how you are using water.
    ▪ Be careful not to waste it or pollute it.
    ▪ One important thing each of us can do to conserve water is to not let the faucet run longer than necessary. For example, turn off the faucet while brushing your teeth. Then use a glass of water for rinsing your mouth. There’s no need to leave it running, so turn it off! If you notice a faucet is dripping, ask your parents to fix it.
    ▪ Don’t use the toilet as a trash can. That wastes water and may pollute it, too. If you have chemicals, old medicines or anything else you aren’t sure whether it is safe to put into a toilet, ask an adult how to dispose of them properly.

Energy

• Energy is the ability to do work.
  o Oil, coal, natural gas, wind, water – just to name a few - provide us the energy we need in our daily lives. For example, we use oil to produce gasoline for our cars. We use natural gas, coal, solar and wind power to generate electricity that makes the computer you are using work!
Energy is very important in today's world. For example, we use different energy sources to generate the electricity we need for our homes, schools, businesses and factories. Electricity "powers" our TVs, computers, air conditioners, cell phones and washing machines — just to mention a few. We also use energy to run cars, planes, trains, buses and motorcycles.

Energy such as heat, light, electricity, or motion can be produced by renewable or nonrenewable resources. A renewable resource is a resource that is naturally replaced in a relatively short time (solar power, wind power, hydroelectric power —dams, wood). A nonrenewable resource is a natural resource that is not replaced as it is used (fossil fuels coal, oil, natural gas).

- Solar energy comes from the light of the sun and can be used to create pollution free electricity.
  - How does solar energy work? When the sun shines on "solar cells," they absorb its energy causing a chemical reaction that generates electricity. The electricity generated by solar cells or photovoltaic system can be used at homes or factories or it can be stored in a battery.
  - Simple photovoltaic systems power many of the small calculators and wristwatches used everyday. More complicated systems provide electricity to pump water, power communications equipment, and even provide electricity to our homes.
  - For example, solar energy is commonly used for domestic lighting, street lighting, water pumping and railway signals just to mention a few.

- Hydropower is energy from water sources such as the ocean, rivers and waterfalls.
  - Because the source of hydropower is water, hydroelectric power plants must be located on a water source. Electricity is produced by directing or channeling moving water to power electric generators. The flow or fall of the moving water determines the amount of energy available. There is a new technology on the horizon called Microhydro. It uses smaller water flows such as water flowing out of abandoned mines to run small generators. These small generators can then power equipment on remote sites to help treat the pollution in the abandoned mine water flow.

- Wind power in its most basic form, is taking the breezes and winds that you feel on your face or that cause a flag to flap and converting it into energy. It has been used for hundreds of years for sailing, grinding grain, and for irrigation.
  - A wind turbine turns wind into electricity. It consists of a nacelle, rotor, tower, foundation and transformer. The wind turns the rotor of the wind turbine. The rotor turns a generator (a dynamo), which makes electricity

- Earth's heat is called geothermal energy.
  - Geothermal direct use dates back thousands of years, when people began using hot springs for bathing, cooking food, and loosening feathers and skin from game. Today, hot springs are still used as spas. But there are now more sophisticated ways of using this geothermal resource. In modern direct-use systems, a well is drilled into a geothermal reservoir to provide a steady stream of hot water. The water is brought up through the well, and a mechanical system delivers the heat directly for its intended use.
  - Geothermal hot water can be used for many applications that require heat. Its current uses include heating, raising plants in greenhouses, drying crops, heating water at fish farms, and several industrial processes, such as pasteurizing milk.

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Biomass is a renewable energy source from wood, manure, garbage and agricultural waste.

- Biomass has been used for hundreds of years to produce heat. People have used wood—a form of biomass—to heat their homes for centuries. Now, with new technology available, biomass can be used to generate electricity and cleaner fuels. When biomass is burned, energy is released as heat that can be transformed into electricity or fuel.

- Garbage or municipal solid waste can be a source of energy by burning it in special power plants or by capturing the gases it releases. When trash is burned at special waste power plants, it produces steam that can be used either to heat buildings or to generate electricity. If you would like to learn more about how this process work click on the following link: A Report from Energy Ant - My Trip to Baltimore RESCO Trash-to-Energy Plant.

- Manure can also be turned into electricity. Farmers can use the manure of cows, pigs or chickens to produce electricity for their farms. When manure is collected and put into a large digester, methane gas is separated from the liquid and solid waste. The methane gas can then be used to generate electricity and the remains can be used to produce fertilizer!

- Biodiesel is an alternative fuel for diesel engines—cars, buses and trucks—derived from natural oils—like soybean oil or animal fats. Biodiesel is usually blended with petroleum diesel to create cleaner fuels. Vehicles that use biodiesel emit less pollution. It also helps us lessen our dependence on foreign oil because we can grow soybeans on our farms! If you would like to learn more about biodiesel, visit the National Biodiesel Board website.

- Other crops, such as corn and sugar cane, can be used to produce ethanol. Ethanol is a colorless liquid that is distilled from agricultural crops—usually corn. It is a renewable alcohol based fuel that can be mixed with gasoline. A blend of 10 percent ethanol with gasoline is considered an oxygenated fuel. Using ethanol in gasoline means we don't burn quite as much fossil fuel in our cars. It is cleaner than traditional gasoline and, since we grow our own corn, it reduces our dependence on fuels from other countries. DEP has several fleet vehicles that are designed to run on 85% ethanol, 15% gasoline to further reduce our dependence on oil.

Almost all oil and natural gas are found deep underground in tiny holes in rocks. Millions of years ago, the remains of plants and animals decayed and built up in thick layers. Over time, this organic material changed into coal, oil and natural gas.

Oil is a smelly liquid that is usually found in underground areas called reservoirs. Crude oil comes in many forms. Usually it is black, but green, red or brown oils are not uncommon. After crude oil is removed from the ground, it is sent to a refinery where different parts of the crude oil are separated into usable petroleum products.

- Some products made from petroleum include gasoline, diesel, crayons, dishwashing liquids, deodorant, tires, plastics etc.

Natural gas is usually found underground near an oil source. It is a mixture of light hydrocarbons including methane, ethane, propane, butane, and pentane. This gas is lighter than air and is highly flammable. Because natural gas
colorless, odorless and tasteless, a chemical that has a sulfur-like odor is added before distribution, to give it a distinct unpleasant odor. This serves as a safety device by allowing it to be detected in cases where leaks occur.

- Natural gas is the cleanest burning fossil fuel. The gas companies collect it in huge storage tanks, or underground, in old gas wells. The gas remains there until it is added back into the pipeline when people begin to use more gas, such as in the winter to heat homes. Natural gas is an essential raw material for products such as plastics, medicines, paints and fertilizers.

- Coal is by far the most abundant fossil fuel on earth. It is mainly used as a combustion fuel. The large-scale use of coal began with the Industrial Revolution in the 19th century. As the number of industries increased, demand for more sources of energy grew.
  - There are three main types of coal: lignite, bituminous, and anthracite. Lignite and bituminous have a lesser percentage of carbon in them and therefore burn faster. They release a great deal of pollutants into the atmosphere. Anthracite has about 98 percent carbon and therefore burns slowly and releases much less smoke.
  - Power plants burn coal to generate electricity. When coal is baked in hot furnaces, it is used to smelt iron ore into iron needed for making steel. Coal can also be used to produce plastics, tar, synthetic fibers, fertilizers and medicine.

- Nuclear energy is energy that comes from the nucleus (core) of an atom. Atoms are the particles that make up all objects in the universe. Atoms consist of neutrons, protons, and electrons.
  - The fuel most widely used by nuclear power plants for fission is uranium. Uranium is the heaviest of the 92 naturally occurring elements and is classified as a metal.
  - Uranium was formed when the earth was created and is found in rocks all over the world. Rocks that contain a lot of uranium are called uranium ore, or pitch-blend. Uranium, although abundant, is a nonrenewable energy source.

- Population Growth and Energy Consumption
  - The US population size is increasing (see Instructional Activities Lesson 5). The current 2006 US population is around 298 million and the world population is 6.5 billion. The US with less than 5% of the world's population, consumes over 25% of the world's resources.
    - Increasing population size increases the demand on energy resources.
  - US Energy Consumption Graph (see Instructional Activities Lesson 5)
    - The US is facing an eventual depletion of nonrenewable resources- it depend on how quickly and how much we use energy.

- Why is it important to conserve energy?
  - All of us use energy every day - for entertainment, cooking, transportation, lighting, heating and cooling homes, manufacturing, etc. We consume a lot of energy. The United States consumes about one fourth of the world’s energy resources.
    - When energy is produced from non-renewable fuels, to heat our homes or power our cars for example, pollutants are released into the air contaminating the air we breathe and water too. The more energy we use
or miles we drive in our cars, the more energy power plants must produce or gasoline our cars burn, releasing more pollutants into the air.

- By conserving energy we can lower the amount of pollutants we release into the air and water and thereby help to keep our environment clean. Additionally, if we use less energy we can save money on our electric bill or reduce the amount of money we spend on gasoline. So you can help the environment and save money at the same time!
- Additionally, we can use energy sources that are clean and efficient. For example, wind and solar energy generate electricity without polluting the air. Another example is soybeans, which we can use to produce biodiesel. Biodiesel can be blended with regular diesel fuel or used all by itself to fuel tractors, buses and trucks. These types of energy are friendly to our environment and help us reduce our dependence on fossil fuels such as oil and coal, which cannot be replenished.

Recycling

- You probably help with recycling at home or know something about it. You may have even seen the triangular loop of arrows on beverage containers that lets you know those containers can be recycled. Each of the three represents a step in the recycling process: collection, processing and making recyclables into new products. Keeping recyclable items inside the Recycling Loop keeps them out of landfills and reduces pollution.
  - Recycling means taking materials from products you have finished using and making brand new products with them. For example, most of the aluminum cans in the United States are made with recycled aluminum. So if you drink juice or soda from a can, recycle that can instead of throwing it in the trash. That can will stay in the Recycling Loop and out of the landfill.
    - Making new things from recycled ones takes less money, less energy, and less of the Earth’s resources. Because less energy is used, factories don’t release as much pollution either.
    - Recycling starts with people separating recyclable materials from their other trash. The separated recyclable materials are collected by recycling programs, processed and then sold to manufacturers for use in new products.
  - Aluminum and steel cans, cardboard, glass, newspapers and plastic bottles are all recyclable. These items can be made into new products including cans that hold food and drinks, the steel used to build skyscrapers and school buses, cardboard boxes, glass jars and bottles, newspaper and office paper, plastic laundry detergent bottles and even playground equipment!
    - Also, food scraps from home or cafeterias at school can be separated rather than put in the trash. The scraps can then be turned back into nutrients that help plants grow through a process called composting, which accelerates the natural decay process. Yard waste, such as grass clippings, leaves and small tree limbs, can be converted through composting into mulch to help gardens grow.
  - The best way to reduce the amount of trash you generate is to be a careful shopper. Don’t buy more than you need, especially if the product can go bad over time.
• As a consumer, you have purchasing power. As more and more people buy products that are reusable, refillable or concentrated, manufacturers will take notice and produce more of these Earth friendly products.

  o Other ways to reduce your trash output
    • Buy products in bulk or larger containers rather than multiple small containers.
    • Use a sponge rather than disposable towels.
    • Buy concentrates.
    • Buy fresh fruits and vegetables without packaging.
    • Avoid products with excessive packaging.
    • Repair, rather than replace, broken items.
    • Donate unwanted materials to charity.

• Reuse means just what it sounds like: using something again rather than throwing it out. That usually means finding a new use, such as making a jelly jar into a drinking glass.
  o Reuse conserves the energy and raw materials needed to make new products, and doing so saves energy and reduces the amount of pollution factories release into the air and water. By recycling or reusing plastic, metal, or glass items, you can reduce the need to mine, transport, and manufacture natural resources to make new products.

• Your trash is picked up by a collection truck and taken either to a landfill or a waste-to-energy incinerator. Currently, in the United States, about 26 percent of the waste generated is recycled or composted, 8 percent is burned at incinerators, and the remaining 66 percent is disposed of in landfills.
  o A landfill isn’t just a pile of trash buried in the ground. Landfills are carefully designed to prevent waste from mixing with groundwater and to reduce odors. Most landfills have a thick plastic liner between the ground and the trash, and a layer of soil is added every day to cover up the trash on top. Materials deposited in a landfill do not decompose quickly (Diagram of a Landfill, see Unit Instructional Activities- Lesson 6).
  o Some trash is burned in a controlled process called waste-to-energy incineration. Incinerators, when properly equipped, can convert water into steam to fuel heating systems or generate electricity. Methane gas generated by decomposing garbage at landfills can also be captured and used to generate electricity.

• Litter is trash of any type thrown where it doesn’t belong. Litter is chewing gum wrappers, cigarette butts tossed on the ground or a broken washing machine pushed down a rural hillside.
  o Littered roadways, properties and illegal dumps cost Pennsylvania millions of dollars each year in cleanup costs. Littering and illegal dumping also scar communities and make people sad. No one wants to live surrounded by litter.
    • Some types of trash are dangerous and need to be disposed of in special ways. Old paints, pesticides, pool chemicals, cleaning chemicals, fluorescent lamps, mercury thermometers, batteries and electronic equipment can contaminate our lands, water and air if they are placed in the regular trash stream, or worse yet, poured down the drain or dumped outside.
    • The best way to manage these household hazardous wastes is to avoid creating them. Pick the least dangerous product to do the job, and then buy only as much as you need. If you have extra, try to give it to someone who needs it. If you have to dispose of hazardous waste, check with your town or county to see if there is a local household hazardous waste collection program.
Environmental Justice

- Principles of Environmental Justice:
  - Environmental justice affirms the sacredness of Mother Earth, ecological unity and the interdependence of all species, and the right to be free from ecological destruction.
  - Environmental justice demands that public policy be based on mutual respect and justice for all peoples, free from any form of discrimination or bias.
  - Environmental justice mandates the right to ethical, balanced and responsible uses of land and renewable resources in the interest of a sustainable planet for humans and other living things.
  - Environmental justice calls for universal protection from nuclear testing, extraction, production and disposal of toxic/hazardous wastes and nuclear testing that threaten the fundamental right to clean air, land, water, and food.
  - Environmental justice affirms the fundamental right to political, economic, cultural, and environmental self-determination of all peoples.
  - Environmental justice demands the cessation of the production of all toxins, hazardous wastes, and radioactive materials, and that all past and current producers be held strictly accountable to the people for detoxification and containment at the point of production.
  - Environmental justice affirms the right of all workers to a safe and healthy work environment, without being forced to choose between an unsafe livelihood and unemployment. It also affirms the right of those who work at home to be free from environmental hazards.
  - Environmental justice protects the right of all victims of environmental injustice to receive full compensation and reparations for damages as well as quality health care.
  - Environmental justice must recognize a special legal and natural relationship of Native Peoples to the U.S. government through treaties, agreements, compacts, and covenants affirming sovereignty and self-determination.
  - Environmental justice affirms the need for urban and rural ecological policies to clean up and rebuild our cities and rural areas in balance with nature, honoring the cultural integrity of all of our communities, and providing fair access for all to the full range of resources.
  - Environmental justice calls for the strict enforcement of principles of informed consent, and a halt to the testing of experimental reproductive and medical procedures and vaccinations on people of color.
  - Environmental justice calls for the education of present and future generations which emphasizes social and environmental issues, based on our experience and an appreciation of our diverse cultural perspectives.
  - Environmental justice requires that we, as individuals, make personal and consumer choices to consume as little of Mother Earth’s resources and to produce as little waste as possible; and make the conscious decision to challenge and re-prioritize our lifestyles to insure the health of the natural world for present and future generations.
Unit References


Unit Instructional Activities

- Environmental Awareness Survey (Lesson 1)
- Graphing Results of Environmental Awareness Survey (Lesson 2)
- Air Pollution in Maine- Environment Justice (Lesson 3)
- Smokestack Air Pollution Activity (Lesson 3)
- Global Water Supply and Sanitation- Environmental Justice (Lesson 4)
- Daily Water Use- website (Lesson 4)
- Acid Lakes Game- website (Lesson 4)
- Renew-A-Bean Energy Activity (Lesson 5)
- How Energy Efficient Are You? - website (Lesson 5)
- Trash: Myth or Fact- website (Lesson 6)
- Recycle City- website (Lesson 6)
- U Pick: Reduce, Reuse, Recycle (Lesson 6)
- Biodiversity: People and Wildlife (Extra Activity)

For detailed description of instructional activities, see lesson plans and instructional aids sections.
Unit Evaluation

• Evaluation Discussion
  o Do you think you would have done better on the environmental knowledge section after this unit?
  o How many people are more interested in environmental issues after this unit?
  o How will your behavior change after this unit?
  o Environmental issues are always in the news. Talk to your parents and teachers about environmental issues when you hear about them.

• Writing Assignment: Compare your first survey to your second survey. How did the results change? Did you gain more environmental knowledge? Are you more interested in learning about the environment?

• Home Assignment: Creative project on one of the environment topics (air pollution, water, energy, recycle) showing what conservation actions individuals can take.
  o Examples: poem, poster, collage
LESSON 1: Environmental Awareness Survey
(2 class periods)

Objectives:

• To participate in an environmental awareness survey.
  o Survey results will be compiled anonymously but students will receive their survey back at the end of the unit for their evaluation.
  o To understand and follow the survey directions

Content:

• See Unit Content: Surveying Environmental Awareness

Instructional Activities:

• Introduction to Environmental Studies Unit (5 min.)
  o Use a current environmental issue to explain why the environment is important to study
  o Ask students to describe examples of environmental issues in their area
  o Write the unit outline on the board (3 min.):
    ▪ Survey environmental awareness
    ▪ Analyze survey results
    ▪ Introduction into environmental topics (air pollution, water, energy, recycling)
    ▪ Re- take the survey
    ▪ Home Assignment: Creative Project showing conservation actions for one of the environmental topics covered

• Explain survey directions (2 min.)
  o Explain why surveying environmental awareness is important
  o In class today and tomorrow, you will be participating in an environmental awareness survey. Your parents or guardian have been notified about your participation in this project. I would like to highly encourage you to take part in this survey but it is your choice to participate. If you are confused about any directions please raise your hand. Please write your name on the small yellow post-it note on top of the survey. Tomorrow you will be given the same survey back and the second half of the survey to complete. After you finish the survey tomorrow, staple the two parts of the survey together. Thanks for your participation.
  o Students should do independent reading when they finish the survey each day
  o NOTE: the survey should be divided into two sections and each section distributed on consecutive days. The post-it-note with the student’s name is necessary to make sure that students could compile both sections of the survey together on the second day.

• Take Part 1 of Environmental Awareness Survey (30 min.)
Closure:
• Remind students that you will comply the survey results and they will analyze the survey results tomorrow (2 min.)

Materials:
• Handout: Environmental Awareness Surveys (see Unit Instructional Activities-Lesson 1)

Day Two of Survey:
• Remind students they are finishing Environmental Awareness Survey (5 min)
  o Hand part two of the survey to students
  o Explain directions to question 36 and part 5 of survey using a practical example not on the survey
• Take Part 2 of survey (30 min.)
  o Have students staple their part 1 and part 2 surveys together (5 min.)
LESSON 2: Results of Environmental Awareness Survey
(2 class periods)

Objectives
• To learn about the current status of students’ environmental experience, knowledge, and behavior
  o To understand the process of participating in an environmental awareness survey
  o To understand the basic results and implications of the survey

Content:
• See Unit Content: Analyzing Environmental Awareness Survey Results

Instructional Activities:
• Have students write down their definition of the environment and why the environment is important (5 min)
• Discuss their responses (5 min)
  o What do you think the environment is?
    ▪ The environment is everything around us - where we live
    ▪ We will be talking about mostly the natural living and non-living things on the Earth (air, water, trees, and animals outside)
  o Why is the environment important?
    ▪ Benefits to humans: provides materials for food, shelter, medicines, services (plants carbon dioxide to oxygen, water purification in wetlands), visual value
    ▪ Animals and plants have a right to exist

• Discuss results of Environmental Awareness Survey (25 min)
  o How scientific method was applied to design, conduct, and evaluate the survey
    ▪ What are the steps of the scientific method?
    ▪ Question, Research, Hypothesis, Experiment, Analyze Data, Conclusions
  o Question: How environmentally aware are students and what factors contribute to their environmental awareness?
  o Research: Environmental Education and Benefits of Children in Nature
  o Hypothesis: There is a relationship between:
      Outdoor activities - Environmental knowledge
      Outdoor activities - Environmental behavior
      Environmental knowledge - Environmental behavior
      Environmental concern - Environmental behavior
  o Experiment: Design and conduct survey
  o Results: Hand out summary of results (see Unit Instructional Activities - Lesson 2) and go over results
• Explain correlations to students: outdoor experience influences environmental concern, activities at home influence environmental behavior

• Have students analyze the data—drawing graphs (30 min.)
  o Hand out sheet summaries of raw data (see Unit Instructional Activities—Lesson 2).
  o Sources of environmental information as bar graph
    ▪ School, outdoor activities, internet, personal reading, talking with friends/people, TV/movie, talking with parents, newspaper, radio, other
  o Graph of knowledge results by question (each question should have a bar for number of students who correctly and incorrectly answered question)
    ▪ renewable resources, biodiversity, energy generation, biodegradability, ozone layer, benefit of wetlands, local wildlife, garbage storage, water pollution, animal extinction, source of drinking water, supply of fossil fuels
  o Graph of behavior results by question (each question should have a bar for number of students who showed pro-environmental and anti-environmental responses)
    ▪ Water conservation, animal rights, litter clean up, limit hunting, electricity conservation, positive attitude outdoors, rainforest concern, recycling, minimizing lawn chemicals, limit consumption, preservation of forest, hearing nature, playing outside, confidence in technology

• Discuss what the graphs show and why (10 min.)
  o See Unit Content: Analyzing Environmental Awareness Survey Results
    ▪ Sources of knowledge—school, media, outdoor activities
    ▪ Environmental Knowledge—compare to adult knowledge of environmental issues and degree of local knowledge
    ▪ Environmental Behavior—local vs. global concern, consumption

Evaluation:
• Have the students discuss the results in small groups (5 min.)
• Each group should report one result and their hypothesis for that result to the rest of the class (10 min.)
• Student should hand in three properly labeled graphs—can be finished for homework

Closure:
• Discuss why environmental awareness is important (2 min.)
• Nature experiences are key factors in fostering environmental stewardship
• Environmental concern fosters pro-environmental behavior
  o This unit will hopefully increase your concern about environmental issues and understanding of how you can act on behalf of the environment

Materials:
• Handout: Survey Results Summary (see Unit Instructional Activities—Lesson 2)
• Handout: Raw Survey Data (see Unit Instructional Activities—Lesson 2)
• Graph paper and colored pencils
LESSON 3: Pollution
(1.5 class periods)

Objectives:
• To understand what air pollution is and what are sources of air pollution
  o To understand how air pollution affects people and the environment
• To understand how sources of air pollution contribute to range of air pollution
  o To measure and determine the area of a circle

Content:
• See Unit Content: Air Pollution and Environmental Justice

Instructional Activities:
• Background information about air pollution (9 min.)
  o What is air pollution?
    - Pollution is any change to the environment that has a negative effect on living things. Pollution is often generated by human activities.
  o Types of air pollution and sources
  o How air pollution affects the environment and our health

• Environmental Justice and Air Pollution in Maine (20 min.)
  o Discuss how sources of pollution or heavily polluted areas are often correlated with poor/working class communities or communities of color (see The Quest for Environmental Justice: Human Rights and the Politics of Pollution by Robert Bullard 2005 for more information)
  o Particulate Matter
    - Correlation with diesel bus stops and working class communities
    - View maps of 1990 Diesel Particulate Matter Concentrations Across Maine’s Census Tracts
      - http://www.weact.org/gis/metadata/map-29.html (State of Maine)
      - http://www.weact.org/gis/metadata/map-30.html (Lower one-third of Maine- including Waterville as an area of highly concentrated particulate matter pollution)
    - Particulate matter pollution can lead to respiratory illnesses
  o Power plants and factories that burn coal and oil produce nitrogen oxides and sulfur oxides. These gases react with air and form acids which fall with rain
    - Acid rain collects in lakes and many fish cannot survive in more acidic water.
    - Factories have tried to get rid of the air pollution by making their smokestacks taller. Several decades ago, factories in the Midwest used taller smokestacks which has caused northeast Maine to suffer from acid rain pollution

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Smokestack Air Pollution Activity Directions (25 min.)

- Set up a fan in the room and distribute flour and short and tall tubes to small groups of students.
- Pour flour on top of the short tube and blow through the bottom of the tube. The area the flour covers represents the area that the pollution is covering.
- Follow directions on handout to determine the area covered by flour on the floor.
- Repeat with the long tube.
- Fill in the data sheet for three trials of the short and tall tube and average the trials together (see Unit Instructional Activities - Lesson 3). Did the short or tall tube contribute to larger areas of “pollution?” Which tube spread the pollution farther from the source?
- Clean-up

Evaluation: (3 min.)

- Discuss whether the tall or short smokestack made pollution travel further.
  - How do local people benefit from tall smokestacks?
  - National, how are people disadvantaged by tall smokestacks?

Closure: (3 min.)

- What can be done to help solve this problem? *(filters on smokestacks, add substances to lakes to help neutralize acid in lakes)*
- Tomorrow we will talk about the water cycle, why we need to conserve water, and who is impacted by water pollution.
  - Today we saw how acid rain gets to Maine lakes, tomorrow we will see the effects of acid rain in lakes

Materials:

- Tall and short paper towel roles covered with tin foil, fan, flour, tape measure, calculator
- Handout: Air Pollution (see Unit Instructional Activities - Lesson 3)
- Laptops with internet connection or print maps from [www.weact.org/index.html](http://www.weact.org/index.html)
LESSON 4: Water
(1.5 class periods)

Objectives:
• To understand the basic process of the water cycle and a watershed
• To understand where drinking water comes from and how much water we use every day
  o To understand the global implications of access to sanitary water
• To understand the effects of acid rain in lakes and make the connection to the source of acid rain (Lesson 3)

Content:
• See Unit Content: Water and Environmental Justice

Instructional Activities:
• Background information about water (10 min.)
  o Explanation of the water cycle and a watershed
    ▪ Handout: The Water Cycle and Watershed Processes (see Unit Instructional Activities- Lesson 4)
    o Where does your drinking water come from?
    o Why do we need to conserve water?
      ▪ Oceans contain 97% of the earth’s water (salt water) while only 3% is freshwater. 77% of freshwater is stored as ice and 22% is in groundwater. That leaves only 1% of freshwater available for human use.
• Global View of Drinkable Water (15 min.)
  o Environmental Justice: handout- Water Supply and Sanitation (see Unit Instructional Activities- Lesson 4)
    ▪ 1.1 billion people lack access to improved water supply and 2.4 billion to improved sanitation.
    ▪ Those who lack adequate and affordable water supplies are the poorest in society.
    ▪ Despite the fact that the right to water has been internationally recognized as a human right, one sixth of the world population is still without water and two fifths are without sanitation.
    ▪ Look at Global Map of Sanitation- What continents have the most sanitation coverage? What continents have the least sanitation coverage?
  o Bottled Water
    ▪ The world bottled water market represents an annual volume of 89 billion liters, and is estimated to be worth US$ 22 billion.
    ▪ While bottled water originates from protected sources (75 percent from underground aquifers and springs), tap water comes mostly from rivers and lakes. Poland Spring Water is bottled in Maine.
- Look at graph of World Bottled Water Consumption - What continents consume the most bottled water? What continents consume the least bottled water?
- Explain the relationship between developing countries and less access to sanitary water
- Some 6,000 children die every day from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene.
- By 2050 at least one out of four people is likely to live in countries affected by chronic or recurrent shortages of freshwater.

- How much water do you use everyday? (10 min.)
  [Website Link]
  - Water conservation is important because many areas of the world do not have clean drinking water.

- ACID LAKES GAME (15 min.)
  [Website Link]
  - Remember smokestack activity: factories in the Midwest used taller smokestacks which has caused northeast Maine to suffer from acid rain pollution in lakes and ponds

**Evaluation:** (5 min)
- Have students explain the process of acid rain pollution from source to its effects in Maine lakes
  - Students should describe the process and use pictures
  - This assignment should be finished for homework

**Closure:** (2 min.)
- What can you do in your house to help conserve water?
  - Turn off the water when bushing teeth, shorter shower, less lawn irrigation, full laundry loads
- Today we talked about water at the global level and local level
  - Tomorrow we will talk about types of energy and how global population growth is causing us to deplete our energy resources faster.

**Materials:**
- Laptops with internet connection
- Handout: The Water Cycle and Watershed Processes and Water Supply and Sanitation (see Unit Instructional Activities - Lesson 4)
LESSON 5: Energy
(2 class periods)

Objectives:
• To compare and understand types of nonrenewable and renewable resources
• To understand the correlation between population growth and use of energy resources
• To learn ways to conserve energy

Content:
• See Unit Content: Energy and Environmental Justice

Instructional Activities:
• Background information about energy (20 min)
  o What is energy?
  o Energy such as heat, light, electricity, or motion can be produced by renewable or nonrenewable resources.
    - A nonrenewable resource is a natural resource that is not replaced as it is used (fossil fuels, coal, oil, natural gas).
    - A renewable resource is a resource that is naturally replaced in a relatively short time (solar power, wind power, hydroelectric power— dams, wood).
    - Explain what each resource is and how it produces energy for us to use.
  o Energy Production and Population Growth (see Unit Instructional Activities—Lesson 5)
    - US Energy Production (graph)
      - The US population size is increasing. The current 2006 US population is around 298 million and the world population is 6.5 billion.
  o Environmental Justice—We, as individuals, make personal and consumer choices to consume as little of Mother Earth’s resources as possible.
    - The US with less than 5% of the world’s population, consumes over 25% of the world’s resources.
    - Developing and poorer countries have less energy resources and often resort to poor environmental practices to get energy.
  o Increasing population size increases the demand on energy resources.
    - The US is facing an eventual depletion of nonrenewable resources—it depend on how quickly and how much we use energy.

• Renew-A-Bean Activity (25 min.)
  o To see how population growth is contributing to the depletion of nonrenewable resources
  o Get with a partner. Count the number of beans—92 red, 8 black
Close eyes when you reach into the bag to represent a population that is using energy without thinking about whether it is renewable or nonrenewable.

Each trial will be a little different

- The first trial, you will remove 10 beans each year.
- The second trial, you will remove 5 more beans each year (i.e. year 1: 10 beans, year 2: 15 beans, year 3: 20 beans).
- The third trial, you will remove 10 more beans each year (i.e. year 1: 10 beans, year 2: 20 beans, year 3: 30 beans).

You will be removing increasing numbers of beans each year to represent the population increasing and using more energy. Any renewable beans pulled from the container can be replaced after they are counted. Write down how many beans remain on your data sheet. Continue until only renewable beans are left.

Predict how many years it will take to use all of the nonrenewable resources.

- How Energy Efficient Are You Game (15 min.)
  [link](http://www.ecokids.ca/pub/eco_info/topics/energy/energy_efficient/index.cfm#)

**Evaluation:** (15 min.)

- Discuss Renew-A-Bean Activity
  - How long does it take to use all nonrenewable beans?
  - How does population increase affect the rate of energy consumption?
  - What does this mean for the US, which is currently relying on nonrenewable resources?
- Discussion: What can you do in your house to help conserve energy (save money and cut down on pollution)?
  - Have each student write down 3 things they can do in their house to save energy
    - turn off the lights, turn down the heat, use fans instead of AC, insulation, energy efficient appliances
  - Have a few students share their suggestions with the class

**Closure:** (5 min.)

- Poem- How can we conserve Energy? (Unit Instructional Activities- Lesson 5)
- Tomorrow we will continue our discussion about conservation by talking about the 3 Rs- reduce, reuse, recycle- You will decide how to recycle certain objects because individual actions are important

**Materials:**

- Bags, two different colored beans
- Laptops with internet connection
- Handouts: Energy Graphs, Data Sheets, Energy Poem (see Unit Instructional Activities- Lesson 5)
LESSON 6: Recycling
(2 class periods)

Objectives:
• To understand why recycling is important
• To understand the recycling loop- reduce, reuse, recycle
• To understand what materials can be recycled

Content:
• See Unit Content: Recycling

Instructional Activities:
• Background information about energy (12 min.)
  o Why recycling is important
    ▪ Most of the trash in the US ends up in landfills but landfill space is limited. In order to decrease the amount of trash that ends up in landfills
    ▪ How does a landfill work? handout- Recycle (see Unit Instructional Activities- Lesson 6)
  o Environmental Justice calls for universal protection from nuclear testing, extraction, production and disposal of toxic/hazardous wastes and nuclear testing that threaten the fundamental right to clean air, land, water, and food.
    ▪ Many hazardous waste disposal sites and landfills are near working class communities and communities of color (see The Quest for Environmental Justice: Human Rights and the Politics of Pollution by Robert Bullard 2005 for more information)
  o What is litter?
  o Important to follow the three Rs: Reduce, Reuse, Recycle. Recycling is the process of reclaiming raw materials and reusing them.
    ▪ Substances that are broken down or recycled naturally by bacteria and other decomposer are biodegradable (bread, leaves, wood are biodegradable while glass is not)
    ▪ Recycling aluminum cans use less energy, costs less and cause less pollution than making new cans.
    ▪ Each ton of recycled paper saves 17 trees.

• Trash: Myth of Fact (15 min.)
  o www.pacleanways.org/kids/talktrash/trash_mythorfact/mythfact_intropage.html

• EPA Recycle City (25 min)
  o www.epa.gov/recyclecity/mainmap.htm

• Reduce, Reuse, or Recycle Activity (20 min.)
  o Break students into groups of 4
  o Each group will get a bag with several objects
Students need to decide which objects could be reduced, which object could be reused, and which objects could be recycled?

- Students should describe how packaging could be reduced, how objects could be reused, and what objects can be brought to recycle centers.

**Evaluation:** (10 min.)
- Each group will present how their objects can be Reduced, Reused, or Recycled to the rest of the class.

**Closure:** (2 min.)
- Discussion: What can you recycle in your house?
  - newspapers, cans, glass bottles, plastics, composting
- Tomorrow we will talk about what you have learned about the environment by retaking parts of the survey.
  - You will then evaluate what you have learned through a writing assignment and creative project.

**Materials:**
- Bags of several objects: one object should have excess packaging, one object should be able to be reused, and one object should be a commonly recycled material.
  - Possible objects
    - Reduce: toy, Discman, video game set
    - Reuse: shoebox, 2-liter bottle, paper towel tube
    - Recycle: newspaper, aluminum cans, glass bottles
- Laptops with internet connection
- Handout: Recycle (see Unit Instructional Activities- Lesson 6)
LESSON 7: Evaluation

Objectives:
- To understand how surveys are useful to evaluate environmental knowledge and perceptions
- To reflect on what they learned about the environment
- To describe how their behavior might change after learning about environmental issues

Content:
- See Unit Content: Surveying Environmental Awareness and Analyzing Environmental Awareness Survey Results

Instructional Activities:
- Overview of unit (2 min)
  - Survey environmental awareness
  - Analyze survey results
  - Introduction into environmental topics (air pollution, water, energy, recycling)
- Retaking the Survey (35 min.)
  - Have students retake a subset of the environmental knowledge, environmental concern, and environmental behavior survey questions
  - Students receive their old surveys back and compare how their environmental knowledge, concern, and behavior have changed
  - Students should compare their surveys in the writing assignment

Evaluation:
- Writing Assignment: Compare your first survey to your second survey. How did the results change? Did you gain more environmental knowledge? Are you more interested in learning about the environment?
- Home Assignment: Creative project summarizing one of the environment topics (air pollution, water, energy, recycle, or environmental justice) and showing what conservation actions individuals can take.
  - Examples: poem, poster, collage

Closure: (5 min.)
- Class Discussion (students raise hands if they agree and ask a few students to share responses)
  - Do you think you would have done better on the environmental knowledge section after this unit?
  - How many people are more interested in environmental issues after this unit?
  - How will your behavior change after this unit?
  - Environmental issues are always in the news. Talk to your parents and teachers about environmental issues when you hear about them.

Materials:
- Environmental Awareness Survey (see Unit Instructional Activities- Lesson 1)
Extra Activity

Biodiversity

• Take a class field trip to the schoolyard.
  o See what plants and animals can be identified
  o Look for signs of animals (nests, footprints, droppings)
  o Look for threats to animals (roads, trash, etc.)

• Review the following information with students outside:
  o Biodiversity is the variety and differences among living organisms and the different environments in which they live.
  o Biodiversity is decreasing due to human activities causing animals and plants to be endangered, or have the possibility of going extinct
  o Local Connection: Some endangered or threaten species in Maine include: Bald Eagle, Grey Wolf, Box Turtle, Atlantic Salmon

• Activity- Using the booklet (can be done for homework):
  o Read about globally endangered species.
  o Are any of these species also endangered in Maine?
    - Grey Wolf and Salmon

• What can be done to help protect biodiversity?
  o Create reserves, list species on Endangered Species List, stop hunting, stop destroying habitat

Materials:

• Local plant and animal identification guides
• People and Wildlife booklet
LESSON 1

Environmental Awareness Survey (Appendix A)
### LESSON 2

**Raw Survey Data**

<table>
<thead>
<tr>
<th>Source of Environmental Information</th>
<th>Number of Students</th>
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<tbody>
<tr>
<td>School</td>
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<td>Outdoor Activities</td>
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<td>Internet</td>
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<tr>
<td>Personal Reading</td>
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<td>Talking with Friends/People</td>
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<td>TV/Movies</td>
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<td>Talking with Parents</td>
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<td>Newspaper</td>
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<td>Radio</td>
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<td>Other</td>
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<th>Environmental Knowledge Questions</th>
<th>Response A</th>
<th>Response B</th>
<th>Response C</th>
<th>Response D</th>
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<tr>
<td>Q 17 Biodiversity</td>
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<td>Q 18 Energy Generation</td>
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<td>Q 19 Biodegradability</td>
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<td>Q 20 Ozone Layer</td>
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<td>Q 21 Benefit of Wetlands</td>
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<td>Q 22 Local Wildlife</td>
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<td>Q 23 Garbage Storage</td>
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<td>Q 24 Water Pollution</td>
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<td>Q 25 Animal Extinction</td>
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<td>Q 26 Source of Drinking Water</td>
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<td>Q 27 Supply of Fossil Fuels</td>
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### LESSON 2

<table>
<thead>
<tr>
<th>Behavior Statement</th>
<th>Pro-Environmental Responses</th>
<th>Anti-Environment Responses</th>
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<tr>
<td>Q 37 Water Conservation</td>
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<td>Q 38 Animal Rights</td>
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<td>Q 39 Litter Clean Up</td>
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<td>Q 40 Limit Hunting</td>
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<td>Q 41 Electricity Conservation</td>
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<td>Q 42 Positive Attitude Outdoors</td>
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<td>Q 43 Rainforest Concern</td>
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<td>Q 44 Recycling</td>
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<td>Q 45 Min. Lawn Chemicals</td>
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<td>Q 46 Limit Consumption</td>
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<td>Q 47 Preservation of Forests</td>
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<td>Q 48 Hearing Nature</td>
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<td>Q 49 Playing Outside</td>
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<tr>
<td>Q 50 Confidence in Technology</td>
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</table>
LESSON 2
Sample Survey Results Summary

- There were 125 6th graders surveyed: 54% female, 45% male
- You have learned the most about environmental issues from school, TV, talking with parents, and outdoor activities.
- Many students have participated in outdoor activities. The most common are camping, hiking/walking, bicycling, and swimming. Many students want to participate in snowmobiling and horseback riding. Many students also wrote in sports as an outdoor activity.
- 42% of students always recycle bottles, cans, or newspapers at home
- On a typical summer day 41% of students like to play a sport outside.
- Almost half of the 6th graders reported they learned a fair amount about the environment in school this year.
- 70% of 6th graders reported they like learning about nature and the environment. Girls like to learn about the environment more than boys.
- 53% of students think they know a fair amount about local animals and plants in Waterville
- Environmental Knowledge: 46% of students know their water comes from a nearby lake. Most students did not correctly answer that surface water carrying pollutants from yards, streets and farms as the most common pollutant in rivers.

![6th Grade Scores on Environmental Knowledge Section](image)

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• Only 55% of adult Americans can pass a similar environmental knowledge quiz. (NEETF 1997-2000). The 6th grade is on their way to knowing more about the environment than adults.

• Half of sixth graders think that industries, governments, environmental groups, and individuals should be responsible for the environment.

• 62% of students are concerned about pollution in lakes and tree harvesting in ME. 79% of students are willing to do more to protect the environment.

• Most students do not think population growth is at risk for harming the environment. This is probably true in Maine but around the world population growth is causing many environmental problems.

• This study found outdoor experience, rather than environmental knowledge was the greater predictor of environmental awareness and behavior in Waterville Junior High students. Nature experiences are key factors in fostering environmental stewardship.
Directions:
1. Pour flour on top of the tall tube and blow through the bottom of the tube.
2. The area the flour covers represents the area the pollution is falling.
3. Measure the diameter (width of the circle) of the area the flour covers.
4. Divide the diameter in half, this is the radius. On a calculator, multiply the radius by the radius again times pi = 3.14. This equals the area of the circle.
   Area = radius x radius x 3.14
5. Repeat for the short tube
6. Repeat for two more trials
7. Average the data for the tall smokestack. Average the data for the short smokestack.
   • Compare the area of the tall and short smokestack
   • Question: Did the tall or short smokestack make the pollution travel further?

<table>
<thead>
<tr>
<th>Smokestack</th>
<th>Diameter of Flour</th>
<th>Radius of Flour</th>
<th>Area of Circle</th>
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<tbody>
<tr>
<td>Trial 1: Tall</td>
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<tr>
<td>Trial 1: Short</td>
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<tr>
<td>Trial 2: Tall</td>
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<tr>
<td>Trial 2: Short</td>
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<tr>
<td>Trial 3: Tall</td>
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<tr>
<td>Trial 3: Short</td>
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<td></td>
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<tr>
<td>Average: Tall</td>
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<td></td>
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<tr>
<td>Average: Short</td>
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</tbody>
</table>
The Water Cycle

Watershed Processes
LESSON 4

Water Supply and Sanitation

World bottled water consumption in 1999, in liters/year/person and in %.
LESSON 5

How can we conserve energy?

When you enter a room and turn on the light,
To help you see in the dark of night,
Do you ever stop to think and ponder,
What will happen if we continue to squander?

Not all our energy is the renewable kind,
So ways to save it, you must keep in mind,
For if we don't, one day there will be,
No energy left for you or for me!

What can we do? What must we change?
What habits should we rearrange?
There's lots to be done, changes big and small,
And most take almost no effort at all!
LESSON 5

Population Growth in the US


Source: www.censusscope.org

Energy Use in the US

Total Energy = 97.6 Quadrillion Btu
Renewable Energy = 5.9 Quadrillion Btu

Source: www.eia.doe.gov/.../renewableenergy.htm
LESSON 5
Renew-A-Bean Activity
1. Count and make sure you start with 100 beans
   92 Red Beans = nonrenewable
   8 Black Beans = renewable (renewable can be placed back in bag)
2. Start in Chart 1. Reach into the bag and take out 10 beans for year 1. Write down the number of nonrenewable beans left in the bag. Do not put nonrenewable beans back in the bag. Write down the number of renewable beans left.
3. Continue to take out the correct number of beans for each year until you run out of nonrenewable beans.
4. After you finish with Chart 1, put all the beans back in the bag and go on to Chart 2. This time the population is increasing and you will take 5 more beans out of the bag each time. Predict what year you will run out of nonrenewable resources. Then go on to Chart 3.

Data Chart 1
<table>
<thead>
<tr>
<th>Consumption Level</th>
<th>Prediction Years to Deplete</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
<th>Year 9</th>
<th>Year 10</th>
<th>Year 11</th>
<th>Year 12</th>
<th>Total Year</th>
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<tbody>
<tr>
<td>Remove 10 beans each year</td>
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<td>10</td>
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<td>Year 10</td>
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<tr>
<td>Number of remaining Nonrenewable beans</td>
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Data Chart 2
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<th>Year 3</th>
<th>Year 4</th>
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<th>Year 10</th>
<th>Year 11</th>
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<tbody>
<tr>
<td>Remove 5 MORE beans each year</td>
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<td>Year 12</td>
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Data Chart 3
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<th>Year 10</th>
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WASTE REDUCTION

When we don't recycle, most of our wastes end up here: