

EXCELLENCE IN ENVIRONMENTAL EDUCATION: GUIDELINES FOR LEARNING (K-12)

The North American Association for Environmental Education

The North American Association for Environmental Education (NAAEE) is a network of professionals, students, and volunteers working in the field of environmental education throughout North America and in over 55 countries around the world.

NAAEE combines the perspectives of the environmental and educational communities, taking a cooperative, non-confrontational, scientifically balanced approach to promoting life-long learning about environmental issues.

NAAEE members think about how people become literate concerning environmental issues and believe education must go beyond consciousness-raising about these issues. It must prepare people to think together about the difficult decisions they have to make concerning environmental stewardship, and to work together to improve, and try to solve, environmental problems.

NAAEE recognizes the need for a coherent body of information about environmental issues. Its members also recognize that information and analysis are only part of an effective education program. To be truly effective, this body of knowledge must be integrated into all aspects of the curriculum and into all types of educating institutions for the widest array of audiences.

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North American Association
for Environmental Education

THE NATIONAL PROJECT FOR EXCELLENCE IN ENVIRONMENTAL EDUCATION

Excellence in Environmental Education—Guidelines for Learning (K–12) is part of a continuing series of documents published by the North American Association for Environmental Education (NAAEE) as part of the National Project for Excellence in Environmental Education. The Project is committed to synthesizing the best thinking about environmental education through an extensive process of review and discussion. Thus far, thousands of individuals and organizations representing all aspects of education and environmental education have reviewed working outlines and drafts. Reviewers include teachers, educational administrators, environmental scientists, curriculum developers, and natural resource agency and education department staff.

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TABLE OF CONTENTS

Introduction	1
Environmental Education: A Vision for the Future.....	1
Essential Underpinnings of Environmental Education ...	2
Teaching from the Guidelines	4
How the Guidelines are Organized.....	5
The Guidelines at a Glance.....	6
21st Century Skills	9
 Guidelines for Fourth Grade	 11
 Guidelines for Eighth Grade	 29
 Guidelines for Twelfth Grade	 49
 Appendices:	
A: Executive Summary	71
B: Background for the	88
Development of the Learner Guidelines Framework	

INTRODUCTION

Excellence in Environmental Education—Guidelines for Learning (K–12) provides students, parents, educators, home schoolers, administrators, policy makers, and the public a set of common, voluntary guidelines for environmental education. The guidelines support state and local environmental education efforts by:

- setting expectations for performance and achievement in fourth, eighth, and twelfth grades;
- suggesting a framework for effective and comprehensive environmental education programs and curricula;
- demonstrating how environmental education can be used to meet standards set by the traditional disciplines and to give students opportunities to synthesize knowledge and experience across disciplines;
- defining the aims of environmental education.

These guidelines set a standard for high quality environmental education across the country, based on what an environmentally literate person should know and be able to do. They draw on the best thinking in the field to outline the core ingredients for environmental education.

Environmental Education: A Vision for the Future

Excellence in Environmental Education—Guidelines for Learning (K–12) is grounded in a widely shared understanding of effective environmental education. For many educators, that understanding begins with two founding documents of the field: the Belgrade Charter (UNESCO-UNEP, 1976) and the Tbilisi Declaration (UNESCO, 1978).

The Belgrade Charter was adopted by a United Nations conference and provides a widely accepted goal statement for environmental education:

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

A few years later, the world's first intergovernmental conference on environmental education adopted the Tbilisi Declaration. This declaration built on the Belgrade Charter and established three broad goals for environmental education. These goals provide the foundation for much of what has been done in the field since 1978:

- To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas
- To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment

- To create new patterns of behavior of individuals, groups and society as a whole towards the environment

As the field has evolved, these principles have been researched, critiqued, revisited, and expanded. They still stand as a strong foundation for a shared view of the core concepts and skills that environmentally literate citizens need. Since 1978, bodies such as the Brundtland Commission (Brundtland, 1987), the United Nations Conference on Environment and Development in Rio (UNCED, 1992), the Thessaloniki Declaration (UNESCO, 1997) and the World Summit on Sustainable Development in Johannesburg (United Nations, 2002) have influenced the work of many educators, highlighting the importance of viewing the environment within the context of human influences. This perspective has expanded the emphasis of environmental education, focusing more attention on social equity, economics, culture, and political structure.

Environmental education is rooted in the belief that humans can live compatibly with nature and act equitably toward each other. Another fundamental belief is that people can make informed decisions that consider future generations. Environmental education aims for a democratic society in which effective, environmentally literate citizens participate with creativity and responsibility.

Essential Underpinnings of Environmental Education

Environmental education builds from a core of key principles that inform its approach to education. Some of these important underpinnings are:

Systems: Systems help make sense of a large and complex world. A system is made up of parts. Each part can be understood separately. The whole, however, is understood only by understanding the relationships and interactions among the parts. The human body can be understood as a system; so can galaxies. Organizations, individual cells, communities of animals and plants, and families can all be understood as systems. And systems can be nested within other systems.

Interdependence: Human well being is inextricably bound with environmental quality. Humans are a part of the natural order. We and the systems we create—our societies, political systems, economies, religions,

Environmentally literate students possess the knowledge, intellectual skills, attitudes, experiences and motivation to make and act upon responsible environmental decisions. Environmentally literate students understand environmental processes and systems, including human systems. They are able to analyze global, social, cultural, political, economic and environmental relationships, and weigh various sides of environmental issues to make responsible decisions as individuals, as members of their communities, and as citizens of the world. (Adapted from Maryland Partnership for Children in Nature, April 2009)

The Need for Environmental Literacy

The ultimate goal of environmental education is the development of an environmentally literate citizenry. Environmental literacy is not, however, a goal that is reached easily. We are asking individuals to go beyond the fact by fact, piece by piece examination of our environment and begin to understand and think in terms of systems bound together. We are asking individuals to develop a sophisticated set of skills that allow them to solve novel environmental problems and determine the best set of actions. We are asking individuals to become thoughtful, skillful, and active citizens in a democracy.

We need an environmentally literate citizenry that is not only capable of taking individual action, but of making well-informed public policy decisions collectively. Increasingly, individuals are asked to make choices on complex issues that affect their own lives, the lives of their families, their communities, and the world beyond their shores. Choices are made every time people enter a store, turn on a water faucet, plant a butterfly garden, or set the thermostat in their homes. Each time citizens vote, they make environmental decisions. When public policy is made, these decisions not only impact the economy and jobs, but the environment. Environmental literacy is predicated on the belief that if we educate our citizens so they are capable of making quality decisions, they will do so when the time comes.

Environmental literacy is a vital goal for our society. Environmental education must play an integral role throughout our educational system – at the national level, at the state level, and in each and every classroom.

cultures, technologies—impact the total environment. Since we are a part of nature rather than outside it, we are challenged to recognize the ramifications of our interdependence.

The importance of where one lives: Beginning close to home, learners forge connections with, explore, and understand their immediate surroundings. The sensitivity, knowledge, and skills needed for this local connection provides a base for moving out into larger systems, broader issues, and an expanding understanding of causes, connections, and consequences.

Integration and infusion: Disciplines from the natural sciences to the social sciences to the humanities are connected through the medium of the environment and environmental issues. Environmental education offers opportunities for integration and works best when infused across the curriculum, rather than being treated as a separate discipline or subject area.

Roots in the real world: Learners develop knowledge and skills through direct experience with the environment, environmental issues, and society. Investigation, analysis, and problem solving are essential activities and are most effective when relevant to the real world.

Lifelong learning: Critical and creative thinking, decision making, and communication, as well as collaborative learning, are emphasized. These

skills are essential for active and meaningful learning, both in school and over a lifetime.

Teaching from the Guidelines

Excellence in Environmental Education—Guidelines for Learning (K–12) is primarily focused on learner achievement. The instructional strategies necessary for implementing environmental education are taken up in more detail in three other documents in this series, *Environmental Education Materials: Guidelines for Excellence* (2009), *Guidelines for the Preparation and Professional Development of Environmental Educators* (2004), and *Nonformal Environmental Education Programs: Guidelines for Excellence* (2009). Guidelines for the development and implementation of early childhood education programs will be published in 2010.

Learning and instruction are closely linked, however, so these environmental education guidelines for learning include examples that offer specific ideas for implementation in instructional settings. These examples are based on several general principles that help guide environmental education instruction:

The **learner is an active participant**. If learning is to become a natural, valued part of life beyond school, **instruction should be guided by the learner's interests and treated as a process of building knowledge and skills**. Using the guidelines and knowledge of individual learners and different classes, instructors can make environmental education relevant to specific learners at particular developmental levels.

Instruction provides opportunities for learners to enhance their capacity for **independent thinking and effective, responsible action**. Engaging in individual and group work helps learners develop these capacities independently and in collaborative situations that anticipate the ways in which problem solving happens in the community, on the job, and in the family. A **strong emphasis on developing communication skills** means that learners will be able to both demonstrate and apply their knowledge.

Because environmental issues can prompt deep feelings and strong opinions, educators must take a **balanced approach to instruction**. Educators incorporate differing perspectives and points of view

The Importance of Thinking Skills

Environmentally literate citizens are constantly challenged to use and improve their critical and creative thinking skills. Creative thinking is defined as thinking which results in connections or possibilities previously unrecognized or unknown to the learner. Critical thinking requires an analysis or consideration based on careful examination of information or evidence. Critical thinking relies on thoughtful questioning and logical thinking skills such as inductive and deductive reasoning. They use systems thinking as they make judgments and solve real world problems.

even-handedly and respectfully, and present information fairly and accurately.

Environmental literacy depends on a personal commitment to apply skills and knowledge to help ensure environmental quality and quality of life. For most learners, **personal commitment begins with an awareness of what immediately surrounds them**. Instructors foster learners' innate curiosity and enthusiasm, providing them with **early and continuing opportunities to explore their environment**. "Taking the show on the road"—or at least out of the classroom—is an important instructional strategy for engaging students in direct discovery of the world around them.

How the Guidelines are Organized

Excellence in Environmental Education—Guidelines for Learning (K–12) offers a vision of environmental education that makes sense within the formal education system and promotes progress toward sustaining a healthy environment and quality of life. Guidelines are suggested for each of three grade levels—fourth, eighth, and twelfth. Each guideline focuses on one element of environmental literacy, describing a level of skill or knowledge appropriate to the grade level under which it appears. Sample performance measures illustrate how mastery of each guideline might be demonstrated.

The guidelines are organized into four strands, each of which represents a broad aspect of environmental education and its goal of environmental literacy. The strands are:

Strand 1: Questioning, Analysis and Interpretation Skills

Environmental literacy depends on learners' ability to ask questions, speculate, and hypothesize about the world around them, seek information, and develop answers to their questions. Learners must be familiar with inquiry, master fundamental skills for gathering and organizing information, and interpret and synthesize information to develop and communicate explanations.

Strand 2: Knowledge of Environmental Processes and Systems

An important component of environmental literacy is understanding the processes and systems that comprise the environment, including human social systems and influences. That understanding is based on knowledge synthesized from across traditional disciplines. The guidelines in this section are grouped in four sub-categories:

- 2.1—The Earth as a physical system
- 2.2—The living environment
- 2.3—Humans and their societies
- 2.4—Environment and society

Strand 3: Skills for Understanding and Addressing Environmental Issues

Skills and knowledge are refined and applied in the context of environmental issues. These environmental issues are real-life dramas where differing viewpoints about environmental problems and their potential solutions are played out. Environmental literacy includes the abilities to define, learn about, evaluate, and act on environmental issues. In this section, the guidelines are grouped in two sub-categories:

- 3.1—Skills for analyzing and investigating environmental issues
- 3.2—Decision-making and citizenship skills

Strand 4: Personal and Civic Responsibility

Environmentally literate citizens are willing and able to act on their own conclusions about what should be done to ensure environmental quality. As learners develop and apply concept based learning and skills for inquiry, analysis, and action, they also understand that what they do individually and in groups can make a difference.

Taken together, these strands create a vision of environmental literacy. The sequence of the strands—and the individual guidelines themselves—may suggest that some skills or knowledge serve as a foundation for others. But the process of becoming environmentally literate is not linear, and the sequence of the guidelines is more a function of bringing an order and logic to this document than a reflection of a hierarchy of skills and knowledge.

Communication and expression are skills that are obviously critical to environmental literacy. Examples of how learners might communicate their understanding and express ideas and conclusions are scattered throughout this document. These are only a representation of the modes of artistic and linguistic expression that are both fundamental to, and fostered by, environmental education. The richness of the relationship between environmental education and the language and fine arts is not fully reflected by the few references made to their disciplinary standards. Learners should use many forms of communication in their pursuit of environmental literacy, ranging from oral and written communication to theater, and from dance and music to the visual arts.

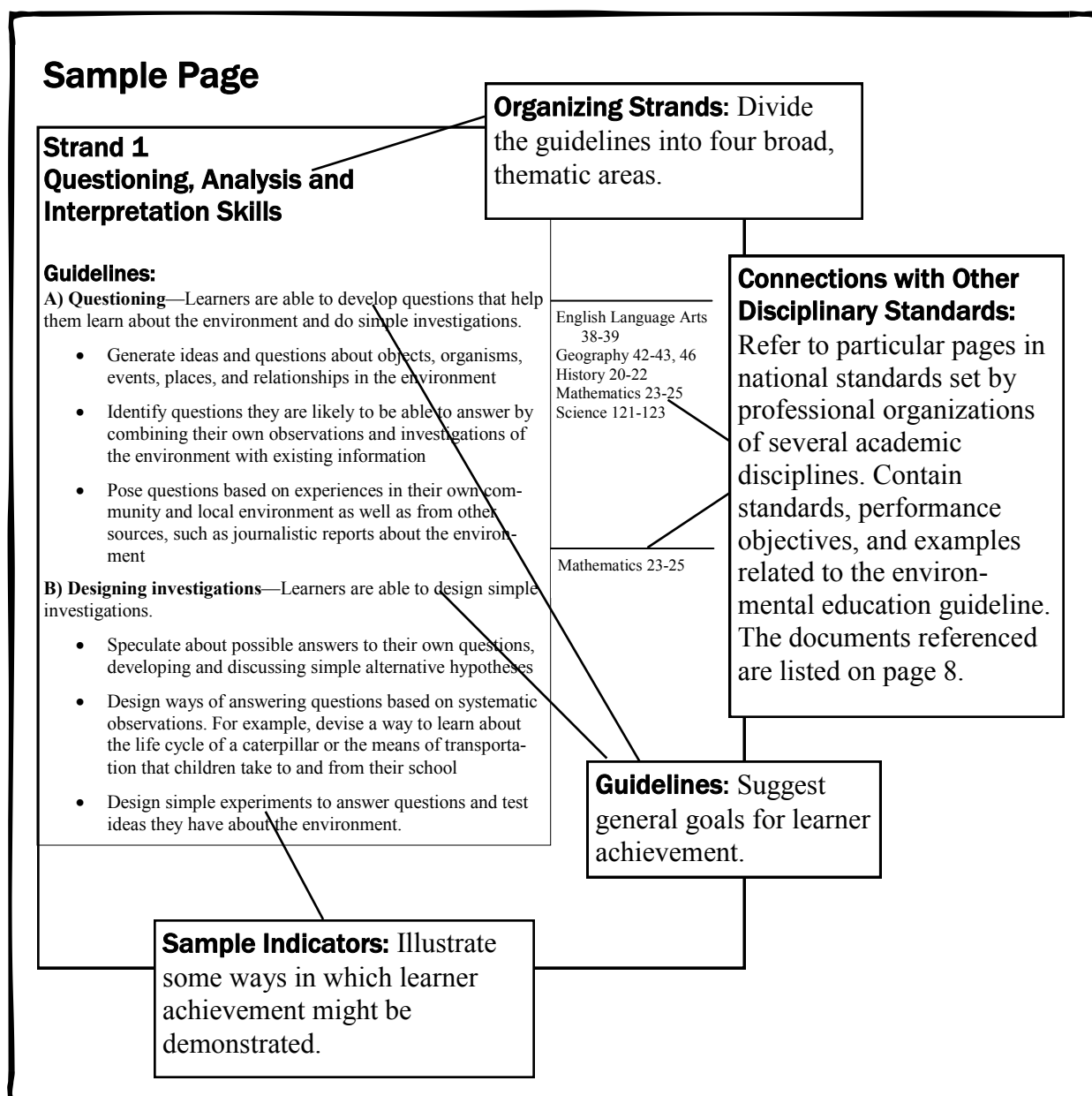
The Guidelines at a Glance

Excellence in Environmental Education—Guidelines for Learning (K–12) sets appropriate expectations for learner performance and achievement at the end of fourth and eighth grades and by high school graduation. The diagram on page 7 will help the user understand how this *Guidelines* document is constructed, and what kinds of information it offers.

Sample classroom techniques for meeting the guidelines are included throughout the publication. These summaries also indicate correlations to specific guidelines and suggest additional performance measures.

Also included in this *Guidelines* document are:

- *introductory materials* that place the guidelines in context, outlining a comprehensive vision of environmental education;
- an easy reference chart summarizing the strands and guidelines (see Appendix A);
- *background for the Development of the Learner Guidelines Framework*, an appendix that relates key developments in the field of environmental education to the framework around which the guidelines are structured (see Appendix B).



Connections with Other Disciplinary Standards

These are the national standards documents referenced and the short titles used to represent them.

Short Title	Standards Document Referenced
Arts	<i>National Standards for Arts Education: What Every Young American Should Know and Be Able to Do in the Arts</i> . Reston, VA: Music Educators National Conference, 1994.
Civics and Government	<i>National Standards for Civics and Government</i> . Calabasas, CA: Center for Civic Education, 1994.
Economics	<i>Voluntary National Content Standards in Economics</i> . New York: National Council on Economics Education, 1997.
English Language Arts	<i>Standards for the English Language Arts</i> . Urbana, IL: National Council of Teachers of English, 1996.
Geography	<i>Geography for Life: National Geography Standards</i> . Washington, DC: National Geographic Research and Exploration, 1994.
History	<i>National Standards for History</i> . Los Angeles, CA: National Center for History in the Schools, 1996.
Mathematics	<i>Principles and Standards for School Mathematics</i> . Reston, VA: National Council of Teachers of Mathematics, 2000.
Science	<i>National Science Education Standards</i> . Washington, DC: National Academy Press, 1996.
Science Benchmarks	Project 2061, American Association for the Advancement of Science. <i>Benchmarks for Science Literacy</i> , 2009 (available online at http://www.project2061.org/publications/bsl/online/index.php) .
Social Studies	<i>Expectations of Excellence: Curriculum Standards for Social Studies</i> . Washington, DC: National Council for the Social Studies, 1994.

Environmental Education Supports 21st Century Skills

The Partnership for 21st Century Skills brings together the business community, education leaders, and policy makers to define a powerful vision for 21st century education and to ensure that students emerge from our schools with the skills needed to be effective citizens, workers, and leaders in the 21st century. The Partnership's framework for education describes the skills, knowledge and expertise students should master to succeed in work and life in the 21st century:

Core Subjects and 21st Century Themes: Mastery of core academic subjects is the base upon which all 21st century learning occurs. Core subjects include English, reading or language arts; world languages; arts; mathematics; economics; science; geography; history; government; and civics. Schools must support students in developing deep mastery of core academic subjects while also integrating 21st century interdisciplinary themes into these academic subject areas. These themes include:

- Global Awareness
- Financial, Economic, Business and Entrepreneurial Literacy
- Civic Literacy
- Health Literacy
- Environmental Literacy

Learning and Innovation Skills: Learning and innovation skills are what separate students who are prepared for increasingly complex life and work environments in the 21st century and those who are not. They include:

- Creativity and Innovation
- Critical Thinking and Problem Solving
- Communication and Collaboration

Information, Media and Technology Skills: People in the 21st century live in a technology and media-driven environment, marked by access to an abundance of information, rapid changes in technology tools and the ability to collaborate and make individual contributions on an unprecedented scale. To be effective in the 21st century, citizens and workers must be able to exhibit a range of functional and critical thinking skills, such as:

- Information Literacy
- Media Literacy
- ICT (Information, Communications and Technology) Literacy

*Used with permission from the Partnership for 21st Century Skills
<http://www.21stcenturyskills.org>*

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GUIDELINES FOR FOURTH GRADE

Learners should be able to meet the guidelines included in this section by the end of fourth grade.

The kindergarten through fourth grade years are a time of tremendous cognitive development. By third and fourth grades, learners have developed some basic skills that help them construct knowledge. Instructors in earlier grade levels should use these fourth grade guidelines as a target, extrapolating from this end goal appropriate activities and lessons for younger learners.

In these early years of formal education, learners tend to be concrete thinkers with a natural curiosity about the world around them. Environmental education can build on these characteristics by focusing on observation and exploration of the environment—beginning close to home.

Examining Environmental Issues in Fourth Grade

Many educators believe that exploring issues helps fourth-grade learners make important links between conceptual understanding, what is happening in their community, and their own responsibility for environmental quality. Others caution that fourth graders are only beginning to synthesize their knowledge into the kind of complex understanding that is essential to examining environmental issues. When deciding how to handle environmental issues in the fourth grade classroom, educators must rely on their own judgment about what each class—and each student—is ready to handle.

Basic guidelines for examining environmental issues with fourth graders are:

- Keep it simple.
- Keep it local.
- Make close links with what they're observing and learning about the local environment.

Local solid waste and water issues easily fit these basic guidelines. Similarly, gardening and habitat improvement projects are especially appropriate for these young learners.

Understanding the Local Environment

Experiencing and observing the local environment is an essential part of environmental education. Understanding their surroundings helps learners build a strong foundation of skills and knowledge for reaching out further into the world and deeper into the conceptual understandings that environmental literacy demands. Direct experience in the environment also helps foster the awareness and appreciation that motivate learners to further questioning, better understanding, and appropriate concern and action.

The following chart suggests ways in which learners at different grade levels might explore and understand the local environment. It is printed in each grade level section of these guidelines to help show progression as learners mature. Other ideas are included in the guidelines.

Grades K–4

Identify basic types of habitats (e.g., forests, wetlands, or lakes). Create a short list of plants and animals found in each.

Trace the source of their drinking water and where it goes after it is used.

Recognize resident animal species, migrants, and those that pass through on migratory routes.

Collect or produce images of the area at the beginning of European settlement.

Describe aspects of the environment that change on a daily, weekly, monthly, and yearly basis.

Record weather observations such as precipitation, temperature, or cloud cover.

Identify food crops that are grown or processed locally.

Grades 5–8

Classify local ecosystems (e.g., oak-hickory forest or sedge meadow). Create food webs to show—or describe their function in terms of—the interaction of specific plant and animal species.

Describe how drinking water and wastewater are treated.

Map migratory routes of birds, butterflies, and other animals that pass through the area. Identify their local habitat needs.

Monitor changes in water or air quality, or other aspects of the local environment.

Identify species that are locally threatened, endangered, or declining in population. Describe their habitat needs.

Identify sources of electricity used in the community (e.g., hydroelectric, fossil fuels, solar, nuclear).

Describe the area's climate and identify factors that contribute to it and have changed it over time.

Create a map for the local area that shows where food that is consumed locally comes from.

Grades 9–12

Identify several plants and animals common to local ecosystems. Describe concepts such as succession, competition, predator/prey relationships, and parasitism.

Evaluate sources of nonpoint source pollution of local bodies of water, including sources that are not local.

Investigate short- and long-term environmental changes in a local watershed, and aquifer, or in air quality. Or document changes in land use and their environmental effects.

Research population trends for a locally threatened species. Describe changes, activities, and other factors that seem to affect the population trends.

Calculate the potential for generating wind or solar power on a particular site.

Identify local sources of greenhouse gases. Examine the relationship between greenhouse gases in the Earth's atmosphere and climate change.

Trace human population trends and make research-based projections.

Strand 1— Questioning, Analysis and Interpretation Skills

Guidelines:

A) Questioning—Learners are able to develop questions that help them learn about the environment and do simple investigations.

- Identify questions they are likely to be able to answer by combining their own observations and investigations of the environment with existing information.
- Pose questions based on experiences in their own community and local environment as well as from other sources, such as journalistic reports about the environment.
- Generate ideas and questions about objects, organisms, events, places, and relationships in the environment.

B) Designing investigations—Learners are able to design simple investigations.

- Predict possible answers to their own questions, developing and discussing simple alternative hypotheses.
- Design ways of answering questions based on systematic observations. For example, devise a way to learn about the life cycle of a caterpillar or the means of transportation that children take to and from their school.
- Design simple experiments to answer questions and test ideas they have about the environment.

C) Collecting information—Learners are able to locate and collect information about the environment and environmental topics.

- Observe and record characteristics, differences, and change in objects, organisms, events, places, and relationships in the environment.
- Find, assess, select, and use resources such as atlases, data bases, charts, tables, graphs, and maps.
- Use basic field skills, such as observing, interviewing and measuring, to collect information.

References to Standards:

English Language Arts 38–39
Geography 42–43, 46
History 20–22
Mathematics 108, 176
Science 121–123
Science Benchmarks 285

Geography 46
Mathematics 176
Science 122
Science Benchmarks 10

Arts 31
English Language Arts 27–29,
38–39
Geography 46, 106–107
History 22
Mathematics 78, 102, 148, 158,
170
Science 122
Science Benchmarks 10, 285–286
Social Studies 35

Oil Spill Clean-Up Contest

From: Environmental Education Association
of New Mexico
Grade Level: 4th

While on an after-school community clean-up walk, fourth graders from a school in New Mexico traced a puddle of dirty oil to the dumpster behind an auto lubrication service. The students talked to the owner, who assured them this was not normal procedure, and showed them how they collect motor oil for recycling.

A follow-up class discussion generated a lot of questions about oil pollution. Many students were particularly concerned about a recent oil spill, which prompted an Oil Spill Clean Up Contest.

Allowed to work independently or in groups, the students were challenged to clean a tablespoon of gear lube oil from a beaker of water. They were given three days to conduct research and plan their approach and each team was allowed to bring from home one shoebox-worth of equipment. To ensure safety, plans had to be approved by the teacher.

Then came the contest! Students tested their techniques, recording the time required to complete their process. The students then rated the cleanliness of each beaker and entered their findings into a database later used to examine the advantages and disadvantages of each method.

Using their research results, students also mapped the size and location of the world's largest spills and explored actual methods of cleaning oil spills.

Finally, students devised their own assessments to show what they had learned, and still wanted to learn, about oil spills. Assessments included books created for third graders, a computerized presentation, a comic book, and illustrated essays.

- Use tools such as rulers, thermometers, watches, scales, magnifiers, and microscopes to make observations and measurements.
- Use computers, calculators and other devices to conduct investigations and manipulate information.

History 20–21
Science 121–123

D) Evaluating accuracy and reliability—Learners understand the need to use reliable information to answer their questions. They are familiar with some basic factors to consider in judging the merits of information.

- Provide specific examples of information they believe to be factual, fictitious, or of questionable merit and explain their reasoning.
- Identify some factors that might influence the credibility of a specific source of information, for example, who created it, how old it is, and what kind of arguments or evidence are used.

E) Organizing information—Learners are able to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.

- Summarize observations and describe data.
- Construct, read, and interpret maps, graphs, tables, diagrams, and other displays of data.
- Identify patterns in events, designs, organisms, and sets of numbers.
- Describe mathematical relationships and use those relationships as a way of organizing data. For example, chart the relationship between plant growth and different amounts of water or sunlight.

F) Working with models and simulations—Learners understand that relationships, patterns, and processes can be represented by models.

- Interpret information and situations by noting associations and similarities, and recognizing patterns, trends, relationships, and sequences.
- Give examples of models or simulations and how they can be used to learn about what they represent. Identify ways in which a model differs from what it represents.
- Use a number of types of models such as geometric figures, graphs, and maps to summarize observations of the environment.

G) Drawing conclusions and developing explanations—Learners can develop simple explanations that address their questions about the environment.

- Summarize information, compare findings, and use basic mathematics to analyze data.
- Identify information that is not relevant to a proposed explanation and explain their reasoning.
- Use models and examples to explain their thinking.
- List strengths and weaknesses of the explanations they propose.

Arts 34

English Language Arts 35–36

Geography 47, 107–111

Mathematics 90, 108, 132, 136,
158, 176, 200, 206

Science Benchmarks 10–11

Geography 47–48, 106–107

Mathematics 90, 96, 158, 164

Science Benchmarks 267–268

English Language Arts 38–39

Geography 48–49

History 22

Mathematics 108, 132, 136, 158,
176, 200, 206

Science Benchmarks 10–11

Strand 2— Knowledge of Environmental Processes and Systems

Strand 2.1—The Earth as a Physical System

References to Standards:

Geography 118–119
Science Benchmarks 72

Science 127
Science Benchmarks 76–77

Guidelines:

A) Processes that shape the Earth—Learners are able to identify changes and differences in the physical environment.

- Identify some of the forces that cause erosion within their own region, pointing out factors such as freezing and thawing, wind, waves, and gravity.
- Identify some distinctive landforms within their region and, using maps and images, in other areas of the world. For example, understand that the ocean is a single, interconnected body of water.
- Differentiate among climates, considering factors such as precipitation, temperature, and resident plants and animals and how they form the different biomes. Understand that the ocean is a major influence on weather and climate no matter where you live.
- Observe and record seasonal differences. For example, draw a series of pictures or compile photographs that illustrate differences such as day length, migration of specific bird species, and when specific tree species lose their leaves.

B) Changes in matter—Learners are able to identify basic characteristics of and changes in matter.

- Describe objects in terms of the materials they are made of and their observable properties. For example, describe buildings constructed with different materials and discuss why these materials may have been selected based on such properties as rigidity, ability to reflect or gather heat, and transparency.
- Identify the effects of factors such as heating, cooling, and moisture on the properties of materials and how quickly change happens. For example, describe the change of water from solid to liquid to gas in the environment.
- Describe the basic elements of the hydrologic cycle (including the role of the ocean) and geologic processes (including weathering, erosion, and deposition). Locate examples of these in the local environment.

C) Energy—While they may have little understanding of formal concepts associated with energy, learners are familiar with the basic behavior of some different forms of energy.

- Identify different forms of energy including radiant light, geothermal, electrical, and magnetic energy. Identify examples of these different forms in their homes, school, community, and natural environment.
- Explain some of the ways in which heat, light, or electricity are produced, travel, stored and used. Use examples such as the sun, power generation, batteries, and so forth.

Science 127
Science Benchmarks 83–84

Finding Urban Nature

From: *Changing What We Do*, North American Association for Environmental Education, Washington, DC
Grade Level: 3rd

Correlating Guidelines:

Strand 1 A, B, C, F, G
Strand 2.2 A, C

What's better than having fun volunteers leading outdoor activities with your students? Having FUN volunteers!

Finding Urban Nature (FUN) is an initiative of the VINE (Volunteer-Led Investigations in Neighborhood Ecology) program, a national program available in many urban areas. Specially trained parent volunteers work with schools to develop pre and post classroom studies to enhance a FUN visit to the school site.

One Seattle teacher tied his planned FUN visit to a year-long unit on habitats. The unit began when the teacher placed a cracked aquarium in front of his third grade students and asked what they wanted to do with it. Before long, the aquarium became a four-star worm hotel!

The teacher asked what the worms would need to live in their habitat. The discussion triggered as many questions as answers: What do worms eat? Why do they come out when it rains? Are they really more active at night? The questions were recorded in a concept map that laid the foundation for many future investigations.

Prepared by schoolyard observations and research, the students built their worm hotel. Anxiously, they designed experiments to find answers to all their questions. Carefully, they poured water into one corner to study how worms react to rain. The students blocked light from one side of the aquarium to see if they could learn why worms come out at night. Hand lenses, microscopes and soil guides became routine tools as the third graders enthusiastically explored every change.

Volunteer seedlings sprouted, launching more investigations on plants and roots. Students discovered that worms and plants were interconnected, an essential part of understanding habitats.

When the FUN volunteers arrived, the students were proud of what they knew. Even better, they were excited to learn more, readily grasping new ideas about the effects of temperature, wind, and light.

Strand 2.2—The Living Environment

References to Standards:

Science Benchmarks 102–103,
111, 119
Science 127–129
Geography 120

Science 127–129
Science Benchmarks 107, 123

Geography 132
Science 129
Science Benchmarks 72, 116, 123

Guidelines:

A) Organisms, populations, and communities—Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat.

- Identify similarities and differences among living organisms ranging from single-celled organisms they can observe under microscopes to plants and animals they encounter through direct observation, videos, books, or other media.
- Classify or group organisms using categories such as how animals bear their young, anatomical features, or habitats. Compare organisms that live in the ocean to those that live on land.
- Describe the basic needs of all living things and explain how organisms meet their needs in different types of environments such as deserts, lakes, ocean, or forests, and across different climates.

B) Heredity and evolution—Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited.

- Identify some basic traits of plants and animals. Give examples of how those traits may vary among individuals of the same species.
- Identify some similarities among offspring and parents as being inherited and others as resulting from the organism's interactions with its environment.
- Compare fossil life forms and living organisms to identify similarities and differences between organisms that lived long ago and those alive today.

C) Systems and connections—Learners understand basic ways in which organisms are related to their environments and to other organisms.

- Describe ways in which an organism's behavior patterns are related to its environment. Identify examples of environmental change and discuss how these changes may be helpful or harmful to particular organisms.
- Identify ways in which organisms (including humans) cause changes in their own environments. Create a skit that shows how these changes may help or harm both

the organisms that caused the change and other organisms.

- Identify ways in which organisms are interdependent. For example, some animals eat plants, some fish depend on other fish to keep them free of parasites, earthworms keep soil loose and fertile, which makes it easy for plants to grow.

D) Flow of matter and energy—Learners know that living things need some source of energy to live and grow.

- Explain how most living organisms depend on the sun as the source of their life energy. Give examples that illustrate the understanding that animals ultimately depend on plants for this energy and that plants depend on the sun. Use this idea to trace the energy in the food they eat for lunch back to the sun.
- Describe how matter can be recycled, sometimes in a changed form from the original material. Use examples from their own experience, such as fleece jackets made from recycled soda bottles or envelopes made from recycled telephone books. Or make their own recycled paper and explain how the use of matter differs between making recycled paper and new (or "virgin") paper.
- Explain the process of life, growth, death, and decay of living organisms as a form of recycling. For example, use a compost pile to study recycling of organic materials.

Science 129
Science Benchmarks 119

Strand 2.3—Humans and Their Societies

Guidelines:

A) Individuals and groups—Learners understand that people act as individuals and as group members and that groups can influence individual actions.

- Give examples of influences on individual behavior, particularly behavior that affects the environment. For example, discuss why a person might choose to dispose of household garbage, candy wrappers, or toxic products in certain ways. Consider influences such as financial costs, convenience, laws, and the opinions of friends and family members.
- Identify some of the many groups that a person can belong to at the same time. Describe some tensions that a person might feel as a result of belonging to different groups.

References to Standards:

Science Benchmarks 154, 158
Social Studies 57–62

Arts 30
Civics and Government 15–21
English Language Arts 27–29,
38–39
Geography 117, 124–125
History 20–21
Science Benchmarks 154
Social Studies 49–50

Economics 5–6, 30–31
Geography 126–127
Science Benchmarks 168–169
Social Studies 63–66

- Discuss why students might belong to school or after-school clubs (such as environmental clubs or scouting troops). Consider personal benefits (such as fun and learning) as well as good things the clubs do for the whole school or community.

B) Culture—Learners understand that experiences and places may be interpreted differently by people with different cultural backgrounds, at different times, or with other frames of reference.

- Describe their favorite place or their own community from a variety of perspectives, including their own.
- Role-play the reactions of different people to a place or historical event—especially one with local significance.
- Compare how people live in different climates and how different cultures meet basic human needs. For example, prepare a visual display that compares how people support themselves in different climates and discuss how those livelihoods can both affect the environment and depend on the environment.

C) Political and economic systems—Learners understand that government and economic systems exist because people living together in groups need ways to do things such as provide for needs and wants, maintain order, and manage conflict.

- Discuss what might happen if there were no laws to protect the environment in their area. Consider possible positive and negative effects on plants and animals, specific natural areas, landowners, specific businesses, water users, and others.
- List jobs in their community that are linked to processing natural resources. Identify clusters of related businesses and interview employees or owners to determine why those economic activities are located in their community.
- Identify elements of infrastructure (e.g. communications and transportation systems) in their community. For example, create a map or a skit showing how information, people, and goods move from place to place. Include information about who is responsible for, or who pays for, this infrastructure (e.g., the government, private business, individuals).

D) Global connections—Learners understand how people are connected at many levels—including the global level—by actions and common responsibilities that concern the environment.

- Identify ways in which individual needs and wants are related to environmental concerns such as energy use, conservation and environmental protection.
- Describe how trade connects people around the world and enables them to have things they might not be able or willing to produce themselves. For example, create a map that shows where a learner's food, clothing and household items are produced, where the raw materials come from, products that are traded into and out from their region, and so forth.
- Identify possible environmental concerns that might come up in other regions or countries as a result of producing or shipping products that learners use regularly.
- Discuss how television, computers, and other forms of communication connect people around the world.

E) Change and conflict—Learners recognize that change is a normal part of individual and societal life. They understand that conflict is rooted in different points of view.

- Identify aspects of family and community life that have remained constant over generations, as well as aspects that have changed. For example, interview family or community members and develop a visual display about their findings.
- Give examples of rules related to the environment at home, in school, or elsewhere that have changed and others that have stayed the same.
- Identify some basic ways in which individuals, groups, and institutions such as schools resolve conflict concerning the environment. For example, develop and perform short skits about different ways of solving a school problem such as littering on the playground or in hallways.

Civics and Government 33–34
Economics 11, 13
Geography 126–127
Science Benchmarks 176
Social Studies 70–72

English Language Arts 38–39,
45–46
Science Benchmarks 162, 165,
172
Social Studies 51–53

Strand 2.4—Environment and Society

References to Standards:

Geography 132–135
Science 140
Science Benchmarks 128

Arts 34
Geography 113–117
History 29–31
Social Studies 54–56

Economics 1–2
Geography 136–137
History 22
Science 140

Guidelines:

A) Human/environment interactions—Learners understand that people depend on, change, and are affected by the environment.

- Identify ways in which people depend on the environment. For example, create an artistic representation of how the environment provides food, water, air, recreation, minerals, and other resources.
- Identify ways in which human actions change the environment. For example, list changes that activities such as building houses or stores with parking lots, farming, or damming rivers have caused within their community or region.
- Describe how the environment affects human activities in their community or region. For example, describe the effects of weather and climate, the likelihood of earthquakes or flooding, soil and mineral types, or the presence of water on where people live, how they make a living, how they recreate, and so forth.

B) Places—Learners understand that places differ in their physical and human characteristics.

- Identify and describe places in their region that they or others think are important. For example, draw pictures, create a video, or take photographs that illustrate what people find unique or important about regional landmarks, downtown areas, parks, farms, wilderness areas, and so forth.
- Discuss how humans create places that reflect their ideas, needs, and wants, as well as the physical environment. Illustrate with examples of places within their experience such as playgrounds, parks, classrooms, and homes.
- Compare their neighborhood or town with another nearby place, or compare their favorite park with another park they know. List characteristics that make one place different from another.

C) Resources—Learners understand the basic concepts of resource and resource distribution.

- Explain what a natural resource is and give examples.
- Distinguish among resources that are renewable and nonrenewable, and resources (like running water or

wind) that are available only in certain places at certain times.

- Identify ways they use resources in their daily lives.
- Locate sources of various resources on a map. For example, trace the origins of the local water supply or map the region's natural resources.
- Link patterns of human settlement and other activity with the presence of specific resources such as mineral deposits, rivers, or fertile farming areas. Research the origins of their own community and explain the role of resource availability on how the community developed.

D) Technology—Learners understand that technology is an integral part of human existence and culture.

- Describe technologies as tools and ways of doing things that humans have invented. Give examples of technologies that affect their lives in areas such as transportation, communications, and entertainment.
- Interview family members or community members to trace technological changes that have taken place over the last three generations.
- Identify drawbacks and benefits of specific technologies. Consider the fact that technologies can benefit some humans and other organisms while harming others.
- Identify important technological systems such as agriculture, transportation, and manufacturing.

E) Environmental issues—Learners are familiar with some local environmental issues and understand that people in other places experience environmental issues as well.

- Discuss some local environmental issues by identifying some changes or proposals that people disagree about. Describe or role-play how different people feel about these changes and proposals.
- Discuss how people in other places with similar conditions might react or perceive the situation in similar ways.

History 37–38

Science 140

Science Benchmarks 54–55,
184–185, 188–189, 193,
197–198, 201–202

Geography 140–141

Strand 3— Skills for Understanding and Addressing Environmental Issues

Strand 3.1—Skills for Analyzing and Investigating Environmental Issues

References to Standards:

Arts 31
English Language Arts 38–39
History 6, 23
Social Studies 49–53, 57–62

Geography 132–133
Social Studies 54–56

Geography 141
History 23
Social Studies 73–75

Guidelines:

A) Identifying and investigating issues—Learners are able to identify and investigate issues in their local environments and communities.

- Identify and describe a current or historical environmental issue in their community.
- Use primary and secondary sources of information to explore the dilemma confronting people in a current or historical situation that involves the environment.
- Apply ideas of past, present, and future to local environmental issues. For example, describe what has changed, is changing, and could change or discuss how long the issue has existed.
- Identify people and groups that are involved.
- Identify some of the decisions and actions related to the issue.

B) Sorting out the consequences of issues—As learners come to understand that environmental and social phenomena are linked, they are able to explore the consequences of issues.

- Observe and speculate about social, economic, and environmental effects of environmental changes and conditions, and proposed solutions to issues. For example, describe short-term and long-term effects of existing uses of land or another resource in the home, community, and region.
- Discuss how an environmental issue affects different individuals and groups.

C) Identifying and evaluating alternative solutions and courses of action—Learners understand there are many approaches to resolving issues.

- Identify proposed solutions to an issue and discuss arguments for and against them.
- Explain why various strategies may be effective in different situations, and that each proposed strategy is likely to have a different effect on society and the

People Can Choose to Care About and Protect Living Things

From: *A Child's Place in the Environment*,
Lessons 16–18, California Department of Education,
Sacramento, California

Grade Level: 1st

Correlating Guidelines:

Strand 1 B, C

Strand 2.2 A, C

Strand 2.4 A

Strand 3.2 A, C, D

This series of lessons focuses on people's attitudes and actions toward other living things. It is part of a lengthy integrated first grade unit on respecting living things.

The lessons begin by introducing the students to role models that care for living things. Professionals whose work involves protecting wildlife and habitats are invited to speak to the class. The teacher also reads stories such as *Miss Rumphius* (by Barbara Cooney) and *Make Way for Ducklings* (by Robert McCloskey), which give more examples of people helping living things.

Students then draw themselves and what they might be doing to care for living things. The illustrations are posted and, over several days, each student is given the opportunity to describe their drawing.

Lesson 17 concentrates on actions students can take to show they care about plants and animals, including pets. The teacher reads Byrd Baylor's *Amigo* to emphasize that wild animals are better left in their own habitats. Students design a class book, mural or paper quilt to illustrate kind actions toward living things.

In lesson 18, class members brainstorm ideas for a community project. They gather ideas from family, friends, and community representatives such as veterinarians or people working in wildlife rehabilitation. Students then select and complete a class project.

Finally, students write poems or stories, or create dioramas, collages or demonstrations that can be presented in a special open house.

environment. Illustrate with examples from a specific issue.

- Describe some of the different levels at which action can be taken—for example by individuals, families, school classes, different levels of government, or businesses. Identify ways that these groups might take action on a specific issue.
- Propose alternative approaches to problems.

D) Working with flexibility, creativity, and openness—

Learners understand the importance of sharing ideas and hearing other points of view.

- Engage in critique and discussion as part of the process of inquiry. Explain why these processes are important.
- Hear and respect different perspectives and communicate with people whose lives, cultures, and viewpoints are different from their own.

English Language Arts 31–34, 41,
44

Geography 140

Mathematics 128, 194

Social Studies 57–59

- Identify ideas and interpretations that differ from theirs. Ask questions about different perspectives and discuss their strong points and drawbacks.

Strand 3.2—Decision-Making and Citizenship Skills

References to Standards:

Arts 31, 34
 Geography 140–141
 History 23
 Social Studies 57–59

Civics and Government 38–39
 Social Studies 73–75

Civics and Government 6
 Social Studies 73–75

Guidelines:

A) Forming and evaluating personal views—Learners are able to examine and express their own views on environmental issues.

- Identify and express their own ideas about environmental issues and alternative ways to address them.
- Test their views against what they know and believe, remaining open to new information and ideas.
- Identify unanswered questions.
- Identify, clarify, and express their own beliefs and values regarding the environment.

B) Evaluating the need for citizen action—Learners are able to think critically about whether they believe action is needed in particular situations and whether they believe they should be involved.

- Discuss whether citizens should take action on a particular environmental issue. Consider findings from their issue investigations such as causes of the problem and promising strategies for addressing it.
- Identify types of citizen action appropriate for a specific issue.
- Discuss whether and how they think they would like to be involved. Identify reasons for and against taking specific kinds of action.

C) Planning and taking action—By participating in issues of their choosing—mostly close to home—they learn the basics of individual and collective action.

- Develop action plans they can carry out individually, in small groups, or as a class. Include clear reasons and goals for action. Consider the results of their environmental issue investigation and their assessment of the need for action.
- Set realistic goals for action and measures of success consistent with learners' abilities.

- Decide whether their plan should be implemented immediately or at another time, changed, or abandoned; and carry through with action when appropriate.

D) Evaluating the results of actions—Learners understand that civic actions have consequences.

- Describe the apparent effects of their own actions and actions taken by other individuals and groups.
- Discuss some of the reasons why identifying the effects of actions may be difficult. Consider, for example, the time required to see effects, the influences of others' actions, and other changes in the situation.

History 23–24
Social Studies 73–75

Strand 4— Personal and Civic Responsibility

Guidelines:

A) Understanding societal values and principles—Learners can identify fundamental principles of U.S. society and explain their importance in the context of environmental issues.

- Identify examples of beliefs that many U.S. citizens hold in common, such as the importance of individual property rights, the right to pursue happiness, the public or common good, and the well-being of future generations. Create a skit that explores why people might decide to act on environmental issues, considering possible connections with these basic beliefs.
- Discuss how their own beliefs about the environment, environmental issues, and society compare to these general, societal beliefs.
- Recognize tensions that occur when basic values and beliefs differ. Illustrate with examples from local environmental issues.

B) Recognizing citizens' rights and responsibilities—Learners understand the basic rights and responsibilities of citizenship.

- Identify examples of the personal, political, and economic rights of U.S. citizens.
- Identify examples of the responsibilities of citizenship.

References to Standards:

Arts 31
Civics and Government 22–27
English Language Arts 44
Social Studies 60–64, 73–75

Civics and Government 35–37
Social Studies 73–75

- Discuss rights and responsibilities in the context of local environmental issues.

C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.

- Describe ways in which individuals and groups act within their community to protect the environment. Identify cases where citizen action has had an effect on an environmental decision or action.
- Identify ways in which they have made a difference through their own actions. Give examples from situations over which learners have some control (for example, in the classroom, at home, or in the community) and that are appropriate to their level of understanding.

D) Accepting personal responsibility—Learners understand that they have responsibility for the effects of their actions.

- Identify and describe some of the effects that they and the groups they belong to (e.g., family or school class) have on the environment and on humans and other living beings.
- Discuss the notion of responsibility and identify some of their personal responsibilities.

Recycling Snowballs

From: *Getting Started*, National Consortium for Environmental Education and Training, Ann Arbor, Michigan
Grade Level: Lower Elementary

Correlating Guidelines:

Strand 1 A
Strand 2.2 D
Strand 2.3 A, C, E
Strand 2.4 A, C
Strand 4 C, D

Third graders at Greenwood Elementary School in LeGrande, Oregon set up a class recycling center that snowballed into an exploration of a town problem. With their success at school, the students decided to encourage recycling at home. But when families took materials to the town recycling center, they found the bins unattended and spilling over.

The students were also learning about local government, so they invited the mayor to speak to their class about recycling problems. The mayor listened carefully, then explained

budget issues at the heart of the drop-off station's problems.

The snowball kept rolling; next, the students started to investigate ways to reduce and reuse classroom materials.

GUIDELINES FOR THE EIGHTH GRADE

Learners should be able to meet the guidelines included in this section by the end of eighth grade.

In the fifth through eighth grades, learners begin to develop skills in abstract thinking and continue to develop creative thinking skills—and along with these, the ability to understand the interplay of environmental and human social systems in greater depth. Environmental education can foster this development by focusing on investigation of local environmental systems, problems, and issues. As learners become actively engaged in deciding for themselves what is right and wrong, educators can use environmental problems to help learners explore their own responsibilities and ethics.

Strand 1— Questioning, Analysis and Interpretation Skills

References to Standards:

Geography 49
Mathematics 248
Science 145

Guidelines:

A) Questioning—Learners are able to develop, focus, and explain questions that help them learn about the environment and do environmental investigations.

- Identify environmental questions based on personal experiences both in and outside school, newspaper and magazine articles, television or radio news, or videos.
- Summarize an environmental problem or situation to provide context for, or explain the origin of, a particular question. Create visual presentations (such as maps, graphs, or video tapes) and written and oral statements that describe their thinking about the problem.
- Pose clear questions and ideas to test (hypotheses), reformulating them when necessary.
- Clarify their own beliefs about the environment and discuss how those beliefs are reflected in the questions they ask.

B) Designing investigations—Learners are able to design environmental investigations to answer particular questions—often their own questions.

- Select types of inquiry appropriate to their questions.

Mathematics 248
Science 145, 148

Understanding the Local Environment

Experiencing and observing the local environment is an essential part of environmental education. Understanding their surroundings helps learners build a strong foundation of skills and knowledge for reaching out further into the world and deeper into the conceptual understandings that environmental literacy demands. Direct experience in the environment also helps foster the awareness and appreciation that motivate learners to further questioning, better understanding, and appropriate concern and action.

The following chart suggests ways in which learners at different grade levels might explore and understand the local environment. It is printed in each grade level section of these guidelines to help show progression as learners mature. Other ideas are included in the guidelines.

Grades Pre K–4

Identify basic types of habitats (e.g., forests, wetlands, or lakes). Create a short list of plants and animals found in each.

Trace the source of their drinking water and where it goes after it is used.

Recognize resident animal species, migrants, and those that pass through on migratory routes.

Collect or produce images of the area at the beginning of European settlement.

Describe aspects of the environment that change on a daily, weekly, monthly, and yearly basis.

Record weather observations such as precipitation, temperature, or cloud cover.

Identify food crops that are grown or processed locally.

Grades 5–8

Classify local ecosystems (e.g., oak-hickory forest or sedge meadow). Create food webs to show—or describe their function in terms of—the interaction of specific plant and animal species.

Describe how drinking water and wastewater are treated.

Map migratory routes of birds, butterflies, and other animals that pass through the area. Identify their local habitat needs.

Monitor changes in water or air quality, or other aspects of the local environment.

Identify species that are locally threatened, endangered, or declining in population. Describe their habitat needs.

Identify sources of electricity used in the community (e.g., hydroelectric, fossil fuels, solar, nuclear).

Describe the area's climate and identify factors that contribute to it and have changed it over time.

Create a map for the local area that shows where food that is consumed locally comes from.

Grades 9–12

Identify several plants and animals common to local ecosystems. Describe concepts such as succession, competition, predator/prey relationships, and parasitism.

Evaluate sources of nonpoint source pollution of local bodies of water, including sources that are not local.

Investigate short- and long-term environmental changes in a local watershed, aquifer, or in air quality. Or document changes in land use and their environmental effects.

Research population trends for a locally threatened species. Describe changes, activities, and other factors that seem to affect the population trends.

Calculate the potential for generating wind or solar power on a particular site.

Identify local sources of greenhouse gases. Examine the relationship between greenhouse gases in the Earth's atmosphere and climate change.

Trace human population trends and make research-based projections.

- Define the scope of their inquiry, identifying the main variables and phenomena to be studied.
- Select appropriate systems of measurement and observation.
- Select tools that are appropriate for their environmental investigations based on the question asked and the type of information sought.

C) Collecting information—Learners are able to locate and collect reliable information about the environment or environmental topics using a variety of methods and sources.

- Observe systematically, measure accurately, and keep thorough and accurate records, which may include written notes and data tables, sketches, and photographs.
- Understand and use various systems of measurement and derived measurements such as rates.
- Assess, choose, and synthesize materials from resources such as aerial photographs, topographic maps, and satellite images; library and museum collections, historical documents, and eyewitness accounts; computerized databases and spreadsheets; the internet; and government records.
- Collect firsthand information about their own community using field study skills.

D) Evaluating accuracy and reliability—Learners are able to judge the weaknesses and strengths of the information they are using.

- Identify and evaluate vague claims they hear on television or through other media. For example, examine the credibility of results of public opinion polling about environmental topics, considering such factors as sampling methods, logical conclusions, and appropriate analogies.
- Identify factors that affect the credibility of information, including assumptions and procedures used to create it; the social, political, and economic context in which the information was created; and potential bias due to omission, suppression, or invention of factual information.
- Examine evidence, identify faulty reasoning, and apply other basic logic and reasoning skills in evaluating information sources.
- Identify gaps in information that indicate a need for further discovery or inquiry.

Arts 47

English Language Arts 27–28,
38–40

Geography 49–50, 144–145

History 67–68

Mathematics 214, 222, 232, 240

Science 145

Science Benchmarks 294

Social Studies 85–87

History 67–68

Mathematics 248, 256

Science 143, 148

Butterflies After the Hurricane

From: Judi Kohler, Village Pines School

Grade Level: 5th–6th

Correlating Guidelines:

Strand 1 B, C, E, F

Strand 2.2 A, C

In 1992, Hurricane Andrew left this Florida school with little remaining landscaping. By creating a butterfly garden, one middle school class turned the difficult experience into a rewarding interdisciplinary unit on habitat restoration.

Students used their math skills to measure the garden plot and figure out how many plants could fit into the area. In language arts, they wrote letters seeking help selecting plants, and spelling lessons focused on related vocabulary words. The butterflies inspired haiku and acrostic poems, while illustrating the poems drew upon the students' artistic skills.

In social studies, students researched the places butterflies live, and studied the different cultures found along their migratory routes.

A field trip to a local nature center provided an opportunity to learn from a local expert about the needs of butterflies, and scientific observations unveiled the mysteries of metamorphosis and the life cycle of a butterfly.

Arts 50
English Language Arts 35–36
Geography 50–51, 144–145
Mathematics 222, 248, 274, 280
Science 145

- Evaluate data and evidence for accuracy, relevance, significance, appropriateness, and clarity.

E) Organizing information—Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation.

- Present environmental data in a variety of formats including charts, tables, plots, graphs, maps, and flow charts. For example, chart stream flows, create a map of local businesses that require air quality permits, or organize survey results into a table.
- Explain why they chose specific ways of ordering and displaying information. Consider factors such as the question being answered, the type of information, and the purpose of the display.
- Present environmental data in ways that demonstrate possible relationships between sets of information such as population census counts of a certain bird species and the prevalence of certain tree species or habitat types.

F) Working with models and simulations—Learners understand many of the uses and limitations of models.

- Describe how models are used to think about long-term processes such as population growth or processes that are difficult to see such as bird migration or the movement of the planets in relationship to the sun.
- Use models to represent and investigate aspects of the physical world such as weather and specific phenomena such as hurricanes.
- Manipulate mathematical and physical models using a computer.
- Evaluate models based on the question being investigated. Account for variables such as the complexity of the model, its scale, its ability to represent important features of the process being modeled, and its reliability and accuracy.
- Recognize limitations of models and simulations. For example, describe a situation in which a model of an environmental phenomenon is not useful.

G) Drawing conclusions and developing explanations—Learners are able to synthesize their observations and findings into coherent explanations.

- Distinguish between description and explanation and give examples of each based on their own environmental investigations.
- Consider the possible relationships among two or more variables.
- Propose explanations based on what they observed or learned through research, selecting which evidence to use and accounting for discrepancies. Synthesize and interpret information from a range of sources.
- List strengths and weaknesses of proposed explanations. Discuss how the proposed explanation could be rejected or its reliability improved.
- Use their proposed explanations to form new questions and suggest new avenues of inquiry.

Geography 144–145
Mathematics 222, 232
Science 145
Science Benchmarks 286–287

English Language Arts 39–40
Geography 51–52
History 68–70
Mathematics 222, 248, 274, 280
Science 145, 148

Strand 2— Knowledge of Environmental Processes and Systems

Strand 2.1—The Earth as a Physical System

References to Standards:

Geography 156–157
Science 158–160
Science Benchmarks 73

Guidelines:

A) Processes that shape the Earth—Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.

- Analyze physical patterns such as climate, areas of geothermal activity, soil types, sea level rise, and arid regions, suggesting reasons for these patterns. Explain these patterns in terms of abrupt forces (such as earthquakes or major storms) and long-term processes (such as erosion and rock formation), as well as those that are human-caused (such as increases in greenhouse gases, suburban development or agricultural practices).
- Predict the consequences of specific physical phenomena such as a hurricane in a coastal area or heavy grazing in an arid region.
- Consider historical evidence of changes in physical processes and patterns. For example, examine tree rings or formation and melting of glaciers as evidence of climate change.
- Relate physical processes and patterns (such as climate, weather phenomena, and seasonal change) to the Earth/sun relationship. For example, create a model that shows how seasonal change is affected by the Earth/sun relationship.

B) Changes in matter—Learners understand the properties of the substances that make up objects or materials found in the environment.

- Describe a variety of chemical reactions and offer examples from daily life and the local environment.
- Consider the relationship between ocean and atmospheric chemistries.
- Explain properties of materials in terms such as atomic and molecular structure or reactivity. For example, describe why particular building materials have properties such as rigidity, impermeability, or the ability to reflect or gather heat.

Science Benchmarks 77–79
Science 154

- Explain an object's characteristics based on its composition and how it was formed. For example, describe the characteristics of different types of rock and account for these characteristics based on their constituent parts and the processes by which they were formed.

C) Energy—Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.

- Trace the flow of energy in examples that encompass several different transfers and transformations of energy. For example, trace the path of energy in the creation and consumption of fossil fuels.
- Describe how atmospheric gases alter how much solar energy is absorbed or radiated.
- Explain how solar energy contributes to the movement of global air masses, the hydrological cycle and ocean currents.
- Explain how the process of life is based on the conversion, utilization, storage and transfer of energy. For example, create a visual display that shows how plants or animals use energy, where that energy comes from, and where it goes.

Science 155
Science Benchmarks 84–85

Strand 2.2—The Living Environment

Guidelines:

A) Organisms, populations, and communities—Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments.

- Define and give examples to illustrate the concepts of species, population, community, and ecosystem. Trace and give examples of connections among organisms at those levels of organization.
- Link features of internal and external anatomy with the ability of organisms to make or find food and reproduce in particular environments.
- Understand that some animals and plants have adapted to extreme environmental conditions. Give examples of adaptations that are behavioral (for example, the migration of Canada geese and other birds) and physical (such as the physical structures that enable desert animals and plants to exist on minimal amounts of

References to Standards:

Geography 158–159
Science 156–157
Science Benchmarks 104

water). Understand that organisms may be vulnerable to rapid or significant environmental changes.

- Describe how organisms differ in how they use energy. For example, identify organisms that use energy quickly for growth and metabolism, and therefore must replace it quickly (e.g., a hummingbird) and others that use energy more slowly and therefore need to replace it less frequently (e.g., a python). Predict the habitat needs of these different types of organisms.

Science 157–158
Science Benchmarks 108, 124

B) Heredity and evolution—Learners have a basic understanding of the importance of genetic heritage.

- Describe some ways in which variation among individuals of the same species can sometimes give certain individuals an advantage within a specific environment.
- Describe in general terms the theory of natural selection for particular traits and how that process can result in descendants that are quite different from their ancestors.
- Define extinction, cite evidence of extinction, and identify some of its causes.
- Discuss the possible implications of permanent loss of a species and how it affects interdependence within an ecosystem.

Geography 158
Science 157–158
Science Benchmarks 117

C) Systems and connections. Learners understand major kinds of interactions among organisms or populations of organisms.

- Describe and give examples of producer/consumer, predator/prey, and parasite/host relationships.
- Identify organisms that are scavengers or decomposers. Describe the roles they play within particular systems focusing on their relationship to other organisms and physical elements of the system.
- Summarize how abiotic and biotic components in combination influence the structure of an ecosystem. For example, create a map for the local region that shows average temperature and rainfall correlated with local forest, grassland or desert ecosystems. Or discuss the process of soil formation in terms of the interaction of climate, geology, and living organisms.

Science 158
Science Benchmarks 120

D) Flow of matter and energy—Learners understand how energy and matter flows among the abiotic and biotic components of the environment.

- Trace the flow of energy through food webs that identify relationships among organisms in natural systems.
- Explain how matter is transferred among organisms and between organisms and their environment in these food webs. Describe the role played by organisms in the global carbon cycle.
- Describe how energy, which enters ecosystems as sunlight, changes form and is transferred in the exchanges (production, consumption, and decomposition) that comprise food webs.

Strand 2.3—Humans and Their Societies

Guidelines:

A) Individuals and groups—Learners understand that how individuals perceive the environment is influenced in part by individual traits and group membership or affiliation.

References to Standards:

Arts 46
Science Benchmarks 141–142,
155, 159
Social Studies 88–90

PRISM—Providing Resolution with Integrity for a Sustainable Molokai

From: Vicki Newberry, Kaunakakai, Hawaii

Grade Level: Upper Elementary

Correlating Guidelines:

Strand 1 A, B, C, D, E,
F, G
Strand 2.3 C
Strand 2.4 A, B
Strand 3.1 A, B

This Molokai, Hawaii upper elementary school class begins studying local issues early in the school year. To start, they learn about local ecology and begin developing their skills in issue analysis—identifying the problem, issue, parties, positions, beliefs, values, and solutions (according to *Investigating Environmental Issues and Actions* by Hungerford, Litherland, Peyton, Ramsey, and Volk).

The students then select specific problems and issues to work on throughout the year. They are limited to island issues to make it easier to obtain background information and involve the community. Visits to field sites, and an in-class speakers forum help students

begin to understand the complexity of their issues and the players involved. Further investigations during the second quarter deepen their understanding and help them develop findings.

In the spring, students sponsor a community-wide symposium called PRISM. The students invite an adult keynote speaker, but the rest of the day is theirs. They write speeches and present their findings in panels, workshops and action-planning sessions. In 1998, 12 different issues were explored, and 100 adults and 125 students attended the symposium.

- Describe individual development and identity in terms such as learning, perception, innate abilities, culture, social influences, and experience. Interpret their own beliefs about the environment using similar concepts.
- Explain how group membership—and shared values, beliefs, and assumptions—can influence individuals, impel different reactions to physical and social environments and changes, and cause social change. For example, describe how family, religion, gender, ethnicity, socioeconomic status, and other factors may influence individuals' values and perceptions about the environment and their communities.
- Identify and critique instances of stereotyping based on group affiliation. For example, discuss how people who are all identified as "environmentalists" may have very different perspectives from one another.

Arts 48, 51
 English Language Arts 27–29,
 38–39
 Geography 154–155, 162–163
 Science Benchmarks 155
 Social Studies 79–81

B) Culture—As they become familiar with a wider range of cultures and subcultures, learners gain an understanding of cultural perspectives on the environment and how the environment may, in turn, influence culture.

- Explain how the environment is perceived differently by various cultures, and how these perspectives may influence individuals' perceptions of the environment. For example, based on stories from other cultures, script and perform scenes about what is considered beautiful, valuable, or frightening in the environment.
- Explain how new technologies can change cultural perceptions and social behavior. For example, discuss how snowmobiles have changed subsistence lifestyles in Alaska, or the impact of air conditioning on settlement in southern Florida.
- Identify ways in which transportation and communications technology helps, or has helped, spread cultural values and behavior patterns.

C) Political and economic systems—Learners become more familiar with political and economic systems and how these systems take the environment into consideration.

- Differentiate among public and private goods and services, using environment-related goods and services to illustrate. For example, examine the values and functions of wetlands. Distinguish among public goods, such as groundwater recharge, flood control, and wildlife habitat; and private goods, such as their value for agricultural production or water storage, or

Civics and Government 47–52,
 61–70
 Economics 5–7, 19–20, 30–31
 Geography 164–166
 Science Benchmarks 169
 Social Studies 94–98

the value of draining the land for other uses. Discuss difficulties encountered in drawing these distinctions.

- Identify economic and political features of the local community and state, and describe how environmental decisions can be influenced by these economic and political systems and actors.
- Identify ways in which governments and economic systems work to protect the environment and distribute natural resources. Give examples of laws, incentives, and penalties that affect people's behavior toward the environment and each other.

D) Global connections—Learners become familiar with ways in which the world's environmental, social, economic, cultural, and political systems are linked.

- Explain international trade in terms of uneven distribution of resources.
- Describe ways in which the global environment is affected by individual and group actions, as well as by government policies and actions having to do with energy use and other forms of consumption, waste disposal, resource management, industry, and population.
- Explain how an environmental change in one part of the world can have consequences for other places. For example, develop a map or another visual presentation that shows the effects of acid rain or nuclear fallout in places distant from the source of the pollution.
- Identify a variety of global links, including transportation and communication systems, treaties, multi-national corporations, and international organizations.

E) Change and conflict—Learners understand that human social systems change over time and that conflicts sometimes arise over differing and changing viewpoints about the environment.

- Describe patterns of change within and across cultures, communities, and other groups. Consider the rapidity of change, mechanisms that helped spread change, and what motivated change. For example, discuss how and why wastewater treatment became a common practice in the United States.
- Explain how change affects individuals and groups differently and give examples of the trade-offs involved in decisions and actions ranging from the individual to the societal levels. For example, discuss

Civics and Government 71–73
Geography 164–166, 171–172
Science Benchmarks 177
Social Studies 102–104

Science Benchmarks 163, 166,
173
Social Studies 82–84, 91–93

how a decision about where to site a landfill, build a chemical plant, or locate a new highway might affect different neighborhoods, businesses, workers, people of varying socio-economic status, and others.

- Describe and analyze examples of tensions between individual rights and benefits and the societal good. Illustrate with examples from the local community, possibly including disagreements over zoning, controversial proposals to raise taxes to pay for the purchase of open space or sewer system upgrades, or tradeoffs between commuting to work individually in a car or taking public transportation.
- Identify some of the formal and informal ways that groups (including governments) attempt to anticipate, avoid, or resolve conflicts related to the environment.

Strand 2.4—Environment and Society

References to Standards:

Geography 173–175
Science 168–169

Guidelines:

A) Human/environment interactions—Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.

- Describe intended and unintended environmental and social consequences associated with the changing use of technologies. Consider consequences that may be positive as well as negative. For example, discuss particular irrigation methods, different ways of generating electrical power, or the use of synthetic pesticides.
- Explain how human-caused environmental changes cause changes in other places. For example, discuss the effects of building a dam on downstream plant and animal communities as well as on human communities or how climate change might reduce the availability of food, water and land.
- Describe the effects of a local environmental restoration effort, such as wetlands creation. Predict the long-term consequences of such efforts, or a particular restoration project.

B) Places—Learners begin to explore the meaning of places both close to home and around the world.

- Analyze physical and human characteristics of places and make inferences about how and why these characteristics have developed and changed over time.

Arts 50
Geography 150–155
Social Studies 85–87, 99–101

Live Oaks Communities

From: Teaching Naturally

Grade Level: Middle School (Grades 5–8)

Correlating Guidelines:

Strand 1 E

Strand 2.3 A

Strand 2.4 A, B, C

Strand 3.1 A, B, C, D

Near the school, there's a wooded section of public land, called a green way, with a live oak hammock ecosystem. Taking advantage of the green way's proximity, four instructors developed a coordinated unit that used the site and met learning objectives for each discipline.

In science, students learned about interrelationships by studying an oak tree and the diverse organisms that it supports. The class walked to the green way and, in small groups, conducted inventories of selected trees. The groups used field guides to identify and record the plants, animals, and animal signs they discovered.

The math instructor helped students compile and graph their data and interpret their findings. The students learned to calculate percentages by figuring the relationship of each animal or plant group to the total biodiversity of the area.

Students read Longfellow's *Evangeline* and other stories involving oaks, which

prompted them to write folk tales about trees. The art teacher also got into the act with lessons on foreground and background perspectives that helped students draw pencil sketches of their study trees to illustrate their stories.

In social studies, students estimated the age of their trees and developed time lines of historical events that took place during the trees' life spans.

As questions arose about preserving and removing trees, students researched city planning, tree ordinances, and other related civic issues.

To culminate the interdisciplinary unit, student groups used county maps to identify several large oak trees, then developed a rationale for locating a new county road that accounted for site and materials. The recommendations were presented in a mock county planning meeting.

For example, use maps and satellite photographs to examine how cities change in response to natural disasters such as floods, hurricanes, or earthquakes.

- Identify ways in which personal perceptions, culture, and technology influence people's perceptions of places. Discuss the importance of some places (such as Yellowstone National Park or the Mississippi River) as cultural symbols.
- Identify regions based on different criteria such as watershed boundaries, climate, sales and service areas for different businesses, or the area from which sports teams draw fans or symphony orchestras attract audiences.

C) Resources—Learners understand that uneven distribution of resources influences their use and perceived value.

- Map and discuss distribution and consumption patterns for specific resources, such as metals, fresh water, or certain types of forests. Note resources that are being rapidly depleted or might be impacted by climate change.
- Explain why certain resources (such as oil, coal, or natural gas) have been key to the development of human societies, and identify resources that were critical to development at different times in history. Consider the implications of switching from carbon-intensive to renewable energy sources.
- Explain conflicts between individuals, states, regions, or nations noting factors such as differing attitudes about the use of specific resources and scarcity of natural resources. Illustrate with local or regional examples such as conflicts over water rights and use of habitat for local endangered species.

D) Technology—Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.

- Discuss technologies in the context of larger systems that have shaped the course of human history as well as human relationships with the environment. Use illustrations from the agricultural, industrial and transportation revolutions that have dramatically changed how people live and use resources.
- Analyze how the ability to develop and use technology gives humans great influence over the environment and ability to adapt to environmental changes such as rising sea levels and new climate conditions. Use examples from their region, such as the ability to construct levees to protect areas from flooding or create wildlife refuges, build machines that produce or reduce air or water pollution, or domesticate plants or animals for food production.
- Identify some of the important environmental and social issues related to particular technological developments in fields such as agriculture, manufacturing, and energy.

E) Environmental issues—Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that people in other places

around the world experience environmental issues similar to the ones they are concerned about locally.

- Identify other places, either contemporary or historical, experiencing issues similar to those in the learner's community or region.
- Explain how issues arise because of conflicting points of view about a specific proposal, event, or condition in the environment. For example, discuss conflicting perspectives about past and present proposals to build large-scale dams such as the Three Gorges project in China, the Hetch Hetchy dam in the U.S., or a similar project in the learner's region.
- Discuss how the disagreements at the heart of environmental issues makes them difficult to resolve. Consider the role of understanding, creativity, or compromise in finding solutions to issues such as climate change.

Strand 3— Skills for Understanding and Addressing Environmental Issues

Strand 3.1—Skills for Analyzing and Investigating Environmental Issues

Guidelines:

A) Identifying and investigating issues—Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community.

- Clearly articulate and define environmental issues. For example, describe the history and origins of the issue, actions that have been taken to address the issue, the apparent effects of these actions, and the current situation.
- Identify key individuals and groups involved, their viewpoints, and the types of action they support. Describe areas of conflict and agreement.
- Investigate the issue using secondary sources and original research where needed.
- Examine how others have analyzed and understood the issue, identifying their approaches and the assumptions behind them.

References to Standards:

Geography 164–166, 169–170,
179–182
History 68–70
Social Studies 79–93, 105–107

- Compare the issue with similar issues from other places and times.

B) Sorting out the consequences of issues—Learners are able to apply their knowledge of ecological and human processes and systems to identify the consequences of specific environmental issues.

- Describe the effects of human actions on specific elements, systems, and processes of the environment.
- Analyze issues by looking at trade-offs that have been made. For example, consider where various human activities (such as landfills, highways, chemical factories, or hazardous waste incinerators) are located and their effects on different places and different segments of the population.
- Speculate about the effects of a proposed state or local environmental regulation. For example, consider effects on different sectors of the economy, neighborhoods, public health, particular plant and animal species and communities, and overall environmental quality.
- Predict the consequences of inaction or failure to resolve particular issues.

C) Identifying and evaluating alternative solutions and courses of action—Learners are able to identify and develop action strategies for addressing particular issues.

- Identify different proposals for resolving an environmental issue. Recognize and explain the perspectives on the issue that are embedded in those views.
- Explain why various strategies may be effective in different situations. Consider their likely effects on society and the environment.
- Independently and in groups, develop original strategies to address issues.
- Discern similarities and differences in problem situations which might affect their ability to apply strategies that were successful in other places and times.

D) Working with flexibility, creativity, and openness—Learners are able to consider the assumptions and interpretations that influence the conclusions they and others draw about environmental issues.

- Explain how the interplay of ideas and perspectives strengthens the process of inquiry and the societal ability to address issues.
- Receive questions and alternative explanations that others offer in discussions as well as in readings.
- Explain why it is not always possible to select one correct explanation or a single best approach to addressing an issue.

Strand 3.2—Decision-Making and Citizenship Skills

Guidelines:

A) Forming and evaluating personal views—Learners are able to identify, justify, and clarify their views on environmental issues and alternative ways to address them.

- Discuss personal perspectives with classmates, remaining open to new ideas and information.
- Justify their views based on information from a variety of sources, and clear reasoning.
- Discuss their own beliefs and values regarding the environment and relate their personal view of environmental issues to these.
- Identify ways in which others' views correspond or differ with their own views.

B) Evaluating the need for citizen action—Learners are able to evaluate whether they believe action is needed in particular situations, and decide whether they should be involved.

- Discuss whether action is warranted. Account for factors such as the scale of the problem; legal, social, economic, and ecological consequences; and alternatives to citizen action.
- Identify different forms of action that citizens can take in the economic, political, and legal spheres, as well as actions aimed at directly improving or maintaining some part of the environment or persuading others to take action.
- Speculate about the likely effects of specific actions on society and the environment, and the likelihood these actions will resolve a specific environmental issue.

References to Standards:

Arts 40
 Geography 179–182
 History 70
 Social Studies 88–90

Civics and Government 68–70
 Social Studies 105–107

The Many Sides of Cotton

From: *Windows on the Wild—Biodiversity Basics*,
World Wildlife Fund

Grade Level: Middle School (grades 6–9)

Correlating Guidelines:

Strand 1 A, C, D, E, G

Strand 2.4 A, C, D, E

Strand 3.1 A, B, C, D

This activity is part of a broader unit on biodiversity, and incorporates social studies, science, and language arts.

Students begin by exploring a hypothetical controversy, such as supposing that the school has to cut the budget and must choose between the music program or after-school sports.

Through this exercise, students are introduced to issue analysis: identifying the problem, the issue, the parties involved and their positions, the beliefs that shape those positions, and the values that underlie them, and examine possible solutions.

Once familiar with the approach, students apply the issue analysis process to examine the pros and cons of growing organic and

conventional cotton. Using readings written by people with diverse perspectives on the issue, students work individually or in groups to analyze the articles for points of agreement and disagreement, facts, opinions, and bias. Individually or in groups, they complete a chart on sorting out the issues.

Finally, students write a personal position statement on conventional versus organic cotton, making sure to back up their statements with specific reasons, and describing whether and how their positions will affect their actions as a consumer and a citizen.

- Point out advantages and disadvantages of their personal involvement, considering factors such as their own skills, resources, knowledge, and commitment.

Civics and Government 80–83
Social Studies 105–107

C) Planning and taking action—As learners begin to see themselves as citizens taking active roles in their communities, they are able to plan for and engage in citizen action at levels appropriate to their maturity and preparation.

- Develop action plans they can carry out individually, in small groups, or with a class, club, or larger organization. Include clear reasons and goals for action. Base these plans on knowledge of a range of citizen action strategies and the results of their environmental issue investigations.
- Set realistic goals for action and include measures of success consistent with learners' abilities and an understanding of the complexity of the issue.
- Decide whether their plan should be implemented immediately or at another time, changed, or abandoned; and carry through with action when appropriate.

D) Evaluating the results of actions—Learners are able to analyze the effects of their own actions and actions taken by other individuals and groups.

- Analyze the effects of decisions, policies, and actions taken by individuals and groups on a particular issue.
- Analyze their own actions, explaining apparent effects and discussing them in light of students' goals and reasons for acting.
- Describe some of the reasons why analyzing the results of actions may be difficult, including the scale of the issue, the time required to see effects, and the influence of other actions and factors.

History 70
Social Studies 105–107

Strand 4— Personal and Civic Responsibility

Guidelines:

A) Understanding societal values and principles—Learners understand that societal values can be both a unifying and a divisive force.

- Identify some of the shared political values and principles that unite American society, and explain their importance.
- Discuss conflicting views about the meaning and application of shared values in specific issues. For example, explore conflicting views about the idea that one person's rights end where they infringe on another's. Use a specific context such as proposed sports stadium or whether to permit an industrial facility or housing development that is likely to pollute a stream.
- Identify ways in which advocates appeal to values such as individual freedoms, property rights, the public good, economic well-being, and patriotism. For example, analyze speeches and writings on specific environmental issues.
- Evaluate the principle of stewardship as a shared societal value. For example, compare conceptions of stewardship contained in writings of John Muir, Gifford Pinchot, and Aldo Leopold with their own understanding.

References to Standards:

Civics and Government 58–60
English Language Arts 44
Social Studies 105–107

B) Recognizing citizens' rights and responsibilities—Learners understand the rights and responsibilities of citizenship and their importance in promoting the resolution of environmental issues.

- Identify rights and responsibilities associated with citizenship, including personal and civic responsibilities.
- Describe ways in which commonly accepted rights and responsibilities of citizenship motivate people to help resolve environmental issues. Consider rights and responsibilities such as acquiring, using and selling property; the right to vote; freedom of speech and assembly; accepting responsibility for the consequences of one's actions; obeying the law; and respecting the rights and interests of others.

C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.

- Explain the ways in which citizen action and public opinion influence environmental policy decisions.
- Describe how individuals and groups act within society to create change, meet individual needs and promote the common good. Illustrate with examples from environmental issues.
- Describe ways in which their actions have made a difference. Use examples that begin in the classroom and the home, and extend beyond to encompass the broader communities in which students begin to see possibilities for action.

D) Accepting personal responsibility—Learners understand that their actions can have broad consequences and that they are responsible for those consequences.

- Analyze some of the effects that their actions (and the actions of their families, social groups, and communities) have on the environment, other humans, and other living beings.
- Describe actions in terms of their effects that reach into the future.
- Describe their personal responsibilities, comparing their view of their responsibilities with commonly accepted societal views.
- Identify ways in which they feel responsible for helping resolve environmental issues within their community.

GUIDELINES FOR TWELFTH GRADE

Learners should be able to meet the guidelines included in this section by the time they graduate from high school.

By the end of twelfth grade, learners are well on their way to environmental literacy. They should possess the basic skills and dispositions they need to understand and act on environmental problems and issues as responsible citizens—and to continue the learning process throughout their lives. In the ninth through twelfth grades, environmental education can promote active and responsible citizenship by challenging learners to hone and apply problem-solving, analysis, persuasive communication, and other higher level skills—often in real-world contexts.

Strand 1— Questioning, Analysis and Interpretation Skills

References to Standards:

Geography 53
History 68–70
Mathematics 324
Science 175

Guidelines:

A) Questioning—Learners are able to develop, modify, clarify, and explain questions that guide environmental investigations of various types. They understand factors that influence the questions they pose.

- Articulate environmental phenomena or topics to be studied at scales ranging from local to global.
- Pose a research question and hypothesis, identifying and defining key variables. For example, develop hypotheses about land use in a region by drawing on maps, newspaper articles, databases, and personal observations.
- Identify historical and current ideas and beliefs—for example, about the environment, human perceptions of the environment, or the nature of knowledge—that inform their questions.

B) Designing investigations—Learners know how to design investigations to answer particular questions about the environment. They are able to develop approaches for investigating unfamiliar types of problems and phenomena.

- Select appropriate means of inquiry, including scientific investigations, historical inquiry, and social science observation and research.

Geography 53
History 67–68
Mathematics 324
Science 175

Understanding the Local Environment

Experiencing and observing the local environment is an essential part of environmental education. Understanding their surroundings helps learners build a strong foundation of skills and knowledge for reaching out further into the world and deeper into the conceptual understandings that environmental literacy demands. Direct experience in the environment also helps foster the awareness and appreciation that motivate learners to further questioning, better understanding, and appropriate concern and action.

The following chart suggests ways in which learners at different grade levels might explore and understand the local environment. It is printed in each grade level section of these guidelines to help show progression as learners mature. Other ideas are included in the guidelines.

Grades Pre K–4

Identify basic types of habitats (e.g., forests, wetlands, or lakes). Create a short list of plants and animals found in each.

Trace the source of their drinking water and where it goes after it is used.

Recognize resident animal species, migrants, and those that pass through on migratory routes.

Collect or produce images of the area at the beginning of European settlement.

Describe aspects of the environment that change on a daily, weekly, monthly, and yearly basis.

Record weather observations such as precipitation, temperature, or cloud cover.

Identify food crops that are grown or processed locally.

Grades 5–8

Classify local ecosystems (e.g., oak-hickory forest or sedge meadow). Create food webs to show—or describe their function in terms of—the interaction of specific plant and animal species.

Describe how drinking water and wastewater are treated.

Map migratory routes of birds, butterflies, and other animals that pass through the area. Identify their local habitat needs.

Monitor changes in water or air quality, or other aspects of the local environment.

Identify species that are locally threatened, endangered, or declining in population. Describe their habitat needs.

Identify sources of electricity used in the community (e.g., hydroelectric, fossil fuels, solar, nuclear).

Describe the area's climate and identify factors that contribute to it and have changed it over time.

Create a map for the local area that shows where food that is consumed locally comes from.

Grades 9–12

Identify several plants and animals common to local ecosystems. Describe concepts such as succession, competition, predator/prey relationships, and parasitism.

Evaluate sources of nonpoint source pollution of local bodies of water, including sources that are not local.

Investigate short- and long-term environmental changes in a local watershed, and aquifer, or in air quality. Or document changes in land use and their environmental effects.

Research population trends for a locally threatened species. Describe changes, activities, and other factors that seem to affect the population trends.

Calculate the potential for generating wind or solar power on a particular site.

Identify local sources of greenhouse gases. Examine the relationship between greenhouse gases in the Earth's atmosphere and climate change.

Trace human population trends and make research-based projections.

- Select and develop appropriate problem solving strategies for conducting environmental investigations.
- Incorporate a wide range of tools and technologies as appropriate, including complex maps, measurement instruments and processes, and computer-based analysis.

C) Collecting information—Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data.

- Use basic sampling techniques such as spatial sampling and random sampling. Evaluate when these techniques are appropriate.
- Apply data collection skills in field situations, such as interviewing community members about environmental concerns or sampling water in a local stream.
- Gather information from a variety of sources including historical sites, censuses, tax records, statistical compilations, economic indicators, interviews or surveys, geographical information systems, and other data banks.
- Adjust information collection strategies to compensate for potential bias in information sources.
- Perform basic statistical analyses to describe data using quantitative measures such as mean, median and mode.

D) Evaluating accuracy and reliability—Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources.

- Identify logical errors and spurious statements in everyday situations such as political speeches about the environment or commercial advertising.
- Look for and explain flaws such as faulty or misleading use of statistics, misrepresentation of data that is presented graphically, or biased selection of data to support a claim. For example, analyze the public debate over an environmental issue. Examine speeches, advertisements, news releases, and pamphlets put out by groups on various sides of the issue.

English Language Arts 27–28,
38–40
Geography 53, 184–185
History 67–68
Mathematics 290, 296, 308, 320
Science Benchmarks 230
Social Studies 118–120

English Language Arts 38–39
Geography 55
History 67–68
Mathematics 324, 334
Science 175–176
Science Benchmarks 230, 234,
300

English Language Arts 35–36
Geography 53–54, 184–185
Mathematics 296, 324, 354, 360

English Language Arts 37
Geography 54–55, 184–185
Mathematics 296, 308
Science 175
Science Benchmarks 230, 270

English Language Arts 36–37
Geography 55–56
History 68
Mathematics 296, 324, 354, 360
Science 173–176
Science Benchmarks 230, 300

- Explain why some research results are judged to be more credible than are others. Consider factors such as possible sources of bias in interpretation, funding sources, and research procedures.

E) Organizing information—Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes.

- Attend to details such as the type and accuracy of data, scale, accuracy of representation, and ease of interpretation.
- Evaluate the strengths and weaknesses of the particular means of presentation for different purposes.
- Work with technology designed to relate and display data, such as database and mapping software.
- Integrate and summarize information using a variety of media ranging from written texts to graphic representations, and from audiovisual materials to maps and computer-generated images.

F) Working with models and simulations—Learners are able to create, use, and evaluate models to understand environmental phenomena.

- Use algebraic and geometric models to represent processes or objects such as movement along earthquake fault lines, traffic flows, or population growth.
- Use computers to create models and simulations. For example, project the effects of habitat fragmentation on species diversity, the air-quality effects of a new factory, the economic impacts of proposed water quality rules, or the visual changes a new housing development will make on the landscape.
- Compare the applicability of models for particular situations, considering the models' assumptions as one factor. Explain how a single model may apply to more than one situation and how many models may represent a single situation.
- Evaluate and report the limitations of models used.

G) Drawing conclusions and developing explanations—Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses.

- Use basic statistical analysis and measures of probability to make predictions and develop interpretations based on data.

The Wood Duck Project

From: Karen Cifranick, Joppatowne High School,
Joppatowne, Maryland

Grade Level: High School

Correlating Guidelines:

Strand 1 C, D, G

Strand 2.2 A

Strand 2.3 A

Joppatowne High School's science curriculum is taught through investigations and hands-on study. One such study concerned the decline of wood ducks in a freshwater marsh near the school.

With start-up funds from the Chesapeake Bay Trust, students in Joppatowne's environmental science class built fifty wood duck nesting boxes. They worked with staff from Chesapeake Wildlife Heritage and the Chesapeake Bay Foundation to identify appropriate locations and installed the boxes in Maryland's Gunpowder River Marsh.

Next, the students collected baseline data for monitoring the use of the boxes by wood ducks in the next nesting season. Students compared their data to other nesting projects in the county and state.

When spring came, the students anxiously collected field data to gauge nesting success. Their findings showed 25 percent of the boxes were occupied.

Each year, new students continue to monitor nesting and repair boxes as necessary. The latest data shows 69 percent of the boxes in use.

- Differentiate between causes and effects and identify when causality is uncertain.
- Speak in general terms about their confidence in proposed explanations as well as possible sources of uncertainty and error. Distinguish between error and unanticipated results in formulating explanations. Consider the assumptions of models and measuring techniques or devices as possible sources of error.
- Identify what would be needed to reject the proposed explanation or hypothesis.
- Based on experience, develop new questions to ground further inquiry. For example, draw on the results of a stream-monitoring project to develop questions that guide an investigation into water quality issues in the community or the watershed.

Strand 2— Knowledge of Environmental Processes and Systems

Strand 2.1—The Earth as a Physical System

References to Standards:

Geography 197–198
Science 187–189
Science Benchmarks 74

Guidelines:

A) Processes that shape the Earth—Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth.

- Relate different types of climate to processes such as the transfer of heat energy, cloud formation, wind and ocean currents, atmospheric circulation patterns, and the cycling of water. Explain how positive feedback loops can effect climate.
- Use examples such as the El Niño effect or the Santa Ana winds to illustrate how changes in wind patterns or ocean temperatures can affect weather in different parts of the world.
- Explain distinctive landforms in terms of the physical processes (particularly those related to changes in the Earth's crust or long-term processes such as erosion) that shaped them.
- Describe possible relationships between surface water and ground water. For example, create a model or a cross-sectional drawing that shows surface- and groundwater flows in a local drainage. Explain why surface and ground water are related in these ways.

B) Changes in matter—Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.

- Explain everyday chemical reactions such as burning fossil fuels, photosynthesis, or the creation of smog in terms such as the release or consumption of energy, the products of these reactions, and how these products may be involved in further chemical reactions and/or affect biogeochemical cycles.
- Explain the chemical components of biological processes such as photosynthesis, respiration, nitrogen fixation, or decomposition, and how biological and physical processes fit in the overall process of biogeochemical cycling.

Science 177–179
Science Benchmarks 79–80

- Explain why elements cycle through the biosphere at different rates, describing influences on reaction rates. (Oxygen and nitrogen cycle quickly, for example, while phosphorus tends to be released from its immobile form more slowly, depending upon factors such as soil acidity.)

C) Energy—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.

- Compare different means of generating electricity (such as coal-burning plants, nuclear reactors, wind, geothermal, and hydropower) in terms of the transformation of energy among forms, the relationship of matter and energy, and efficiency/production of heat energy.
- Explain differences in conductivity among materials and relate these ideas to real-world phenomena.
- Compare the efficiency of various types of motors or heating systems.
- Use the laws of thermodynamics to explain why natural systems need a certain amount of energy input to maintain their organization.
- Explain the dynamic relationship between greenhouse gases, solar energy absorption and radiation, and climate.

Science 180–181

Science Benchmarks 85–86, 195

Strand 2.2—The Living Environment

Guidelines:

A) Organisms, populations, and communities—Learners understand basic population dynamics and the importance of diversity in living systems.

- Discuss the relationship of habitat changes to plant and animal populations. Consider such factors as variations in habitat size, fragmentation, and fluctuation in conditions such as pH, oxygen, temperature, available light, or precipitation. For example, describe the effects of a lake's eutrophication on plant, insect, bacteria, and fish populations, or why organisms might be vulnerable to rapid or significant climate changes.
- Discuss some of the ways in which populations can change over time, using ideas such as cyclic fluctuations, equilibrium, and coupled oscillations.

References to Standards:

Science 186

Science Benchmarks 105

Evaluate influences on population growth rate, including reproductive strategies and resource limitations.

- Explain how diversity of characteristics among organisms of a species increases the likelihood of the species surviving changing environmental conditions.
- Explain how variation among species in a system increases the likelihood that at least some species will survive changes in environmental conditions.

Science 185
Science Benchmarks 108–109,
124–125

B) Heredity and evolution—Learners understand the basic ideas and genetic mechanisms behind biological evolution.

- Describe the mechanisms of natural selection, incorporating factors such as genetic variation, the effect of inherited characteristics on individual survival and reproduction within a given environment, and the effects of environmental change.
- Use the theory of natural selection and concepts such as mutation, gene flow, and genetic drift to account for the adaptation of species to specific environments.
- Explain the idea that the more biological diversity there is today, the more there may be in the future. Offer examples of exceptions to this general rule, and use it to help explain past mass extinctions.

Geography 158–159
Science 186
Science Benchmarks 117

C) Systems and connections—Learners understand the living environment to be comprised of interrelated, dynamic systems.

- Apply the concepts of ecosystem and ecoregion to organize the multitude of relationships among organisms and environments encountered in earlier studies.
- Discuss the interactions among organisms and their environments. Explain ecosystem change with respect to variables such as climate change, the introduction of new species, and human impacts; and explain processes such as desertification and soil formation as mechanisms for such change.
- Describe succession in ecosystems and their constituent plant and animal communities. Illustrate this idea with examples such as the slow transformation of a volcanic island from barren rock to rain forest as initial plant colonizers create conditions favorable to other species, or the more rapid changes that occur after beavers dam a stream.

- Describe how adding a species to, or removing one from, an ecosystem may affect other organisms and the entire system.

D) Flow of matter and energy—Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.

- Illustrate how energy for life is provided primarily by continual inputs from the sun, captured by plants through photosynthesis and converted into carbon-based molecules. Describe exceptions such as geothermal energy.
- Trace the flow of matter and energy through living systems, and between living systems and the physical environment, identifying feedback loops. For example, show how oxygen is released to the atmosphere by the interaction of plants, animals, and non-living matter in the global carbon cycle. Or use the carbon cycle to explain the existence of fossil energy sources.
- Explain how the abundance and distribution of living organisms are limited by the available energy and certain forms of matter such as water, oxygen, and minerals.

Science 186
Science Benchmarks 121

Strand 2.3—Humans and Their Societies

Guidelines:

A) Individuals and groups—Learners understand the influence of individual and group actions on the environment, and how groups can work to promote and balance interests.

- Predict how the environmental effects of their personal actions might change over time. Consider variables such as technological advances, lifestyle changes, or taking on such roles as business owners, employees in various careers, or parents.
- Analyze how the actions of societal organizations such as businesses or community groups may have environmental consequences and other impacts that go beyond the intended aims of the group.
- Describe how particular groups meet or balance individual needs, group goals, and the common societal good. Use examples such as conservation organizations, organizations of professionals in environmental or resource management fields, community associations, or business groups.

References to Standards:

Economics 1–3, 19–20
Science Benchmarks 142, 156,
160
Social Studies 121–126

B) Culture—Learners understand cultural perspectives and dynamics and apply their understanding in context.

- Analyze how cultural change and altered views of the environment are related. For example, discuss how the shift away from a largely rural society to a predominantly urban one may influence changing perceptions of the environment.
- Recognize diverse cultural views about humans and the environment. Anticipate ways in which people from different cultural perspectives and frames of reference might interpret data, events, or policy proposals.
- Describe and compare historical and contemporary societal strategies for adapting to environmental or social change while preserving and transmitting

Getting Involved in a Local Landfill

From: Environmental Education Association of New Mexico

Grade Level: High School

Correlating Guidelines:

Strand 1 A, B, C, E, G
Strand 2.1 A
Strand 2.2 A, C
Strand 2.3 A, B, C, E
Strand 2.4 A, B, C, D, E
Strand 3.1 A, B, D
Strand 3.2 A

When a controversial landfill opened near their southern New Mexico community, local high school students expressed concerns to teacher, Mr. Licona. Knowing his students needed to be informed about landfills, Licona provided several avenues of investigation. Students teamed up for a year-long research project that ultimately earned university scholarships for two students, and employment at the landfill for a third.

Grants, fundraising activities, and personal funds ensured that the students' vantage point was not restricted. With these funds, the students were able to visit research areas including the proposed location for burial of low-level nuclear waste near Carlsbad and a Texas site where sewage sludge is applied to the arid desert land.

Guest speakers from New Mexico State University's Waste Management Education

Research Consortium and Westex Labs spoke with the class, and students discussed liner safety issues and future reclamation plans with the landfill director. Class members attended city council meetings, and met with a community group concerned with the landfill's placement. Each student was also responsible for providing at least two related internet sources, two magazine articles, and two library sources to the class.

The students synthesized their learning through reflective papers. Using computer technology, concept maps, and other visual aids, they shared their findings and recommendations in presentations to their classmates, community agencies, and the landfill director.

culture. For example, describe ways resource-dependent communities (those whose economies traditionally relied on activities such as mining or timber harvest) work to maintain their identities in the face of mine closures or declining timber harvests.

C) Political and economic systems—Learners understand how different political and economic systems account for, manage, and affect natural resources and environmental quality.

- Explain the development of economic systems using the economic idea of scarcity and the geographic idea of uneven distribution of resources.
- Compare the U.S. political and economic systems with other types of systems, focusing on how the systems govern the use of natural resources, control production and consumption, and protect environmental quality.
- Evaluate the environmental and societal costs and benefits of allocating goods and services in different ways (e.g. through public or private sectors). For example, explain problems such as over-fishing, over-grazing, and deforestation considering what can happen to resources that are commonly owned and openly accessible. Or examine successful common property management systems that promote sustainable use of resources.
- Explain current and historical environmental issues in terms of political and economic ideas. For example, analyze the role of private property rights and the concept of general welfare in shaping decisions about the use and protection of wetlands in the United States.
- Evaluate the structure and functions of the United Nations and its agencies in addressing global environmental issues.

D) Global connections—Learners are able to analyze global social, cultural, political, economic, and environmental linkages.

- Explain regional and national economic specialization and international trade in terms of uneven distribution of resources and differing costs of producing similar goods (due to factors such as climate, labor costs, and energy costs).
- Describe global connections in systems such as the economy, transportation, and communication. Evaluate the effects of changes in these systems on

Civics and Government 96–98,
110–120
Economics 5–7, 19–20, 30–33
Geography 206–207, 210–211
Science Benchmarks 170
Social Studies 127–131

Civics and Government 121–126
Economics 11–12
Geography 206–207, 210–211
Science Benchmarks 178
Social Studies 136–138

communities and the environment on a global scale. Consider instances in which global linkages are strong, and in which they are relatively weak.

- Evaluate the connections among interests, decisions, and actions taken at the individual, community, regional, national, and global levels. Consider their effect on global issues such as human rights, economic development, health, resource allocation, and environmental quality. For example, examine the influence of factors such as consumer preferences, U.S. foreign policy, international treaties and governing bodies, international nongovernmental organizations, and corporate operations on agricultural practices in developing nations.

Economics 19–20
Geography 210–211
Science Benchmarks 163, 166,
173
Social Studies 124–129

E) Change and conflict—Learners understand the functioning of public processes for promoting and managing change and conflict, and can analyze their effects on the environment.

- Explain how public decision-making about the environment takes into account (or fails to account for) uneven distribution of, or different types of, costs and benefits; future or distant consequences; and difficulties assessing the value of certain costs or benefits such as ecosystem services or clean air.
- Evaluate the role of social, political, and economic institutions in the United States in managing change and conflict regarding environmental issues. Account for the influence of institutions such as the legal system and property rights as well as organizations such as banks, nonprofit groups, corporations, and special interest groups.
- Evaluate the conditions and motivations that lead to conflict, cooperation, and change among individuals, groups, and nations. Look particularly at the effects of these forces on the control of natural resources. For example, examine the origins and effects of international treaties and accords on whaling and commercial fishing or climate change.
- Evaluate various governmental and non-governmental strategies for promoting social change. For example, trace the strategies used by different groups to reduce energy use in the U.S.

Strand 2.4—Environment and Society

Guidelines:

A) Human/environment interactions—Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs.

- Evaluate ways in which technology has changed humans' ability to alter the environment and its capacity to support humans and other living organisms. Consider technologies that have had impacts learners see as positive, as well as negative.
- Analyze specific examples of environmental change in terms of qualitative and quantitative costs and benefits for different groups of people and specific species or ecosystems. For example, evaluate the effect of sea level rise and other possible impacts of climate change.
- Describe factors that limit the physical environment's capacity to support particular types of human activity such as suburban development, flood control, or particular agricultural practices.
- Evaluate the cumulative effects of human actions on a specific species or environmental system, such as a stream or a watershed.
- Use the concepts of carrying capacity and ecological footprint to analyze the sustainability of current trends in world population growth and natural resource consumption.

B) Places—Learners understand "place" as humans endowing a particular part of the Earth with meaning through their interactions with that environment.

- Analyze how places change over time as the physical environment changes and as human use and perceptions change. For example, examine the effects of automobiles and the interstate highway system on different places.
- Explain the importance of places to human identity. For example, discuss changes in land use and personal and community identity that occur in a rapidly growing town or city, or one in which the economy has stagnated.
- Describe how regions change over time, examining factors such as human migration and population change, technological change, environmental

References to Standards:

Geography 212–215
Science Benchmarks 56–57

Geography 190–196
Social Studies 118–120

degradation, and seismic activity. For example, trace the causes of the desiccation of the Aral Sea and the changes it has prompted in that region of Russia.

Geography 190–196
Science 198

C) Resources—Learners understand that the importance and use of resources change over time and vary under different economic and technological systems.

- Explain differences in the consumption of resources among nations using factors such as population size, cultural practices, dependence on fossil fuels, and varied geographic or economic distribution of resources.
- Describe how changes in technology alter the use of resources. Illustrate with examples such as the ability to harvest timber on steep slopes using helicopters or building technologies that incorporate nontraditional or recycled materials, or use of renewable energy resources.
- Evaluate public policies related to resource use. Consider variables such as their impacts on the resource and short- and long-term economic effects. For example, anticipate the relationship between water use and the growth of a city like Las Vegas, Nevada, which is in a desert area that receives only four inches of rainfall per year.
- Identify ways in which various resources can be recycled and reused. Evaluate the viability of recycling based on economic and technological factors, spatial variables such as distance from recycling facility to markets, and possible future developments. For example, discuss factors that influenced the development of the steel or plastics recycling industry in the United States.

Social Studies 132–135
Science 199
Science Benchmarks 56–57, 186,
190–191, 195, 198–199, 203,
207

D) Technology—Learners are able to examine the social and environmental impacts of various technologies and technological systems.

- Explain how social and economic forces influence the direction of technological development, and how technologies shape societal values and beliefs. For example, consider the ability to build large dams for water storage or hydropower, or the social impact of the first photos of the Earth from space.
- Using examples of particular technologies (such as genetic manipulation or cyanide heap leach gold mining) or technological systems (such as modern agriculture or energy production and use), discuss the

social and environmental costs, benefits, risks, and possibilities associated with technologies through which humans shape and control their environment.

- Discuss ways in which technological advances have lessened the adverse environmental impacts of human activities.

E) Environmental issues—Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that these scales and issues are often linked.

- Evaluate a range of costs and benefits of particular policies that affect the environment. For example, consider the effects of free trade agreements on the ability of signatory nations to protect the environment, or examine the effects of programs for trading "pollution credits" among companies.
- Place local issues in the context of broader or larger-scale issues, drawing parallels, and noting important similarities and differences. Use the broader issue to point to important local dynamics or perspectives of which to be aware. For example, consider local air pollution problems in the context of larger issues such as global climate change or acid precipitation in other parts of the country.
- Identify links among issues, for example the relationships among traffic congestion, poor air quality, and suburban sprawl. Explain key relationships among technological, social, ecological, economic, and other aspects of issues.

Economics 30–34
Geography 221–222

Strand 3— Skills for Understanding and Addressing Environmental Issues

Strand 3.1—Skills for Analyzing and Investigating Environmental Issues

Guidelines:

A) Identifying and investigating issues—Learners apply their research and analytical skills to investigate environmental issues ranging from local issues to those that are regional or global in scope.

- Define and clearly articulate issues to be investigated. Characterize the issue considering factors such as

References to Standards:

Geography 203–205, 210–211,
219–220
History 68–70
Social Studies 118–120, 139–141

connections with other issues, the pervasiveness of its effects, whether it is a long-term issue or one that is motivated by a sudden change or crisis, and whether it is unique to a particular area.

- Identify key individuals and groups involved. Identify different perspectives on the issue and approaches to resolving it. Discuss assumptions and goals that underlie each position.
- Examine contextual elements that shape the issue and alternative courses of action. Use these to identify relevant historical antecedents or contemporary parallels to the selected issue. For example, in studying questions surrounding the preservation of natural areas in Central America, students may look for similar issues in other developing nations, regions where people maintain traditional or subsistence uses of the land, or areas with similar governmental regimes.
- Investigate the issue as well as similar issues and proposals using secondary sources of information.
- Where needed, conduct original research, applying research methods from the natural and social sciences. For example, survey a community about an environmental issue using a random sample or test soils for the presence of contaminants.

Geography 212–222
History 68–70
Social Studies 118–120

B) Sorting out the consequences of issues—Learners are able to evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems.

- Evaluate the consequences of an environmental issue. For example, bring to bear historical perspectives, an understanding of the impacts of different technological developments, and knowledge of similar issues.
- Discuss the social, political, economic, and ethical implications of environmental issues. For example, trace the root causes of a community's solid waste problem and the effects of the problem and likely consequences of siting a landfill in different areas for different groups of people.
- Project the likely consequences for specific human and environmental systems of failure to resolve the issue.
- Use the idea of cumulative effects to explain why one set of environmental changes or human actions cannot be considered in isolation from others.

C) Identifying and evaluating alternative solutions and courses of action—Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes.

- Synthesize different perspectives, types of data, and means of analysis to propose solutions to environmental issues.
- Apply knowledge of functional relationships, modeling, and statistical analysis to evaluating issues and different approaches to resolving them. For example, do basic traffic flow analyses to project the likely affects of commercial developments at the outskirts of town and evaluate alternative solutions such as widening roads, providing bus service, or changing the location of the development. Predict other likely consequences of different approaches to resolving projected traffic problems associated with the new stores.
- Evaluate proposed solutions using gauges such as likely impacts on society or the environment and likely effectiveness in resolving the issue. Use methods such as cost/benefit analysis, cumulative effects analysis, environmental impact analysis, ethical analysis, and risk analysis. Describe the strengths and weaknesses of each method, considering the main ideas behind each approach including which effects are important to look at and which values or societal goals it tries to protect.
- Define and provide examples of citizen action appropriate to proposed solutions.

D) Working with flexibility, creativity, and openness—While environmental issues investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry.

- Question, offer alternative explanations, and defend interpretations in group discussions.
- Understand and explain the importance of such characteristics as honesty, openness, skepticism, and suspending judgment in the process of building knowledge.
- Discuss when and how characteristics such as openness and decisiveness are valuable in addressing environmental issues.

English Language Arts 41
History 70
Mathematics 324
Science Benchmarks 230
Social Studies 139–141

English Language Arts 31–33,
40–42, 44–45
Mathematics 348
Science 173–176
Science Benchmarks 287

Reducing Risk in Your School or Community

From: *Exploring Environmental Issues: Focus on Risk*, Project Learning Tree, Washington, D.C.

Grade Level: High School

Correlating Guidelines:

Strand 1 A, B, C, D, E,
F, G
Strand 2.3 A, B, C, D, E
Strand 2.4 A, B, C, D, E
Strand 3.1 A, B, C, D
Strand 3.2 A, B, C, D
Strand 4 A, B, C, D

This activity is the last in a module designed to help students learn the rationale for and the mechanics of risk assessment, risk management, and risk communication.

Through additional activities carried out during the semester, students study statistical models, principles of uncertainty, toxicity testing, and variability to form a basis for their understanding of risk. They use these tools to measure risk in their own lives, such as exposure to radon or the chance of losing a term paper to a lightning strike. They also study examples of environmental risk assessment and cost benefit analysis.

In this culminating activity, students apply the knowledge and skills acquired from earlier activities as they identify a risk in their school or community, develop a plan to assess the risk, decide the best way to reduce the risk, educate others, and, if feasible, implement their plan.

Students list known risks present in their school or community—these may vary from a loose step to poor air circulation to habitat destruction. They choose one risk to explore in depth and develop a plan to reduce exposure to the risk. This includes: characterizing the risks (identifying the source, the exposed population, the extent of exposure, and expected adverse consequences of exposure); identifying specific goals and the amount of reduction to be achieved; measuring the uncertainty involved; and balancing different viewpoints and opinions. Additionally, class members estimate the cost of their plan; identify individuals who would be involved; estimate a realistic time frame; and develop methods for informing the public of the risk and of the benefits of their solution.

If feasible, students implement their plan and determine how and when to evaluate its effectiveness.

Strand 3.2—Decision-Making and Citizenship Skills

References to Standards:

Geography 219–222
History 70
Social Studies 121–123
Geography 55

Guidelines:

A) Forming and evaluating personal views—Learners are able to communicate, evaluate, and justify their own views on environmental issues and alternative ways to address them.

- Articulate a position on an environmental issue. Justify the position based on an analysis of information from a variety of sources, personal beliefs and values, and clear reasoning.

- Evaluate personal beliefs and values using criteria such as personal wellbeing; social and environmental welfare; economic vitality; and concern for other living beings.
- Articulate elements of their own environmental ethic and discuss whether personal positions on issues are consistent with this ethic.
- Consider viewpoints that differ from their own, and information that challenges their position. Evaluate whether and how such information might affect their views.

B) Evaluating the need for citizen action—Learners are able to decide whether action is needed in particular situations and whether they should be involved.

Civics and Government 128–132

- Evaluate whether action is warranted in specific situations, accounting for factors such as available evidence about the issue and proposed solutions; the scale of the issue; legal, social, economic, and ecological consequences; and alternatives to citizen action.
- Evaluate whether personal involvement in particular actions is warranted, considering factors such as their own values, skills, resources, and commitment.
- Communicate decisions clearly, articulating well-reasoned arguments supporting their views and decisions.

C) Planning and taking action—Learners know how to plan for action based on their research and analysis of an environmental issue. If appropriate, they take actions that are within the scope of their rights and consistent with their abilities and responsibilities as citizens.

Social Studies 139–141
History 70

- Develop plans for individual and collective action involving groups such as a small group of classmates, a school club, a community organization, or a church. Include clear reasons and goals for action. In planning, refer to their knowledge of a range of citizen action strategies and the results of their environmental issue investigations.
- Develop action plans based on an understanding of the complexity of the issue. Set realistic goals and include measures of success consistent with their abilities and the capacities of the groups involved.

- Decide whether their plan should be implemented immediately or at another time, modified, or abandoned; and carry through with action when appropriate.

D) Evaluating the results of actions—Learners are able to evaluate the effects of their own actions and actions taken by other individuals and groups, including possible intended and unintended consequences of actions.

- Discuss the intended and unintended effects of citizen actions on specific environmental issues. Consider the apparent effects of citizen action on the environment, the political situation, and the individuals involved. Illustrate with examples such as a demonstration at a nuclear test facility, a local watershed festival, or a citizen lobbying effort against proposed environmental regulations.
- Analyze their own actions, evaluating apparent effects in terms of learners' goals, ethics, and broader societal goals. Develop a "lessons learned" document or presentation.
- Account for some of the difficulties they encounter in evaluating the results of their actions.

Strand 4— Personal and Civic Responsibility

References to Standards:

Civics and Government 105–109
Economics 19–20
English Language Arts 44
Social Studies 124–129, 139–141

Guidelines:

A) Understanding societal values and principles—Learners know how to analyze the influence of shared and conflicting societal values.

- Identify shared political values and principles that unite U.S. citizens and analyze conflicting views about their meaning and application. For example, examine conflicting views about how to protect general welfare and private property rights in a specific land-use decision where a lawsuit has been filed alleging a "taking" of private property rights by the government.
- Analyze how societal institutions, such as banks, corporations, nonprofit organizations, lobbying groups, government agencies, and the courts, embody and perpetuate certain societal values and principles.

- Describe and suggest ways that individuals can work to change how societal institutions function and, consequently, to change their environmental impacts.

B) Recognizing citizens' rights and responsibilities—

Learners understand the importance of exercising the rights and responsibilities of citizenship.

- Evaluate conflicts between individual rights and other societal interests such as a healthy environment. Discuss when individuals' civic obligations require them to subordinate their personal interests or desires to the public good.
- Explain the importance and evaluate the usefulness of civic dispositions such as trust, patience, self-discipline, respect, and open-mindedness to individuals and to society.

Civics and Government 128–137
Social Studies 139–141

The Environmental News

From: Teaching Naturally, Office of Environmental Education, Tallahassee, Florida

Grade Level: High School

Correlating Guidelines:

Strand 1 A, B, C, D, E, G
Strand 2.2 A, C
Strand 2.3 A, B, C, E
Strand 2.4 A, B, C, E
Strand 3.1 A, B, D
Strand 4 A, B, C

A high school journalism class published a series of articles about the environment for their own and other student newspapers throughout Florida. The students researched and wrote articles about local, state, and national environmental issues. In composing their articles, students practiced elements of the writing process, such as prewriting, drafting, and editing documents. Students gathered information from a variety of print and electronic media. In addition to developing skills in language arts and small group work, the science and social studies teachers worked on related learning objectives in their respective disciplines.

In one instance, students researched and wrote articles describing laws affecting water quality and their effects on local industry. Using investigative reporting techniques such as interviewing and library research, students learned about the cycles of seasonal rainfall

and nutrients that affect Florida Bay's water composition, the laws guiding government agency decisions concerning freshwater flow to the Bay, and how the Bay's water quality in turn affects the businesses associated with the tourist industry. In addition to writing and researching, students used the school's computers to design headlines and sidebars, and insert photos and captions.

A student-produced news broadcast for the school's closed circuit television channel allowed the journalism students to record and air public service announcements about their articles.

The project was partially funded by a grant from the Florida Advisory Council on Environmental Education.

- Explain the influence of citizen action and public opinion on particular policy decisions that affect the environment.
- Reflect on the impact of citizen participation—particularly learners' own—on public concerns related to the environment and on the community.

C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.

- Evaluate the extent to which individual and group action creates change, meets individual needs, and promotes the common good.
- Identify ways in which learners, individually and collectively, are able to help maintain environmental quality and resolve problems and issues. Provide examples from the range of communities (e.g., family, club or group, school, town, state, nation, world) in which learners see themselves as members.

D) Accepting personal responsibility—Learners understand that their actions can have broad consequences and accept responsibility for recognizing those effects and changing their actions when necessary.

- Evaluate the effects of their actions (and the actions of the larger social groups of which they are part) on the environment, other humans, and other living things.
- Explain ways in which the decisions of one generation create opportunities and impose constraints for future generations. Illustrate this idea with examples from the past, and incorporate it into their analyses of issues.
- Evaluate the importance of fulfilling personal responsibilities for themselves, society, and the environment.
- Demonstrate a willingness to work individually and collectively toward the resolution of environmental issues and to participate thoughtfully and effectively in environmental decision-making.

APPENDIX A

EXECUTIVE SUMMARY

The Executive Summary can be used as an easy reference to *Excellence in Environmental Education: Guidelines for Learning (K–12)* (NAAEE 2010). The Executive Summary is organized into four strands, each of which is further delineated by a set of guidelines that describe a level of skill or knowledge appropriate for each of three grade levels—fourth, eighth, and twelfth. Guidelines for a particular strand are arranged on two page layouts so that the user can quickly understand the flow of guidelines at a grade level or compare how guidelines progress across the grade levels.

OVERVIEW

FOURTH GRADE

Learners should be able to meet the guidelines included in this section by the end of fourth grade.

The kindergarten through fourth grade years are a time of tremendous cognitive development. By third and fourth grades, learners have developed some basic skills that help them construct knowledge.

Instructors in earlier grade levels should use these fourth grade guidelines as a target, extrapolating from this end goal appropriate activities and lessons for younger learners.

In these early years of formal education, learners tend to be concrete thinkers with a natural curiosity about the world around them. Environmental education can build on these characteristics by focusing on observation and exploration of the environment—beginning close to home.

EIGHTH GRADE

Learners should be able to meet the guidelines included in this section by the end of eighth grade.

In the fifth through eighth grades, learners begin to develop skills in abstract thinking and continue to develop creative thinking skills—and along with these, the ability to understand the interplay of environmental and human social systems in greater depth. Environmental education can foster this development by focusing on investigation of local environmental systems, problems, and issues. As learners become actively engaged in deciding for themselves what is right and wrong, educators can use environmental problems to help learners explore their own responsibilities and ethics.

TWELFTH GRADE

Learners should be able to meet the guidelines included in this section by the time they graduate from high school.

By the end of twelfth grade, learners are well on their way to environmental literacy. They should possess the basic skills and dispositions they need to understand and act on environmental problems and issues as responsible citizens—and to continue the learning process throughout their lives. In the ninth through twelfth grades, environmental education can promote active and responsible citizenship by challenging learners to hone and apply problem-solving, analysis, persuasive communication, and other higher level skills—often in real-world contexts.

STRAND 1—
Questioning, Analysis,
and Interpretation Skills

FOURTH GRADE

A) Questioning—Learners are able to develop questions that help them learn about the environment and do simple investigations.

B) Designing investigations—Learners are able to design simple investigations.

C) Collecting information—Learners are able to locate and collect information about the environment and environmental topics.

D) Evaluating accuracy and reliability—Learners understand the need to use reliable information to answer their questions. They are familiar with some basic factors to consider in judging the merits of information.

E) Organizing information—Learners are able to describe data and organize information to search for relationships and patterns concerning the environment and environmental topics.

F) Working with models and simulations—Learners understand that relationships, patterns, and processes can be represented by models.

G) Drawing conclusions and developing explanations—Learners can develop simple explanations that address their questions about the environment.

EIGHTH GRADE	TWELFTH GRADE
<p>A) Questioning—Learners are able to develop, focus, and explain questions that help them learn about the environment and do environmental investigations.</p> <p>B) Designing investigations—Learners are able to design environmental investigations to answer particular questions—often their own questions.</p> <p>C) Collecting information—Learners are able to locate and collect reliable information about the environment or environmental topics using a variety of methods and sources.</p> <p>D) Evaluating accuracy and reliability—Learners are able to judge the weaknesses and strengths of the information they are using.</p> <p>E) Organizing information—Learners are able to classify and order data, and to organize and display information in ways that help analysis and interpretation.</p> <p>F) Working with models and simulations—Learners understand many of the uses and limitations of models.</p> <p>G) Drawing conclusions and developing explanations—Learners are able to synthesize their observations and findings into coherent explanations.</p>	<p>A) Questioning—Learners are able to develop, modify, clarify, and explain questions that guide environmental investigations of various types. They understand factors that influence the questions they pose.</p> <p>B) Designing investigations—Learners know how to design investigations to answer particular questions about the environment. They are able to develop approaches for investigating unfamiliar types of problems and phenomena.</p> <p>C) Collecting information—Learners are able to locate and collect reliable information for environmental investigations of many types. They know how to use sophisticated technology to collect information, including computer programs that access, gather, store, and display data.</p> <p>D) Evaluating accuracy and reliability—Learners can apply basic logic and reasoning skills to evaluate completeness and reliability in a variety of information sources.</p> <p>E) Organizing information—Learners are able to organize and display information in ways appropriate to different types of environmental investigations and purposes.</p> <p>F) Working with models and simulations—Learners are able to create, use, and evaluate models to understand environmental phenomena.</p> <p>G) Drawing conclusions and developing explanations—Learners are able to use evidence and logic in developing proposed explanations that address their initial questions and hypotheses.</p>

STRAND 2—
Knowledge of Environmental
Processes and Systems

FOURTH GRADE

STRAND 2.1—
The Earth as
a Physical System

A) Processes that shape the Earth— Learners are able to identify changes and differences in the physical environment.

B) Changes in matter— Learners are able to identify basic characteristics of and changes in matter.

C) Energy— While they may have little understanding of formal concepts associated with energy, learners are familiar with the basic behavior of some different forms of energy.

STRAND 2.2—
The Living Environment

A) Organisms, populations, and communities— Learners understand basic similarities and differences among a wide variety of living organisms. They understand the concept of habitat.

B) Heredity and evolution— Learners understand that plants and animals have different characteristics and that many of the characteristics are inherited.

C) Systems and connections— Learners understand basic ways in which organisms are related to their environments and to other organisms.

D) Flow of matter and energy— Learners know that living things need some source of energy to live and grow.

EIGHTH GRADE	TWELFTH GRADE
<p>A) Processes that shape the Earth— Learners have a basic understanding of most of the physical processes that shape the Earth. They are able to explore the origin of differences in physical patterns.</p> <p>B) Changes in matter—Learners understand the properties of the substances that make up objects or materials found in the environment.</p> <p>C) Energy—Learners begin to grasp formal concepts related to energy by focusing on energy transfer and transformations. They are able to make connections among phenomena such as light, heat, magnetism, electricity, and the motion of objects.</p>	<p>A) Processes that shape the Earth— Learners understand the major physical processes that shape the Earth. They can relate these processes, especially those that are large-scale and long-term, to characteristics of the Earth.</p> <p>B) Changes in matter—Learners apply their understanding of chemical reactions to round out their explanations of environmental characteristics and everyday phenomena.</p> <p>C) Energy—Learners apply their knowledge of energy and matter to understand phenomena in the world around them.</p>
<p>A) Organisms, populations, and communities—Learners understand that biotic communities are made up of plants and animals that are adapted to live in particular environments.</p> <p>B) Heredity and evolution—Learners have a basic understanding of the importance of genetic heritage.</p> <p>C) Systems and connections—Learners understand major kinds of interactions among organisms or populations of organisms.</p> <p>D) Flow of matter and energy—Learners understand how energy and matter flow among the abiotic and biotic components of the environment.</p>	<p>A) Organisms, populations, and communities—Learners understand basic population dynamics and the importance of diversity in living systems.</p> <p>B) Heredity and evolution—Learners understand the basic ideas and genetic mechanisms behind biological evolution.</p> <p>C) Systems and connections—Learners understand the living environment to be comprised of interrelated, dynamic systems.</p> <p>D) Flow of matter and energy—Learners are able to account for environmental characteristics based on their knowledge of how matter and energy interact in living systems.</p>

STRAND 2—
Knowledge of Environmental
Processes and Systems

FOURTH GRADE

STRAND 2.3—
Humans and Their Societies

A) Individuals and groups—Learners understand that people act as individuals and as group members and that groups can influence individual actions.

B) Culture—Learners understand that experiences and places may be interpreted differently by people with different cultural backgrounds, at different times, or with other frames of reference.

C) Political and economic systems—Learners understand that government and economic systems exist because people living together in groups need ways to do things such as provide for needs and wants, maintain order, and manage conflict.

D) Global connections—Learners understand how people are connected at many levels—including the global level—by actions and common responsibilities that concern the environment.

E) Change and conflict—Learners recognize that change is a normal part of individual and societal life. They understand that conflict is rooted in different points of view.

EIGHTH GRADE

A) Individuals and groups—Learners understand that how individuals perceive the environment is influenced in part by individual traits and group membership or affiliation.

B) Culture—As they become familiar with a wider range of cultures and subcultures, learners gain an understanding of cultural perspectives on the environment and how the environment may, in turn, influence culture.

C) Political and economic systems—Learners become more familiar with political and economic systems and how these systems take the environment into consideration.

D) Global connections—Learners become familiar with ways in which the world’s environmental, social, economic, cultural, and political systems are linked.

E) Change and conflict—Learners understand that human social systems change over time and that conflicts sometimes arise over differing and changing viewpoints about the environment.

TWELFTH GRADE

A) Individuals and groups—Learners understand the influence of individual and group actions on the environment, and how groups can work to promote and balance interests.

B) Culture—Learners understand cultural perspectives and dynamics and apply their understanding in context.

C) Political and economic systems—Learners understand how different political and economic systems account for, manage, and affect natural resources and environmental quality.

D) Global connections—Learners are able to analyze global, social, cultural, political, economic, and environmental linkages.

E) Change and conflict—Learners understand the functioning of public processes for promoting and managing change and conflict, and can analyze their effects on the environment.

STRAND 2—
Knowledge of Environmental
Processes and Systems

FOURTH GRADE

STRAND 2.4—
Environment and Society

A) Human/environment interactions—
Learners understand that people depend on, change, and are affected by the environment.

B) Places—Learners understand that places differ in their physical and human characteristics.

C) Resources—Learners understand the basic concepts of resource and resource distribution.

D) Technology—Learners understand that technology is an integral part of human existence and culture.

E) Environmental issues—Learners are familiar with some local environmental issues and understand that people in other places experience environmental issues as well.

EIGHTH GRADE	TWELFTH GRADE
<p>A) Human/environment interactions— Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times.</p> <p>B) Places—Learners begin to explore the meaning of places both close to home and around the world.</p> <p>C) Resources—Learners understand that uneven distribution of resources influences their use and perceived value.</p> <p>D) Technology—Learners understand the human ability to shape and control the environment as a function of the capacities for creating knowledge and developing new technologies.</p> <p>E) Environmental issues—Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that people in other places around the world experience environmental issues similar to the ones they are concerned about locally.</p>	<p>A) Human/environment interactions— Learners understand that humans are able to alter the physical environment to meet their needs and that there are limits to the ability of the environment to absorb impacts or meet human needs.</p> <p>B) Places—Learners understand “place” as humans endowing a particular part of the Earth with meaning through their interactions with that environment.</p> <p>C) Resources—Learners understand that the importance and use of resources change over time and vary under different economic and technological systems.</p> <p>D) Technology—Learners are able to examine the social and environmental impacts of various technologies and technological systems.</p> <p>E) Environmental issues—Learners are familiar with a range of environmental issues at scales that range from local to national to global. They understand that these scales and issues are often linked.</p>

STRAND 3—

**Skills for Understanding and Addressing
Environmental Issues**

FOURTH GRADE**STRAND 3.1—**

**Skills for Analyzing and Investigating
Environmental Issues**

A) Identifying and investigating issues—

Learners are able to identify and investigate issues in their local environments and communities.

B) Sorting out the consequences of issues—

As learners come to understand that environmental and social phenomena are linked, they are able to explore the consequences of issues.

C) Identifying and evaluating alternative solutions and courses of action—

Learners understand there are many approaches to resolving issues.

D) Working with flexibility, creativity, and openness—

Learners understand the importance of sharing ideas and hearing other points of view.

EIGHTH GRADE	TWELFTH GRADE
<p>A) Identifying and investigating issues— Learners are able to use primary and secondary sources of information, and apply growing research and analytical skills, to investigate environmental issues, beginning in their own community.</p> <p>B) Sorting out the consequences of issues— Learners are able to apply their knowledge of ecological and human processes and systems to identify the consequences of specific environmental issues.</p> <p>C) Identifying and evaluating alternative solutions and courses of action—Learners are able to identify and develop action strategies for addressing particular issues.</p> <p>D) Working with flexibility, creativity, and openness—Learners are able to consider the assumptions and interpretations that influence the conclusions they and others draw about environmental issues.</p>	<p>A) Identifying and investigating issues— Learners apply their research and analytical skills to investigate environmental issues ranging from local issues to those that are regional or global in scope.</p> <p>B) Sorting out the consequences of issues— Learners are able to evaluate the consequences of specific environmental changes, conditions, and issues for human and ecological systems.</p> <p>C) Identifying and evaluating alternative solutions and courses of action—Learners are able to identify and propose action strategies that are likely to be effective in particular situations and for particular purposes.</p> <p>D) Working with flexibility, creativity, and openness—While environmental issues investigations can bring to the surface deeply held views, learners are able to engage each other in peer review conducted in the spirit of open inquiry.</p>

STRAND 3—

**Skills for Understanding and Addressing
Environmental Issues**

FOURTH GRADE**STRAND 3.2—**

Decision-Making and Citizenship Skills

A) Forming and evaluating personal views—Learners are able to examine and express their own views on environmental issues.

B) Evaluating the need for citizen action—Learners are able to think critically about whether they believe action is needed in particular situations and whether they believe they should be involved.

C) Planning and taking action—By participating in issues of their choosing—mostly close to home—they learn the basics of individual and collective action.

D) Evaluating the results of actions—Learners understand that civic actions have consequences.

EIGHTH GRADE	TWELFTH GRADE
<p>A) Forming and evaluating personal views—Learners are able to identify, justify, and clarify their views on environmental issues and alternative ways to address them.</p> <p>B) Evaluating the need for citizen action—Learners are able to evaluate whether they believe action is needed in particular situations, and decide whether they should be involved.</p> <p>C) Planning and taking action—As learners begin to see themselves as citizens taking active roles in their communities, they are able to plan for and engage in citizen action at levels appropriate to their maturity and preparation.</p> <p>D) Evaluating the results of actions—Learners are able to analyze the effects of their own actions and actions taken by other individuals and groups.</p>	<p>A) Forming and evaluating personal views—Learners are able to communicate, evaluate, and justify their own views on environmental issues and alternative ways to address them.</p> <p>B) Evaluating the need for citizen action—Learners are able to decide whether action is needed in particular situations and whether they should be involved.</p> <p>C) Planning and taking action—Learners know how to plan for action based on their research and analysis of an environmental issue. If appropriate, they take actions that are within the scope of their rights and consistent with their abilities and responsibilities as citizens.</p> <p>D) Evaluating the results of actions—Learners are able to evaluate the effects of their own actions and actions taken by other individuals and groups, including possible intended and unintended consequences of actions.</p>

STRAND 4—
Personal and Civic Responsibility

FOURTH GRADE

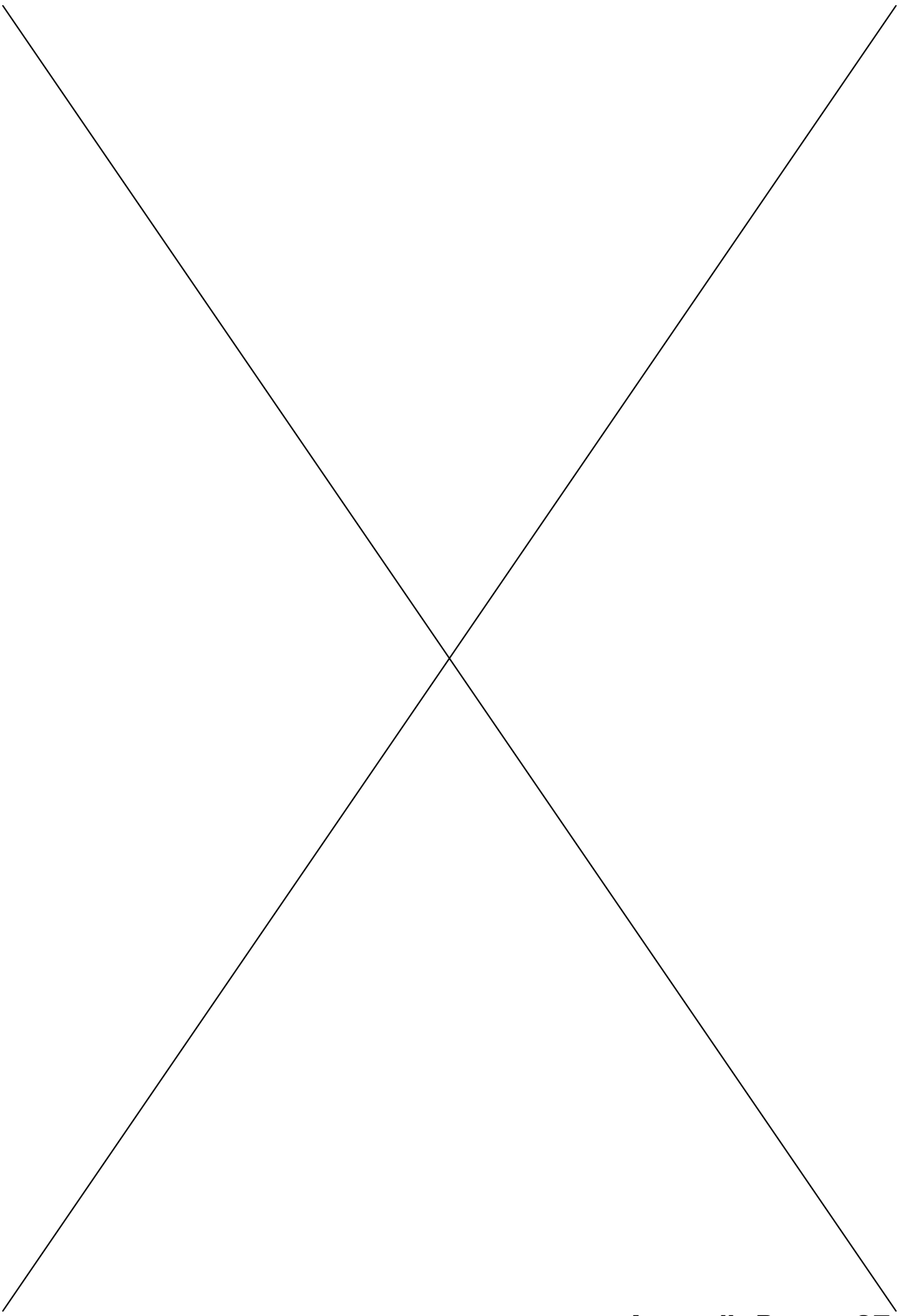
A) Understanding societal values and principles—Learners can identify fundamental principles of U.S. society and explain their importance in the context of environmental issues.

B) Recognizing citizens' rights and responsibilities—Learners understand the basic rights and responsibilities of citizenship.

C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.

D) Accepting personal responsibility—Learners understand that they have responsibility for the effects of their actions.

EIGHTH GRADE	TWELFTH GRADE
<p>A) Understanding societal values and principles—Learners understand that societal values can be both a unifying and a divisive force.</p> <p>B) Recognizing citizens’ rights and responsibilities—Learners understand the rights and responsibilities of citizenship and their importance in promoting the resolution of environmental issues.</p> <p>C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.</p> <p>D) Accepting personal responsibility—Learners understand that their actions can have broad consequences and that they are responsible for those consequences.</p>	<p>A) Understanding societal values and principles—Learners know how to analyze the influence of shared and conflicting societal values.</p> <p>B) Recognizing citizens’ rights and responsibilities—Learners understand the importance of exercising the rights and responsibilities of citizenship.</p> <p>C) Recognizing efficacy—Learners possess a realistic self-confidence in their effectiveness as citizens.</p> <p>D) Accepting personal responsibility—Learners understand that their actions can have broad consequences and accept responsibility for recognizing those effects and changing their actions when necessary.</p>



APPENDIX B: BACKGROUND FOR THE DEVELOPMENT OF THE LEARNER GUIDELINES FRAMEWORK

The Learner Guidelines in Context

The National Project for Excellence in Environmental Education, sponsored by the North American Association for Environmental Education (NAAEE), was initiated in 1993. In facilitating the development of a model set of guidelines for environmental education, it joined standards projects for such disciplines as Mathematics, English Language Arts, Geography, Science, Civics, and History developed in response to the national "Goals 2000" process. The first purpose of *Guidelines for Learning* is to serve the field of environmental education by articulating knowledge and skills essential for environmental literacy. These guidelines also demonstrate the essential link between environmental education and the traditional disciplines and to broader efforts for education reform.

Education Reform the Standards Development Movement

The current push toward education reform in the U.S. was heralded by the 1983 publication of *A Nation at Risk*. This report pointed to declining test scores, poorly prepared high school graduates, declining enrollment in science and mathematics, low academic achievement in comparison to many European and Japanese students, and low levels of literacy—and raised significant questions concerning the quality of the American education system. Following the publication of *A Nation at Risk*, it became common to call into question the very structure of American education.

A decade-long move toward national education reform received its highest level of governmental recognition at the 1989 national education summit in Charlottesville. At the summit, a bipartisan group of the nation's governors and the Bush White House agreed to national goals for education. These broadly formulated goals set out an agenda for education for the year 2000. With the 1994 passage of the "Goals 2000: Educate America Act," the eight goals became official national policy, guiding numerous activities within and outside the federal government.

Of particular importance for developing environmental education guidelines are:

Goal 3—Student Achievement and Citizenship, which states that “by the year 2000 American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter, including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy.”

Goal 4—Science and Mathematics, which states that “by the year 2000, U.S. students will be first in the world in science and mathematics achievement.”

Both Goal 3 and Goal 4 set the stage for developing a range of voluntary national standards for the core disciplines. (See page 8 for a sampling of these standards documents.) These voluntary standards have been designed to provide state and local education leaders guidance in generating locally appropriate academic benchmarks.

Building from a Rich History

Guidelines for Learning has been developed with the input of literally thousands of teachers, school administrators, environmental educators, scientists, and parents, as well as from a variety of professional organizations and government agencies. From the inception of the project, the guidelines have used existing environmental education frameworks, definitions, and models as a foundation. The field as a whole owes a great deal to those who have worked to create these documents. Each document is based on a different set of assumptions and priorities, yet the commonalities are considerable. These commonalities, in essence, define the practice of environmental education and provide the basis for the structure of *Guidelines for Learning*.

Developing a Framework for the Guidelines

Much of the work in environmental education has been guided by the *Belgrade Charter* (UNESCO-UNEP, 1976) and the *Tbilisi Declaration* (UNESCO, 1978). These two documents furnish an internationally accepted blueprint for environmental education. The *Tbilisi Declaration* outlined five categories of objectives for environmental education:

- **Awareness**—to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems
- **Knowledge**—to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems
- **Attitudes**—to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection
- **Skills**—to help social groups and individuals acquire the skills for identifying and solving environmental problems
- **Participation**—to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems

With the evolution of the field, these guiding principles (as well as the more general ones presented in the introduction to this document) have been researched, critiqued, revisited, and expanded. *Guidelines for Learning* draws upon these respected founding writings about environmental education and the field's best thinking to date. This Appendix describes environmental education frameworks developed since *Tbilisi* as a means of revealing the base on which these *Guidelines* are built. In the following examination, a number of environmental education frameworks are divided into those:

- based on research or a synthesis of the research literature;
- created as conceptual frameworks for curricula;
- developed as part of previous standards or criteria development projects.

Each of these frameworks is explored below. To recreate some of the historical logic of the field, the models are presented in chronological order within each category. Each outline is a direct excerpt from the original document. The terminology used reflects common usage of the time and the authors' preferences.

Frameworks/Models Based on EE Literature

The following environmental education frameworks are excerpted directly from key documents in the environmental education literature. They provide insight into the evolution of the field and its core ideas. It becomes clear that, while the field has continued to mature since the Tbilisi Declaration was formulated in 1977, the declaration's original intent is still central to environmental education.

Although the environmental education model proposed by Stapp and Cox (1974) predates *Tbilisi*, it is important to include here because of the central role it played in the development of the *Tbilisi Declaration*. The work by Hungerford, et. al. (1980) proposes goal levels for EE curriculum development. The four goal levels were submitted to a content validity expert panel to judge their congruence with the five *Tbilisi* objectives.

In recent years, much scholarly work in EE has focused on describing the precursors of responsible environmental citizenship and environmental literacy—the types of knowledge, skills and dispositions that describe the environmentally literate citizen. The proposed frameworks offered by Iozzi, et. al. (1990), Marcinkowski (1991), Wisconsin Center for Environmental Education (1992), Roth (1992), and the EE Literacy Consortium (1994) are all based in a synthesis of this research and the EE foundations literature.

Finally, the important influence of issues surrounding sustainable development on EE thinking is considered with the inclusion of a framework for sustainable development education published in Canada (1994).

Framework 1 Stapp, W.B. and Cox, D.A. (1974) Environmental Education Model

Philosophy and Concepts:

An environmental education program should assist the learner in understanding the basic spaceship earth philosophy which would serve as an 'umbrella' of thought and ethic for the entire program. The spaceship earth philosophy has been divided into five basic concepts: ecosystems, population, economics and technology, environmental decisions, and environmental ethics. These concepts encompass the awareness, knowledge, and understanding of the living and

non-living world and their complex interactions; the social, economic, political and aesthetic influences of the populations of people; the need for, and processes of decision making; and development of an environmental ethic that would motivate the learner to adopt a life style compatible with environmental quality.

The Processes:

A. The Skills of Problem Solving

Since the environmental education model is based on student involvement, problem solving skills are essential to developing and carrying out action plans. ... The eight problem solving skills are:

1. Recognizing environmental problems
2. Defining environmental problems
3. Listening with comprehension
4. Collecting information
5. Organizing information
6. Analyzing information
7. Generating alternative solutions
8. Developing a plan of action

B. Clarifying Values

The values clarification approach helps students become aware of personal beliefs, attitudes, values and behavior which they prize and are committed to both in and out of the classroom. This process assists students in considering alternative solutions and the implications of each alternative. ... Values clarification is of major importance in making rational environmental decisions every day of a person's life, and must be a basic part of every environmental education program.

C. Community Problem Solving

Students need to be able to apply learned skills in both valuing and problem solving in an issue that is meaningful to them—a problem that directly affects them either at home, or at school, or in the local community.

The Teaching-Learning Models:

There is no single teaching model that all students will respond favorably toward under all circumstances. ... It is important for a teacher to assess his/her personal skills and the

situation and then blend teaching models in an effort to achieve the best learning environment. ... The role of the teacher would be to create a learning environment, assist students in acquiring information, provide guidance to the student, and to participate with the student in the learning process.

Emphasis of Program at Different Age Levels:

Environmental education activities at each grade level should focus on the feeling (affective), knowing (cognitive) and skill-behavior domains. Emphasis in the early years, however, should be on awareness and feelings and in later years on knowledge and skill-behavior. The learner should also be provided with opportunities to explore his immediate environment with all of his senses—sight, hearing, smell, touch and taste. The learner should be exposed to a variety of physical and social environments in order to have experiences to judge the quality of his immediate environment.

Framework 2

**Hungerford, H.R., Peyton, R.B.,
and Wilke, R. (1980)**

Goals for Curriculum Development in Environmental Education

GOAL LEVEL I—The Ecological Foundations Level:

Upon completion of instruction in environmental education, the learner should be expected to be able to...

1. Communicate and apply the major ecological concepts including those focusing on individuals, species, populations, communities, ecosystems, biogeochemical cycles, energy production and transfer, interdependence, niche, adaptation, succession, homeostasis, and man as a ecological variable
2. Apply a knowledge of ecological concepts to the analysis of environmental issues and identify important ecological principles involved
3. Apply a knowledge of ecological concepts in predicting the ecological consequences of alternative solutions to environmental problems

4. Understand the principles of ecology in order to identify, select and utilize appropriate sources of scientific information in a continuing effort to investigate, evaluate and find solutions for environmental issues

GOAL LEVEL II—

The Conceptual Awareness Level:

5. Understand and communicate how man's cultural activities (e.g., religious, economic, political, social and others) influence the environment from an ecological perspective
6. Understand and communicate how an individual's behaviors impact on the environment from an ecological perspective
7. Identify a wide variety of local, regional, national and international environmental issues and the ecological and cultural implications of these issues
8. Identify and communicate the viable alternative solutions available for remediating crucial environmental issues as well as the ecological and cultural implications of these various solutions
9. Understand the need for environmental issue investigation and evaluation as prerequisite to sound decision making
10. Understand the roles played by differing human beliefs and values in environmental issues and the need for personal values clarification as an important part of environmental decision making
11. Understand the need for responsible citizenship action in the solution of environmental issues

GOAL LEVEL III—

The Investigation and Evaluation Level:

12. Apply the knowledge and skills needed to identify and investigate issues (using both primary and secondary sources of information) and synthesize the data gathered)

13. Demonstrate the ability to analyze environmental issues and the associated value perspectives with respect to their ecological and cultural implications
14. Demonstrate the ability to identify alternative solutions for important issues and the value perspectives associated with these solutions
15. Demonstrate the ability to evaluate alternative solutions and associated value perspectives for important issues with respect to their ecological and cultural implications
16. Demonstrate the ability to identify and clarify personal value positions related to important environmental issues and their associated solutions
17. Demonstrate the ability to evaluate, clarify, and change value positions in light of new information

GOAL LEVEL IV—The Issue Resolution Skill Level:

18. Demonstrate a competence with a variety of citizenship action skills from the following categories of skills: persuasion, consumerism, political action, legal action, and ecomanagement
19. Evaluate selected actions in light of their ecological and cultural implications
20. Demonstrate the ability to apply one or more citizenship action skills for the purpose of resolving or helping to resolve one or more environmental issues

Framework 3

Iozzi, L., Laveault, D., Marcinkowski, T. (1990)

Assessment of Learning Outcomes in Environmental Education

Organization of Learning Outcomes According to Taxonomies of Educational Objectives

Cognitive Domain:

Knowledge: of ecology, environmental problems and issues, and environmental action strategies

Skills for dealing with action strategies:
including identification, investigation, and
analysis of issues

Skills for dealing with action strategies:
including selecting appropriate action strategies,
creating an action plan, evaluating an action plan,
and implementing an action plan.

Affective Domain:

Environmental sensitivity or appreciation:
including 'the characteristics that result in an
individual viewing the environment from an
empathetic perspective' (Peterson, 1982)

Attitudes: towards pollution, technology,
economics, conservation, and environmental
action

Values: a preference for selected means and ends;
values such as a healthy environment and a
peaceful world

Moral reasoning: making decisions and
judgments about environmental issues according
to one's own sense of morality

Ethics: involving the evaluation of a personal
world view which reflects a balance between the
quality of life and the quality of the environment

Responsible Environmental Behavior:

**Active participation aimed at solving problems
and resolving issues:** environmentally sound
consumer purchasing, methods for conserving
resources, assisting with the enforcement of
environmental regulations, using personal and
interpersonal means to encourage environmentally
sound practices, and encouraging environmentally
sound policies and legislative initiatives

Locus of Control:

Individual's sense that he or she can manifest
some influence upon or control over the outcomes
of a specific activity

Assumption of Personal Responsibility:

Recognition that one's negative behavior has a negative effect on the environment and, likewise, one's positive behavior can have potentially positive effects on the environment

Acceptance of personal responsibility for negative environmental effects or impacts, and for one's own role in helping to resolve environmental impacts and issues

Willingness to help correct negative environmental impacts, and a concomitant willingness to help resolve environmental impacts and issues

Framework 4**Marcinkowski, T. (1991)****The Relationship Between Environmental Literacy and Responsible Environmental Behavior in Environmental Education****Environmental Literacy Involves:**

- a. An awareness and sensitivity toward the environment
- b. An attitude of respect for the natural environment, and of concern for the nature and magnitude of human impacts on it
- c. A knowledge and understanding of how natural systems work, as well as of how social systems interface with natural systems
- d. An understanding of the various environmentally-related problems and issues (local, regional, national, international, and global)
- e. The skills required to analyze, synthesize, and evaluate information about environmental problems/issues using primary and secondary sources, and to evaluate a select problem/issue on the basis of evidence and personal values
- f. A sense of personal investment in, responsibility for, motivation to work individually and collectively toward the resolution of environmental problems/issues

- g. A knowledge of strategies available for use in remediating environmental problems/issues
- h. The skills required to develop, implement and evaluate single strategies and composite plans for remediating environmental problems/issues
- i. Active involvement at all levels in working toward the resolution of environmental problems/issues

Framework 5
Wisconsin Center for Environmental Education
(1992)
University of Wisconsin, Steven's Point

Cognitive Outcomes:

Knowledge of Ecological Principles

Individuals, Populations, and Communities: habitats, niches, and adaptations; food chains, food webs; population dynamics; population and community interactions

Change and Limiting Factors: change as a natural process; biotic and abiotic limits to growth, size, and distribution of populations

Energy Flow: sun as primary source, other sources and forms of energy; transfer and energy through living systems; first and second laws of energy—conservation of energy, entropy; need for a consistent source of energy by systems and individuals; photosynthesis and respiration

Biogeochemical Cycling: conservation of matter, nutrient and materials cycling; hydrologic cycle

Ecosystems and Biodiversity: importance of biodiversity; interdependence of organisms; ecosystems

Knowledge of Environmental Problems and Issues

Air Quality: ozone depletion; global warming; acid deposition; air pollution

Water Quality and Quantity: water pollution; use and management

Soil Quality and Quantity: soil depletion and pollution; use and management

Wildlife and Habitat: habitat and biodiversity
loss; use and management

Energy: sustainable and non-renewable;
consumption

Human Population and Health: overpopulation;
environmental health hazards

Waste: solid waste; hazardous wastes

Knowledge of Environmental Issue Investigation and Action Strategies

Knowledge of Strategies Used to Investigate Environmental Problems and Issues

Knowledge of Appropriate Action Strategies for the Prevention or Resolution of Environmental Problems and Issues

Affective Outcomes:

Environmental Sensitivity/Awareness

Positive Attitudes and Values for the Prevention
and Remediation of Environmental Problems and
Issues Regarding: air quality; water quality and
quantity; soil quality and quantity; wildlife and
habitat; energy; human population and health;
waste

Determinants of Environmentally Responsible Behavior

Locus of Control

Assumption of Personal Responsibility

Environmentally Responsible Behaviors

Ecomanagement; Economic Action; Persuasion;
Political Action; Legal Action

Framework 6
Roth, C. (1992)
Environmental Literacy: Its Roots, Evolution and
Directions in the 1990's

Nominal Environmental Literacy:

Knowledge Strand—Nominally environmentally literate individuals are familiar with:

The nature of the basic components of elemental systems (e.g., living and non-living things, requirements for life)

Types and examples of interactions between humans and nature

Basic components of societal systems

Affective Strand—Have affective sensitivities about:

Appreciation of both nature and society

Elementary sensitivity and empathy for both nature and society

Elemental perceptions of points of conflict between nature and society

Skill Strand—Have skills of:

Identifying and defining problems.

Recognizing issues surrounding identified problems or proposed solutions (e.g. latent and visible conflicts)

Behavior Strand—Demonstrate:

Familial, school and organization activities and habits aimed at maintenance of environmental quality

Responding and coping behaviors

Functional Environmental Literacy

Knowledge Strand—The functional environmentally literate citizen, in addition to the knowledge of the nominally literate, has knowledge of and understanding of a number of ecological, economic, geographic, religious, educational and political processes and understanding of the effects/impacts of humans on natural systems, including (abbreviated listing):

Population dynamics

Interactions

Interdependence

Thinking in terms of time frames or scales

Skill Strand—The functionally environmentally literate demonstrate basic skills in analyzing problems and issues and conducting investigations of problems and issues using primary and secondary resource/strategies such as (abbreviated listing):

Identifying environmental issues

Seeking historical background of issues

Investigating environmental issues

Evaluating sources of information

Analyzing environmental issues from various perspectives

Applying ecological concepts to predicting probable ecological consequences

Identifying alternative solutions and value perspectives

Evaluating alternative solutions

Conducting basic risk analysis

Identifying and clarifying his/her value positions

Examining issues from local, national, regional, and international points of view

Thinking in terms of systems

Demonstrating ability to forecast, to think ahead, plan

Affect Strand—The functionally environmentally literate demonstrate such basic affects, attitudes and values as:

Identification with, and feelings of concern for, both society and the environment

Willingness to recognize and choose among differing value perspectives associated with problems and issues

Internal locus of control

Treating public and private property with equal respect

Sense of stewardship

Behavior Strand—The functionally environmentally literate moves to action through selected lifestyle activities/behaviors and community/organizational behaviors demonstrated by:

Taking action positions and actions based on best available knowledge

Taking individual and/or group action through: persuasion, consumerism, political action, legal action, ecomanagement

Operational Environmental Literacy

Skill Strand—Skills involved with evaluating problems and issues on the basis of available evidence (facts) and personal values and skills used in planning, implementing, and evaluating solutions, including using the process skills of scientific inquiry:

Using ability to forecast, to think ahead, plan

Using ability to separate number, quantity, quality, and value

Imagining

Connecting

Valuing and value analysis

Using primary and secondary sources of information

Using ability to separate fact from opinion

determining the roles played by differing human beliefs and values in environmental issues

Affect Strand—Affects, attitudes and values, that indicate a valuation of both nature and society, a sense of investment in and responsibility for the resolution of problems and issues along with a respect for both nature and society and a willingness to participate in, and show a sense of efficacy toward the resolution of problems and issues including (abbreviated listing):

Awareness of and sensitivity to the total environment and its allied programs

Motivation to actively participate in environmental improvement and protection

Taking into account historical perspectives while focusing on current and potential environmental situations

Strong internal locus of control

Personal responsibility: recognition of impacts of personal behavior; acceptance of personal responsibility for the impacts; willingness to help correct or avoid negative impacts

Behavior Strand—Actions that demonstrate leadership in working toward the resolution of problems and issues including:

Evaluating actions with respect to their impact on quality of life and environment

Providing verbal commitments

Working to maintain biological and social diversity

Continually examining and reexamining the values of the culture

Making decisions based on beneficence, justice, stewardship, prudence, cooperation, and compassion

Framework 7

**Environmental Education Literacy Consortium
(Hungerford, H.; Volk, T.; Wilke, R.; Champeau, R.;
Marcinkowski, T.; May, T.; Bluhm, B.; and
McKeown-Ice, R.) (1994)
Environmental Literacy Framework**

Cognitive Dimensions (Knowledge and Skills)

- A. Knowledge of ecological and socio-political foundations
- B. Knowledge of and ability to identify, analyze, investigate and evaluate environmental problems and issues
- C. Knowledge of and ability to apply environmental action strategies seeking to influence outcomes of environmental problems and issues
- D. Ability to develop and evaluate an appropriate action plan for the resolution of environmental problems or issues

Affective Dimensions

- A. Recognition of the importance of environmental quality and the existence of environmental problems and issues
- B. Empathic, appreciative and caring attitudes toward the environment
- C. Willingness to work toward the prevention and/or remediation of environmental problems and issues

Additional Determinants of Environmentally Responsible Behavior

- A. Belief in their ability, both individually and collectively, to influence outcomes of environmental problems and issues
- B. Assumption of responsibility for personal actions that influence the environment

Personal and/or Group Involvement in Environmentally Responsible Behaviors

- A. Ecomanagement—e.g. actions such as using a more energy efficient form of transportation, reducing consumption of energy or water, improving wildlife habitat, recycling, etc.
- B. Economic/consumer action—e.g., purchasing products in returnable/reusable containers, avoiding purchase of excess packaging, avoiding items with toxic by-products, providing financial support to an environmental organization, boycotting products considered to be damaging to the environment, etc.
- C. Persuasion—e.g., using informal discussion to encourage another to support a positive environmental position or action, distributing "pro-environment" literature, signing a petition, encouraging another individual or group to stop some kind of destructive behavior, writing a letter to a person/group/company to stop an action that has negative environmental consequences, giving a speech, etc.
- D. Political action—e.g., writing letters or speaking directly to elected officials on behalf of an environmental issue, supporting by time or finances a candidate or lobbying group based upon an environmental issue, running for or serving in an official capacity with the intent of supporting pro-environmental positions or actions, etc.

- E. Legal action—e.g. reporting violations in pollution/ littering, fishing, trapping or hunting laws or plant or animal collecting to the authorities, working with authorities to patrol areas for enforcing environmental laws, providing information or testimony at a legal hearing or participating in a lawsuit against a person/ group who has violated a law aimed at protecting the environment, etc.

Framework 8

Learning for a Sustainable Future, Developing a Cooperative Framework for Sustainable Development Education (1994)

Education for a Sustainable Future: The Knowledge, Skills and Values Needed

Knowledge Needed:

1. The planet earth as a finite system and the elements that constitute the planetary environment
2. The resources of the earth, particularly soil, water, minerals, etc., their distribution and their role in supporting living organisms
3. The nature of ecosystems and biomes, their health and their interdependence within the biosphere
4. The dependence of humans on the environmental resources for life and sustenance
5. The sustainable relationship of native societies to the environment
6. The implications of resource distribution in determining the nature of societies and the rate and character of economic development
7. Characteristics of the development of human societies including nomadic, hunter-gatherer, agricultural, industrial and post-industrial, and the impact of each on the natural environment
8. The role of science and technology in the development of societies and the impact of these technologies on the environment
9. Philosophies and patterns of economic activity and their different impacts on the environment, societies and cultures

10. The process of urbanization and the implications of de-ruralization
11. The interconnectedness of present world political, economic, environmental and social issues
12. Aspects of differing perspectives and philosophies concerning the ecological and human environments
13. Cooperative international and national efforts to find solutions to common global issues, and to implement strategies for a more sustainable future
14. The implications for the global community of the political, economic and socio-cultural changes needed for a more sustainable future
15. Processes of planning, policy-making and action for sustainability by governments, businesses, non-governmental organizations and the general public

Skills Needed:

1. Frame appropriate questions to guide relevant study and research
2. Define such fundamental concepts as environment, community, development and technology, and apply definitions to local, national and global experience
3. Use of range of resources and technologies in addressing questions
4. Assess the nature of bias and evaluate different points of view
5. Develop hypotheses based on balanced information, crucial analysis and careful synthesis, and test them against new information and personal experience and beliefs
6. Communicate information and viewpoints effectively
7. Work towards negotiated consensus and cooperative resolution of conflicts
8. Develop cooperative strategies for appropriate action to change present relationships between

ecological preservation and economic development

Values Needed:

1. An appreciation of the resilience, fragility and beauty of nature and the interdependence and equal importance of all life forms
2. An appreciation of the dependence of human life on the resources of a finite planet
3. An appreciation of the role of human ingenuity and individual creativity in ensuring survival and the search for appropriate and sustainable progress
4. An appreciation of the power of human beings to modify the environment
5. A sense of self-worth and rootedness in one's own culture and community
6. A respect for other cultures and a recognition of the interdependence of the human community
7. A global perspective and loyalty to the world community
8. A concern for disparities and injustices, a commitment to human rights, and to the peaceful resolution of conflict
9. An appreciation of the challenges faced by the human community in defining the processes needed for sustainability and in implementing the changes needed
10. A sense of balance in deciding among conflicting priorities
11. Personal acceptance of a sustainable lifestyle and a commitment to participation in change
12. A realistic appreciation of the urgency of challenges facing the global community and the complexities that demand long-term planning for building a sustainable future
13. A sense of hope and a positive personal and social perspective on the future
14. An appreciation of the importance and worth of individual responsibility and action

Conceptual Frameworks for Curriculum Materials

The form environmental education takes in practice is based heavily upon the curriculum materials available to those "in the field"—for example, teachers, naturalists, volunteer instructors or museum curators. The conceptual or curriculum frameworks direct the writing of individual lessons as well as the overall organization of the materials. Consequently, looking at how EE has been put into practice is essential to developing a model or framework for EE guidelines. Of the abundance of curricula available, a small number of nationally recognized examples were selected as examples.

Framework 1 Project WILD (1986)

I. Awareness and Appreciation of Wildlife

- A. Humans and wildlife have similar basic needs.
- B. Humans and wildlife share environments.
- C. Humans and wildlife are subject to many of the same environmental conditions.
- D. Humans have far greater ability to alter or adjust to environments than does wildlife; thus, humans have a responsibility to consider effects of their activities on other life forms.

II. Human Values and Wildlife

- A. Wildlife has aesthetic and spiritual values.
- B. Wildlife has ecological and scientific values.
- C. Wildlife has social and political values.
- D. Wildlife has commercial and economic values.
- E. Wildlife has consumptive and non-consumptive recreational values.

III. Wildlife and Ecological Systems

- A. Each environment has characteristic life forms.
- B. All living elements of an ecological system are interdependent.
- C. Variation and change occur in all ecological systems.

- D. Adaptation is continuous within all ecological systems.
- E. Living things tend to reproduce in numbers greater than their habitat can support.
- F. Each area of land or water, and ultimately the planet, has a carrying capacity of plants and animals.

IV. Wildlife Conservation

- A. Management of resources and environments is the application of scientific knowledge and technical skills to protect, preserve, conserve, limit, enhance, or extend the value of a natural resource, as well as to improve environmental quality.
- B. Wildlife is one of our basic natural resources, along with water, air, minerals, soil, and plant life.
- C. Good habitat is the key to wildlife survival.
- D. Wildlife resources can be managed and conserved.
- E. Wildlife conservation practices depend on a knowledge of natural laws and the application of knowledge from many disciplines.
- F. In the U.S., wildlife is considered to be a public resource. Ownership of land or water alone does not secure ownership of wildlife on that land or in that water as it does in some other countries.

V. Cultural and Social Interaction with Wildlife

- A. Human cultures and societies, past and present, affect and are affected by wildlife and its habitat.
- B. Societies develop programs and policies relating to wildlife and its habitat through a variety of social mechanisms.

VI. Wildlife Issues and Trends: Alternatives and Consequences

- A. Human impacts on wildlife and its habitat are increasing worldwide.

- B. Issues involving wildlife and its habitat are a product of social and cultural trends.
- C. Current wildlife issues and trends are complex and involve alternatives and consequences.
- D. Many problems, issues, and trends involving wildlife in other parts of the world are similar to those in this country.

VII. Wildlife, Ecological Systems, and Responsible Human Actions

- A. Each person as an individual and as a member of society affects the environment.
- B. Responsible environmental actions are the obligation of all levels of society, starting with the individual.

Framework 2 Essential Learnings in Environmental Education (1990)

Natural Systems:

General: Environment, Earth, Biosphere

Abiotic Components: Energy, Atmosphere, Land & Soil, Water

Biotic Components: Plant, Animal

Processes: Weather & Climate, Biogeochemical Cycles, Evolution and Extinction

Biological Systems: Ecosystems, Food Chains & Webs, Community, Population, Habitat & Niche

Resources:

Natural Resources: Distribution & Consumption, Management & Conservation, Sustainable Development

Abiotic Resources: Energy & Minerals, Water, Land & Soil

Biotic Resources: Forests, Wildlife & Fisheries, Biodiversity

Degradation of Resource Base: Limits to Systems, Pollution

Human Systems:

Humans and Environment: Humans as part of environment, human adaptation to environment, Human influence upon environment, population factors

Technological Systems: Agriculture, Settlements, Manufacturing and Technology

Social Systems: Economic systems, Sociopolitical Systems, Culture and Religion

Environmental Awareness and Protection: Values and Ethics, Education and Communication, Participation/Voluntary Action, Legislation & Enforcement

Framework 3

Project Learning Tree Environmental Education Activity Guide (1993)

Diversity

Diversity in Environments
Diversity of Resources and Technologies
Diversity among and within Societies and Cultures
Interrelationships
Environmental Interrelationships
Resources and Technological Interrelationships
Societal and Cultural Interrelationships

Systems

Environmental Systems
Resource Management and Technological Systems
Systems in Society and Culture

Structure and Scale

Structures and Scale in Environments
Structure and Scale in Resources and Technology
Structure and Scale in Societies and Culture

Patterns of Change

Patterns of Change in the Environment

Patterns of Change in Resources and
Technologies

Patterns of Change in Society and Culture

Framework 4

Project WET Curriculum & Activity Guide (1995)

Conceptual Framework:

Water has unique physical and chemical characteristics.

Water is essential for all life to exist.

Water connects all Earth systems.

Water is a natural resource.

Water resources are managed.

Water resources exist within social constructs.

Water resources exist within cultural contexts.

Affective Framework:

People's awareness of and sensitivity toward water and water-related concepts and issues

People's attitudes (opinions, likes, dislikes) toward water and water-related concepts and issues

People's values (consideration of worth, need to cherish, importance) toward water and water-related concepts and issues

People's behavior toward and expression of water and water-related concepts and issues, influenced by awareness and sensitivity, attitudes, and values

Skills Framework:

Gathering information

Organizing information

Analyzing information

Interpreting information

Applying learned information

Evaluating application of learned information

Presenting evidence of learning from application and evaluation

Framework 5

Biodiversity Basics, World Wildlife Fund (1999)

Part I: The Conceptual Framework

What Is Biodiversity?

The concepts in this theme provide students with a fundamental knowledge and appreciation of biodiversity. These concepts also help students understand the characteristics of living systems and the fact that the environment is made up of systems nested within larger systems.

- Definition of Biodiversity
- Basic Ecological Principles
- Key Ecological Definitions that Help to Understand Biodiversity

Why Is Biodiversity Important?

Concepts in this section can help students investigate how biodiversity affects their lives and supports life on Earth. Recognizing the importance of biodiversity increases students' awareness of why and how people's actions affect biodiversity and why it's important to maintain and restore biodiversity.

- Quality of the Environment
- Quality of Life (Economics, Health and Safety, Socio/Political, Culture)

What Is the Status of Biodiversity?

Concepts in this theme help students understand the status of biodiversity and why biodiversity is declining around the world. By learning about the causes and consequences of biodiversity loss, students will be able to participate in maintaining biodiversity in the future.

- Factors Affecting Biodiversity (Population Growth, Loss, Degradation, and Fragmentation of Habitat, Introduced Species, Over-Consumption of Natural Resources, Pollution)

How Can We Protect Biodiversity?

Concepts in this section help students identify ways to ensure that adequate biodiversity will be maintained for future generations. For students to willingly and effectively take action to protect biodiversity, they must have a thorough understanding and appreciation of what biodiversity is, why it's important, why we're losing it, and what people can do to help maintain and conserve it. Students should also begin to understand that ecological integrity, social equity, and economic prosperity are connected and are important components of a sustainable society.

- Studying Biodiversity
- Conserving Biodiversity (Role of Values, Role of Civil Society, Government, and Industry, Future Outlooks for Maintaining and Restoring Biodiversity)

Part II: The Skills Framework

- Gathering Information
- Organizing Information
- Analyzing Information
- Interpreting Information
- Applying Information
- Evaluating Information
- Presenting Information
- Developing Citizenship Skills

Previous Standards or Criteria Development Projects

The quest to define what constitutes quality environmental education is not new. The following outlines represent efforts by the National Science Teachers Association and the American Society for Testing and Materials (ASTM) to develop guiding principles for environmental education. Also included is material prepared by the American Forum for Global Education suggesting conceptual guidelines for national standards for international studies education.

Outline 1

National Science Teachers Association, Criteria for Excellence in Environmental Education, Revised Edition

Effective environmental education depends on multidisciplinary instruction but has a strong science component. It involves minds-on, direct contact with environments as well as vicarious experiences. The learner grows from awareness and understanding to concern and action.

Goal:

To develop and practice creativity and critical thinking along with values analyses. Teachers and learners will search for alternative solutions to environmental issues and evaluate the ethical, social, ecological, and economic costs and benefits of alternatives.

Curriculum

1. Provides activities and information in which people interact with the environment.
2. Develops in the students the intellectual tools to effectively explore the world around them.
3. Directly involves students in investigating the world around them and their relationship to it.

Instruction

1. Fosters open minds and the generation and examination of alternatives;
2. Stimulates and fosters creativity and critical thinking;
3. Respects the social, intellectual, and developmental maturity of learners;
4. Links science with other areas of intellectual and emotional activity;
5. Provides opportunities for students to be involved in environmental activity at an appropriate level of challenge; hence, fosters a growing sense of confidence that groups and individuals can positively affect the environment;

6. Relates the components of the ecosystem to our health, well-being, and potential for development.

Evaluation

Effective programs and materials provide:

1. Evaluation design based on stated goals, objectives, and outcomes;
2. Field testing of programs and materials in terms of stated goals and objectives;
3. Continuous modification and feedback.

Teachers

1. Distribute EE guidelines to colleagues;
2. Encourage colleagues to increase their environmental literacy;
3. Hold clearly stated goals and objectives for learner behavior;
4. Treat controversial issues fairly and honestly;
5. Teach people how to think, not what to think.

Outline 2

ASTM, EE Curriculum Draft Standards, Curriculum Task Group (1991)

These guidelines recommend that formal educational institutions and agencies develop, promote, and facilitate environmental education curricula that enhance environmental awareness and knowledge; as such the guidelines will:

impart overall environmental awareness and knowledge

recognize and emphasize ecology as a critical cornerstone of all environmental education programs

communicate and apply major ecological concepts to an improved awareness and understanding of the environment (e.g., humans as ecological variables, and extensive discussions and illustrations of different scales of time and space as they relate to function and development of any ecosystem)

communicate and apply major social science concepts to an improved awareness and understanding of the environment

demonstrate the usefulness of ecological and social science concepts in understanding human dependence upon stable and productive ecological and social systems for survival

These guidelines recommend that formal educational institutions and agencies develop, promote, and facilitate environmental curricula that demonstrate issue investigation, analysis, and action skills; as such, the guidelines will:

identify a wide variety of environmental issues and problems and demonstrate the application of ecological and social science concepts in recognizing and interpreting these issues and problems

describe how human behavior, beliefs, values and cultural activities (e.g. religious, economic, political, social, and others) impact on the environment and relate to environmental issues and problems

recommend various issues investigation strategies using both primary and secondary sources of information (e.g. generating research questions; developing a survey; planning data-collection; organizing data into charts/tables/graphs; generating data-based conclusions; developing inferences and recommendations; and communicating research findings)

identify various alternative solutions to environmental problems and predict the possible or probable ecological, social, political, legal, and economic consequences of alternative solutions to these problems

demonstrate a strategy for the identification, evaluation, and modification of personal and group value positions and action strategies, relative to the environment

demonstrate strategies for the correction of environmental problems (e.g. persuasion, consumer action, political action, legal action, and ecomanagement)

identify sources of scientific and social science information appropriate to the investigation and

evaluation of environmental issues, problems, and solutions

These guidelines recommend that formal educational institutions and agencies develop, promote, and facilitate environmental education curricula that demonstrate the following instructional methodologies:

Goal Orientation

A knowledge of education philosophy will be used to select, develop, and implement curricular programs and strategies to achieve both general educational and environmental education goals.

Coordination with Established Levels of Environmental Literacy

Graded environmental education curricula will be developed to coordinate with the various levels of environmental literacy as detailed in *Literacy Standards for Environmental Education* (refer to documents produced by the Environmental Literacy Subcommittee: e.g., curricula for the nominally, functionally, and operationally literate.)

Coordination with Conventional Levels of Instruction

Environmental education curricula will be developed which are targeted toward several primary levels of instruction: teacher education, lower/upper elementary education, and secondary education. The curricula will be designed so that its facilitation and mode of presentation will be appropriate to the learning level toward which it is targeted.

Curriculum Infusion

Environmental education curricula will be designed with open-ended components to allow for (a) ease of infusion into existing curricula, (b) opportunities for educators to create their own unique topic approaches and presentation formats, and (c) on-going modifications to reflect the dynamic, ever changing nature of environmental instruction.

Compatibility with Accepted Theories of Teaching and Learning

Environmental education curricula will be developed that utilize and reflect a wide diversity of instructional applications, as detailed in Teacher Education Standards for Environmental Education (e.g. contemporary theories and practices relating to education philosophy, learning behavior, teaching methodologies, evaluation, and development of curriculum materials).

Selection of Appropriate Methodologies/Sites

Environmental education curriculum will select and implement instructional methodologies and sites which are appropriate for desired cognitive, affective, and behavioral outcomes and for a variety of learner characteristics (e.g. outdoor education methods, affective education methods, simulation games and role playing, case study methods, community resource use, etc.)

Evaluation

Environmental education curricula should be designed for ease of evaluation. The evaluation criteria should reflect elements typical of any conventional curriculum as well as evaluation components that may be unique to the scope of environmental education.

Outline 3

Smith, A. (1994)

Concept Paper on Developing National Standards for International Studies Education

Global Issues and Topics

- A. Global environment, including biodiversity and species protection
- B. Global resources, the need for conservation, development of alternative energy sources, and sustainability
- C. Global trends in population and related issues such as urbanization, migration, growth and control, and population distribution

- D. Major economic realities and significant issues of international trade, development, aid and investment
- E. World peace and security
- F. International human rights and human values
- G. Hunger, food supply and distribution around the world
- H. Ethnic conflict, diversity and human commonality
- I. Significant differences in systems of government
- J. The United Nations and other international and regional organizations
- K. World cultures
- L. Global developments in science and technology

Culture Studies and Area Studies—America and the World

- A. America's contemporary and historical connections with global issues and areas
- B. Understanding individuals' relationships and connections with global issues and other cultures
- C. Citizenship responsibilities

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THE NATIONAL PROJECT FOR EXCELLENCE IN ENVIRONMENTAL EDUCATION

What does it mean to be environmentally literate? The National Project for Excellence in Environmental Education, initiated by the North American Association for Environmental Education (NAAEE) in 1993, is attempting to answer that question. Environmental education is a process that aims to develop an environmentally literate citizenry that can compete in our global economy; has the skills, knowledge, and inclinations to make well-informed choices; and exercises the rights and responsibilities of members of a community.

Publications

Publications created by the National Project for Excellence in Environmental Education include:

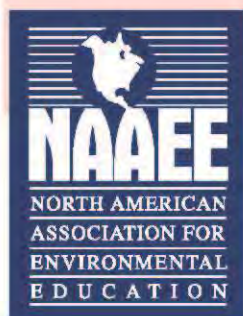
- ***Environmental Education Materials: Guidelines for Excellence*** (4th edition, 2009). A set of recommendations for developing and selecting environmental education materials.
- ***Excellence in Environmental Education: Guidelines for Learning (K-12)*** (4th edition, 2010). A comprehensive framework for environmental education, demonstrating environmental education's alignment with national academic standards.
- ***Excellence in Environmental Education: Guidelines for Learning (K-12) Executive Summary & Self Assessment Tool*** (4th edition, 2010). An easy-to-use outline listing the guidelines and a set of checklists for analyzing educational activities.
- ***Guidelines for the Preparation and Professional Development of Environmental Educators*** (2nd edition, 2004). A set of competencies for educators preparing to teach environmental education in a variety of job settings.
- ***Nonformal Environmental Education Programs: Guidelines for Excellence*** (2nd edition, 2009). A set of recommendations to be used in the development of comprehensive environmental education programs or to trigger improvements in existing ones.
- ***Early Childhood Environmental Education Programs: Guidelines for Excellence*** (2010). A set of recommendations to be used in the development of comprehensive early childhood environmental education programs or to trigger improvements in existing ones.
- ***Environmental Education Materials: Guidelines for Excellence Workbook - Bridging Theory and Practice*** (2000). Activities and examples to deepen your understanding of *Environmental Education Materials: Guidelines for Excellence*.

Hard copies of the *Environmental Education Guidelines* publications can be ordered from NAAEE at www.naaee.org/publications/guidelines-for-excellence.

Free copies may be downloaded from NAAEE's Web site at www.naaee.org/programs-and-initiatives/guidelines-for-excellence.

- ***The Environmental Education Collection: A Review of Resources for Educators, Volume 1*** (1997, updated 2004).
- ***The Environmental Education Collection: A Review of Resources for Educators, Volume 2*** (1998, updated 2004).
- ***The Environmental Education Collection: A Review of Resources for Educators, Volume 3*** (1998, updated 2004).

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