

# 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.

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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.

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.

Trace human population trends for their region and make projections, based on research findings, for the future.

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

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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

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

speeches, advertisements, news releases, and pamphlets put out by groups on various sides of the issue.

- 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.

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

**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.

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

**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.

## 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 68 percent of the boxes in use.

### 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.
- 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.

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

## Strand 2— Knowledge of Environmental Processes and Systems

### Strand 2.1— The Earth as a Physical System

#### References to Standards:

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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, wind and ocean currents, and the cycling of water.
- 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.

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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 fusion 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.

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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, available light, or water level. For example, describe the effects of a lake's eutrophication on plant, insect, bacteria, and fish populations.
- Discuss some of the ways in which populations can change over time, using ideas such as cyclic fluctuations, equilibrium, and coupled oscillations. Evaluate influences on population growth rate, including reproductive strategies and resource limitations.

### References to Standards:

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Science 186  
Science Benchmarks 105

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Science 185  
Science Benchmarks 108-109,  
124-125

- 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.

**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.

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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 and natural nuclear energy.
- Trace the flow of matter and energy through living systems, and between living systems and the physical environment. For example, show how oxygen is released to the atmosphere by the interaction of plants, animals, and non-living matter in the 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.

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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:**

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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.

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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

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

Evaluate the effects of changes in these systems on 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.

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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 or commercial fishing.
- 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.
- 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 degradation, and seismic activity. For example, trace

### References to Standards:

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Geography 212-215  
Science Benchmarks 56-57

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Geography 190-196  
Social Studies 118-120

the causes of the desiccation of the Aral Sea and the changes it has prompted in that region of Russia.

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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, 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.
- 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.

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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.

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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 connections with other issues, the pervasiveness of its

#### **References to Standards:**

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

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.

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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.

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

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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.

- 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.

- 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.

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Civics and Government 128-132

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Social Studies 139-141  
History 70

**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.

- 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:**

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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.

Civics and Government 128-137  
Social Studies 139-141

- 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.
- Explain the influence of citizen action and public opinion on particular policy decisions that affect the environment.

### **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.

- 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.