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Guidelines for Excellence

K–12 Environmental Education

For educators, administrators, policy makers, and the public

naaee
North American Association
for Environmental Education

For more than four decades, the North American Association for Environmental Education (NAAEE) has been a leader in promoting excellence in environmental education throughout North America. With members in more than 30 countries and affiliations with more than 55 state, regional, and provincial environmental education organizations, NAAEE's influence stretches across North America and around the world. Our mission is to bring the brightest minds together to advance environmental literacy and civic engagement through the power of education.

NAAEE supports the field with a variety of programs and services, including:

Annual Conference and Research Symposium—NAAEE has convened an annual conference for environmental education professionals since 1972. The conference is the largest national gathering of environmental education professionals in North America and promotes innovation in the field, networking, new tools and resources, and dissemination of research and best practices.

Resources and eePRO—Through its website and eePRO, our online professional development hub, NAAEE provides its members and supporters with high-quality professional resources including books, resource guides, essays, peer-reviewed research, best practices, research reviews, job listings, grant opportunities, news across the field, and more.

Professional Development—NAAEE offers unique services in professional development and support. Through online networking and professional learning, training seminars, online learning modules, strategic convening of environmental education leaders, and support of certification programs, NAAEE promotes leadership development and builds the capacity of its members and affiliates.

Policy—NAAEE is a non-partisan organization that plays a leadership role in raising the profile of environmental education at an international level. NAAEE works with partners to advocate for environmental education with agencies, organizations, foundations, and others to increase funding and support for the field.

Inspiring Innovation—NAAEE is committed to bringing new voices, ideas, and innovation to the field and broadening the reach and impact of environmental education.

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The contents of this document do not necessarily reflect the views and policies of U.S. EPA, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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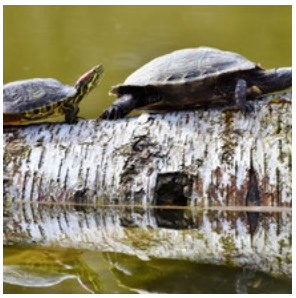



SUSTAINABLE
DEVELOPMENT
GOALS




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Introduction

K–12 Environmental Education: Guidelines for Excellence provides students, parents, caregivers, educators and others a roadmap to achieving environmental literacy by setting expectations for fourth (age 10), eighth (age 14) and twelfth grade (age 18) students and outlining a framework for effective and comprehensive environmental education programs and curricula. These guidelines define the aims of environmental education. They set a standard for high quality education, based on what an environmentally literate person should know and be able to do by the time they graduate from high school. They draw on the best thinking in the field to outline the core ingredients of environmental education.

Defining Environmental Education and Environmental Literacy

Environmental Education[1]
… is a process that helps individuals, communities, and organizations learn more about the environment, develop skills to investigate their environment and to make intelligent, informed decisions about how they can help take care of it. It has the power to transform lives and society. It informs and inspires. It motivates action. EE is a key tool in creating healthier and more civically-engaged communities.

An Environmentally Literate Person[2]
…is someone who, both individually and together with others, makes informed decisions concerning the environment; is willing to act on these decisions to improve the well-being of other individuals, societies, and the global environment; and participates in civic life. Those who are environmentally literate possess, to varying degrees, the knowledge and understanding of a wide range of environmental concepts, problems, and issues; a set of cognitive and affective dispositions; a set of cognitive skills and abilities; and the appropriate behavioral strategies to apply such knowledge and understanding in order to make sound and effective decisions in a range of environmental contexts.

[1] NAAEE (nd) About EE and Why it Matters, https://naaee.org/about-us/about-ee-and-why-it-matters

[2] Hollweg, K. S., Taylor, J. R., Bybee, R. W., Marcinkowski, T. J., McBeth, W. C., & Zoido, P. (2011). Developing a framework for assessing environmental literacy. Washington, DC: North American Association for Environmental Education. https://naaee.org/our-work/programs/environmental-literacy-framework.

The Need for Environmental Literacy

The environment sustains all life on earth. It provides nourishment and inspiration. Research suggests that time spent in nature affords physical and psychological benefits, and personal and cultural identities are often tied to the local environment. The economy thrives on a healthy environment. Yet, this is a time of unprecedented environmental, social, and economic challenges—from climate change and loss of species and habitats, to declines in civic engagement, growing economic and social inequities, and other threats to global well-being.

The goal of environmental education is a sustainable future for all where environmental and social responsibility drive individual, group, and institutional choices. Ultimately, this goal will be achieved through the development of an environmentally literate society. Environmental literacy is not, however, reached easily. Individuals must go beyond the fact by fact, piece by piece examination of our environment and begin to understand and think in terms of systems. They must develop a sophisticated set of skills that allow them to effectively address environmental problems and determine the best set of actions. It is crucial that they become thoughtful, skillful, and active members of their democracy.

Environmentally literate community members are capable of taking individual action and making well-informed decisions collectively. Increasingly, they 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 they turn on a water faucet, plant a garden, or buy electronics. Each time community members vote, they make environmental decisions. When public policy is made, these decisions not only impact the economy and jobs, but the environment.

DID YOU KNOW?

Sustainable Development Goals (SDGs)

The core of the 2030 Agenda for Sustainable Development, adopted by world leaders, are 17 Sustainable Development Goals that call on all countries to mobilize efforts to

> *...secure a sustainable, peaceful, prosperous and equitable life on earth for everyone now and in the future. The goals cover global challenges that are crucial for the survival of humanity. They set environmental limits and set critical thresholds for the use of natural resources. The goals recognize that ending poverty must go hand-in-hand with strategies that build economic development. They address a range of social needs including education, health, social protection, and job opportunities while tackling climate change and environmental protection. The SDGs address key systemic barriers to sustainable development such as inequality, unsustainable consumption patterns, weak institutional capacity and environmental degradation.* (United Nations, 2015)

Environmental education works towards a sustainable future for all where environmental and social responsibility drive individual and institutional choices. By using the Sustainable Development Goals as a springboard, environmental education engages students in meaningful investigations of how to ensure environmental quality, social equity, and economic prosperity.

Source: United Nations. 2015. Transforming Our World: The 2030 Agenda for Sustainable Development. https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

A Vision for Environmental Education

Environmental education is grounded in the belief that if individuals learn how to make informed decisions, they will do so. Environmental education is further 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 and reflect changing circumstances. Environmental education aims for a democratic, inclusive society in which effective, environmentally literate community members possess a sense of empowerment and agency and participate with creativity and responsibility. Ultimately, ensuring environmental literacy is a vital societal goal and must play an integral role throughout educational systems—at the national, tribal, and state/provincial level, and in every classroom.

GUIDELINES IN PRACTICE

El Paso's Community-Wide Air Quality Curriculum

Although the city of El Paso, Texas meets air quality standards most days, there are still ozone-alerts in the hot dry summers, dust storms with zero visibility, and brown inversion layers that spread over the area. Most of the schools in the El Paso Independent District are in areas close to major air pollution sources such as the busy interstate highway, three international bridges with long lines of trucks going both directions, a large military base, and a large oil refinery. El Paso's sister city in Mexico, Ciudad Juárez, is home to about 1.5 million people and about 170 U.S. factories.

Using the *NAAEE K–12 Guidelines for Excellence* as a model framework for environmental literacy, master teachers in the El Paso district worked with university educators to create a curriculum for 50,000 third to 12th- grade students and their families. Focusing on local air quality issues, students use a problem-based approach to learning. Beginning at home and in the community, where local relevance intersects active and meaningful learning, students explore air quality issues through investigation, problem solving, and critical thinking. Third graders read a children's story that introduces them to the concepts of particulate matter and ozone and learn how to read the air quality index. They investigate alternatives to playing outdoors when breathing the air may be unhealthy. The following year, students learn about air pollution caused by burning hydrocarbons from fossil fuels. They explore what it feels like to breathe if you have respiratory problems, and they make plans to decrease air pollution around their school.

Fifth graders use inquiry learning experiences to explore wind, solar, and biofuels, and then make multimedia presentations to inform others. In sixth grade, students measure temperature changes in ambient air compared to CO_2 to understand the greenhouse effect and the foundation of climate change. They create public service announcements about the climate issues for the school news channel and their families.

Students in seventh grade use scientific data bases about cities with high air pollution levels to examine the relation between income, education, and health. They propose reasons why environmental conditions and poverty affect health. El Paso is located in an area where inversions occur, and a brown-gray haze often hangs over the city. Eighth grade students explore causes of thermal inversions and use data sources to find the major pollution sources affecting local air quality.

Explorations become more sophisticated as students' understanding grows. Using the ASARCO copper smelter that was located near downtown El Paso as a case study, chemistry students learn how to identify sources of air pollution, the chemical behavior of these polluting compounds, and then explore options to reduce chemical air pollutants.

Environmental science students use the same case study to examine environmental justice implications. They use wind rose data (a historical record of prevailing winds) to identify trends and ways that wind direction may affect air quality. Applying scientific data helps students understand how actions in the U.S. affect neighboring Mexico, and develop solutions to improve regional air quality.

Throughout the school year, El Paso teachers explicitly discuss how they can work together to develop environmental literacy across the grade levels, and how personal and civic responsibility can be woven into the curriculum.

Information drawn from the Border Air Quality Curriculum Project funded by U.S. Environmental Protection Agency at the University of Texas at El Paso and available at http://baqed.utep.edu/curriculum.htm.

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 and Systems Thinking: Systems thinking helps 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. Earth is a complex system of interacting physical, chemical, and biological processes. Organizations, individual cells, communities of animals and plants, and families can all be understood as systems. And systems can be nested within other systems.

Human Well-being: Human well-being is inextricably bound with environmental quality. Humans are a part of the natural order. Humans, and the systems they create—societies, political systems, economies, religions, cultures, technologies—impact the total environment and are impacted by the environment. Since humans are a part of nature rather than outside it, they are challenged to recognize the ramifications of their interdependence with Earth systems.

Equity and Inclusion: Environmental education instruction is inclusive, respectful, and equitable, and designed to employ the talents of people with different backgrounds, experiences, and perspectives.

The Importance of Where One Lives: Beginning close to home, learners connect with, explore, and understand their immediate surroundings. The sensitivity, knowledge, and skills needed for this local connection provides a base for moving into larger systems, broader issues, and an expanding understanding of causes, connections, and consequences.

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

Integration and Infusion: Disciplines from the natural sciences, social sciences, and the humanities are connected through 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.

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.

Sustainability: Learning is future oriented, and focused on environmental, social, and economic responsibility as drivers of individual and institutional choices.

DID YOU KNOW?

What is Systems Thinking?

Systems thinking is a cross-disciplinary approach to understanding how to think better about real-world systems and the real-world problems we face. Systems thinking emerges when learners make distinctions (D), recognize systems (S) and relationships (R), and take perspectives (P), acting in and on the world around them (or DSRP for short; Cabrera & Cabrera 2015). These four cognitive skills, or simple rules, underlie even the most complex forms of thinking:

1. **Distinctions Rule:** Any idea can be distinguished from other ideas
2. **Systems Rule:** Any idea can be split into parts or lumped into a whole
3. **Relationships Rule:** Any idea can relate to other ideas
4. **Perspectives Rule:** Any idea can be the point or the view of a perspective

These four rules are the cognitive framework through which every person structures information to make meaning. Making these skills explicit in the classroom enables learners to evaluate and reflect on how they make meaning and build knowledge (the mental models they use every day to navigate the real world).

Systems thinking (DSRP) is applicable to all content areas across all grade-levels. Beginning learners start with identifying and applying the simple rules in the world around them. Intermediate learners mix and match D, S, R, and P to build knowledge. Advanced learners become proficient in visualizing systems thinking in DSRP maps to gain a deep understanding of concepts and ideas.

In environmental education, we use systems thinking to equip learners to 1) understand environmental issues as systems; 2) assess the effects of human choices on economic, ecological and social systems; and 3) increase effectiveness of our actions. By embedding DSRP into existing lesson plans and instructional content, we help students develop metacognition, deep understanding of content, and scientific reasoning.

Throughout the guide, you'll find suggestions for ways in which learners at different grade levels might understand and apply systems thinking to concepts in environmental education.

GRADES K-4

In grades K–4, learners are introduced to the foundational concepts and simple rules of systems thinking. Learners identify and discuss characteristics of complex adaptive systems, describe and discuss the concept of mental models, and differentiate between content and structure when constructing the meaning of any idea. Learners use the simple rules of systems thinking (D, S, R, and P) to ask questions about and understand environmental processes, systems and issues. Learners identify what is and is not included in an idea, organize ideas into parts and wholes, identify and discuss interrelationships between and among ideas, and take different points-of-view to see any idea from many new perspectives. Learners model their mental models of environmental processes, systems and issues in simple DSRP maps.

GRADES 5-8

In grades 5–8, learners apply systems thinking to understand environmental issues as systems. Learners understand and analyze environmental issues using the concepts of DSRP. Learners mix and match D, S, R, and P to deconstruct relationships into part-whole systems, group and relate distinct objects and ideas according to a perspective, break down perspectives into sub-perspectives, and compare the relationship between two wholes by comparing the relationships between their parts. Learners understand the importance of feedback loops in complex systems, how human action or inaction affects the systems in which we live, and how to convert mental models into actions or action plans. Learners understand that the structure of a system determines it outcomes and behaviors, and recognize that changing the outcomes of a system requires changing its structure. Learners model their mental models of environmental and human social systems in detailed DSRP maps.

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DID YOU KNOW?

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GRADES 9-12

In grades 9–12, learners apply systems thinking to assess the effects of human choices on economic, ecological and social systems, and to increase effectiveness of outcomes for all three systems. Learners use knowledge of a system's structure to envision, design, plan, act, and assess decision options and develop action plans that achieve positive systematic impacts. Learners identify and analyze mental models used in decision making; impacts, intended and unintended, of decisions on human and ecological systems; and different non-human and human perspectives important to each decision. Learners understand how to modify a system or issue based on feedback. Learners build, share, and evolve DSRP maps of economic, ecological and social systems.

References

Cabrera, D. and Cabrera, L. (2015). Systems Thinking Made Simple: New Hope for Solving Wicked Problems in a Complex World. Ithaca: Odyssean Press.

Connecting to National Academic Standards

How environmental education is conceptualized and implemented in elementary and secondary schools is critical to meeting the goal of environmental literacy. Integrated across the curriculum, environmental education draws upon the natural and physical sciences, social sciences, and humanities. These disciplines are connected not only through the medium of the environment, but also through the development of environmental issue investigation and action skills needed for civic engagement. In the end, however, the ability of school systems to provide comprehensive environmental education will depend on its systematic and cohesive integration into the standards-based curriculum.

Research suggests that curriculum can be designed that supports both academic achievement and the development of environmental literacy[1]. To facilitate this type of curriculum development effort, the writing team crafted guidelines that support and are linked to applicable national standards[2]. Using an iterative approach, they intentionally worked to ensure that this set of guidelines reflects specific content priorities and learning progressions established in the various national standards.

[1] NAAEE (nd) eeWORKS, https://naaee.org/our-work/programs/eeworks

Teaching from the Guidelines

K–12 Environmental Education: Guidelines for Excellence is primarily focused on setting benchmarks for learner achievement. Learning and instruction are closely linked, however, so these environmental education guidelines include examples that offer specific ideas for implementation in varying 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** appropriate for their developmental level. Using the guidelines and knowledge of all learners' needs, cultures, and backgrounds, educators ensure that environmental education instruction is equitable, inclusive, and relevant.

Instruction provides opportunities for all learners to enhance their capacity for i**ndependent 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 information gathering, analysis, and communication skills** means that learners will be able to both demonstrate and apply their understandings.

Because environmental issues can prompt deep feelings and strong opinions, educators must take an **equitable approach to instruction**. Educators incorporate differing perspectives and points of view 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 human well-being. For most learners, **personal commitment begins with an awareness of their immediate surroundings**. Instructors foster learners' innate curiosity and enthusiasm, providing them with **early and continuing opportunities to explore their community and the environment**. Taking instruction out of the classroom and into the local environment is an important instructional strategy for engaging students in direct discovery of the world around them.

[2] National student standards referenced in the development of these guidelines included: Mansilla, V.B. and Jackson, A. (2011). Educating for global competence: Preparing our youth to engage the world. Washington, DC: Council of Chief State School Officers' EdSteps Initiative and Asia Society Partnership for Global Learning.

National Council for the Social Studies (NCSS). (2013). The College, career, and civic life (C3) Framework for Social Studies state standards: Guidance for enhancing the rigor of K-12 Civics, Economics, Geography, and History. Silver Spring, MD: NCSS

National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). Common core state standards. Washington, DC: National Governors Association Center for Best Practices, Council of Chief State School Officers.

NGSS Lead States. (2013). *Next generation Science standards:* For states, by states. Washington, DC: The National Academies Press.

Green Schools

Project Learning Tree's GreenSchools program inspires students to improve the environment at their school, at home, and in their community. Student-led Green Teams apply STEM (science, technology, engineering, math) to create greener and healthier schools—and save schools money!

Most importantly with PLT GreenSchools, it's students who lead the way. Five hands-on, student-driven investigations provide a blueprint for Green Teams to examine their school's energy use, waste and recycling, water consumption, school site, and environmental quality – and establish benchmarks.

- **Energy Investigation**: Students investigate how much energy their school uses, the main sources of that energy, and ways to implement energy-saving strategies.
- **Environmental Quality Investigation**: Students investigate areas where improvements can be made in indoor air quality, transportation, chemical use, and more.
- **School Site Investigation**: Students investigate natural habitats, wildlife, trees, grounds maintenance practices, and ways to make improvements to their school site.
- **Waste & Recycling Investigation**: Students investigate how much waste their school generates and where it goes, as well as recycling and composting efforts.
- **Water Investigation**: Students investigate the source, cost, and quality of their school's water supply, and ways to enhance current water conservation practices

Each investigation details specific things for students to measure and observe, along with student worksheets to complete and guidance on how to combine data collected into a school-wide analysis.

Using their Investigation results, students then select, design, and implement one or more action projects, and measure its impacts. PLT GreenWorks! grants can help provide action project funding.

An online training course for adults offers tips for starting a GreenSchool program, forming Green Teams, obtaining equipment and collecting data, conducting the investigations, and empowering students to design and lead action projects that not only use their STEM skills but also make a tangible difference.

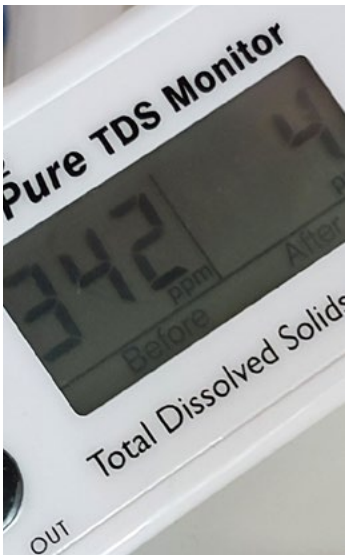
For more information on PLT GreenSchools!
Visit http://www.plt.org/greenschools/

Additional information, resources, and programs that support green schools:

- U.S. Department of Education, Green Ribbon Schools, https://www2.ed.gov/programs/green-ribbon-schools/index.html
- National Wildlife Federation, Eco-Schools USA, https://www.nwf.org/Eco-Schools-USA.aspx
- Green Schools Alliance, https://www.greenschoolsalliance.org/home
- Green Schools National Network, https://greenschoolsnationalnetwork.org/
- Project Green Schools, http://projectgreenschools.org/
- NAAEE, eePRO K-12 Environmental Education, https://naaee.org/eepro/groups/k-12-ee

The Framework: How the Guidelines are Organized

K–12 Environmental Education: Guidelines for Excellence offers a vision of environmental education that makes sense within educational systems and promotes progress toward sustaining a healthy environment and quality of life. The Guidelines for Excellence is organized into four strands, each of which represents a broad aspect of environmental literacy. These strands are further defined by a set of guidelines that articulate knowledge and skill benchmarks for the end of each of three grade levels—fourth (age 10), eighth (age 14), and twelfth (age 18). Sample performance indicators illustrate how competency of each guideline might be demonstrated by the student. These performance indicators (the bullet points) are only examples; there are many more ways a student might demonstrate what they know and are able to do.



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.

- **A. Questioning**
- **B. Designing investigations**
- **C. Collecting information**
- **D. Evaluating accuracy and reliability**
- **E. Organizing and analyzing information**
- **F. Working with models and simulations**
- **G. Drawing conclusions and developing explanations**

STRAND 2

Environmental Processes and Systems

Environmental literacy is dependent on an understanding of the processes and systems that comprise the environment, including human social systems and influences. Students develop an understanding of how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) results in changes in another. They develop an understanding of how human activities affect environmental quality and long-term sustainability at local, tribal, national, and global levels. These understandings are based on knowledge synthesized from across traditional disciplines. The guidelines in this section are grouped in three sub-categories:

2.1—Earth's physicial and living systems

- **A. Earth's physical systems**
- **B. Earth's living systems**

2.2—Human systems

- **A. Individuals, groups, and societies**
- **B. Culture**
- **C. Political systems**
- **D. Economic systems**

2.3—Environment and society

- **A. Human-environment interactions**
- **B. Resource distribution and consumption**
- **C. Places**
- **D. Change and conflict**

STRAND 3

Skills for Understanding and Addressing

Skills and knowledge are refined and applied in the context of environmental issues at varying scales. Environmental literacy includes the abilities to define, learn about, evaluate, and act on environmental issues. Students investigate environmental issues; consider evidence and differing viewpoints; and evaluate proposed action plans, including likely effectiveness in specific environmental, cultural, social, and economic contexts. They analyze the intended and unintended consequences of their own actions and actions taken by other individuals and groups, including long-term environmental, social, and economic implications for sustainability. In this section, the guidelines are grouped in two sub-categories:

3.1—Skills for analyzing and investigating environmental issues

- **A. Identifying and investigating issues**
- **B. Sorting out the consequences of issues**
- **C. Identifying and critiquing alternative solutions and courses of action**
- **D. Working with flexibility, creativity, and openness**

3.2—Decision-making and action skills

- **A. Forming and evaluating personal views**
- **B. Evaluating the need for action**
- **C. Planning and taking action**
- **D. Evaluating the results of actions**

STRAND 4

Personal and Civic Responsibility

Environmentally literate community members are willing and able to act on their own conclusions about what should be done to ensure environmental quality, social equity, and economic prosperity. 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.

- **A. Recognizing rights and responsibilities**
- **B. Recognizing efficacy and developing agency**
- **C. Accepting personal responsibility**

Taken together, this framework creates 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 establishing a hierarchy of skills and knowledge.

DID YOU KNOW?

Involving Your Students in "Citizen Science"

National Geographic's Citizen Explorer Lab engages, inspires and empowers a new generation of explorers, scientists and changemakers through participatory science and open innovation. It aims to engage millions of people around the world in acquiring data that will help us understand the patterns, status and trends of species, ecosystems, people and cultures. The Lab also partners with global leaders in citizen science. Using data-driven, technology-powered tools, these partnerships inspire and empower citizen explorers to become stewards of the planet and contribute to solving real-world issues. And the Lab builds global participatory science tools for conservation and exploration.

The Citizen Explorer Lab collaborates with the National Geographic Education division to support the development of educational assets about citizen science. You can find a collection of these resources at the Citizen Science Resource Library.[3] Nat Geo also hosts information and resources to help educators (and others) hold BioBlitzes.[4] BioBlitzes are events that focus on finding and identifying as many species as possible in a specific area over a short period of time. A great tool for collecting data during a BioBlitz and identifying the species that you find is iNaturalist,[5] which is an online social network of people sharing biodiversity information to help each other learn about nature. Anyone can use it to record their own observations, get help with identifications, collaborate with others to collect this kind of information for a common purpose, or access the observational data collected by iNaturalist users. iNaturalist provides a great Teacher's Guide to help educators use its capabilities in the classroom and beyond. There are also instructions about setting up a BioBlitz on the iNaturalist site.

Educators are also eligible to apply for grants from National Geographic to help support involving kids in citizen science--or other innovative ideas!

[3] National Geographic, Citizen Science Resources Library, https://www.nationalgeographic.org/topics/citizen-science/?q=&page=1&per_page=25

[4] Information on Bioblitzes can be found at https://www.nationalgeographic.org/projects/bioblitz/education/

[5] For more information about iNaturalist, visit https://www.inaturalist.org/).

Be an eePRO

eePRO is NAAEE's online platform for environmental education professional development, offering a searchable bank of **Resources** (lesson plans, journal articles, reports, videos), a listing of **Learning** opportunities (webinars, on-line courses, workshops, conferences), a higher education database and much more. eePRO also includes:

eePRO Groups is a discussion platform where individuals can join special interest groups, network, and discuss key issues related to environmental education.

eeLEARN is a series of online learning modules exploring the foundations of environmental education.

eeNEWS is a biweekly e-newsletter, providing the latest news, opportunities, and resources for the environmental education community.

eeRESEARCH offers a searchable library of environmental education research.

eeWORKS provides research reviews and tools for illustrating the benefits of environmental education.

PRO Picks

PRO Picks is a curated listing of educational resources recommended by experts in environmental education.

Access all of these eePRO resources by visiting **https://naaee.org/eepro**

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Guidelines for **Grades K-4**

STRAND 1

Questioning, Analysis and Interpretation Skills

A. Questioning—Learners develop questions that help them conduct simple investigations and learn about the environment.

Learners are able to:

- Pose questions based on their own experiences, observations, and investigations of the environment as well as external sources. For example, working collaboratively, develop questions about the range of air temperatures across their state.
- Generate ideas and questions about objects, organisms, events, places, and relationships in the environment. For example, develop questions comparing the amount of time it takes to travel a set distance using different transit modes (e.g., walking, biking, in a car, on a public bus).
- Explore and compare existing understandings about the environment. For example, explain what they know about growing a vegetable garden, share their understandings with classmates, and jointly develop questions for future investigation.

B. Designing investigations—Learners design simple environmental investigations.

Learners are able to:

- Predict possible answers to their own questions and develop and discuss alternatives.
- Design ways of answering questions based on qualitative and quantitative data collection methods. For example, determine different ways they can investigate the modes of transportation used to get to and from school.
- Design simple experiments to answer questions and test ideas they have about the environment. For example, devise a way to monitor food waste in the school cafeteria.

C. Collecting information—Learners locate and collect information about the environment and environmental topics.

Learners are able to:

- Use basic field skills, such as observing, interviewing, measuring, recording, and collecting information to carry out investigations. For example, working in small groups, observe and record characteristics, differences, and change over time in objects, organisms, events, places, and relationships in the environment.
- Find, assess, select, and use, as appropriate for their environmental investigation, resources such as atlases, databases, charts, tables, graphs, diagrams, and maps. For example, access and compare contemporary and historic maps of the local watershed.
- Use digital and hands-on tools (such as rulers, thermometers, scales, apps, and computer tablets) to make observations, take measurements, conduct investigations, and manipulate information. Determine ways of recording their observations and measurements.

D. Evaluating accuracy and reliability—Learners identify basic criteria to judge the merits of information and information sources.

Learners are able to:

- Generate explanations for their understandings about the environment. For example, for a selected environmental topic or phenomena, explain how they know what they know about that topic or phenomena.
- Provide specific examples of information they believe to be factual, fictitious, or of questionable merit and explain their reasoning. Share their findings orally and in writing.
- Identify characteristics that influence the credibility of a specific source of information. For example, identify who created the information, how old it is, and what kinds of arguments or evidence is used.

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

Learners are able to:

- Summarize observations and describe data. For example, observe, record, display, and describe seasonal differences in weather conditions.
- Identify patterns and relationships in events, designs, organisms, and sets of numbers. Illustrate their findings.
- 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.
- Construct, read, and interpret maps, graphs, tables, diagrams, and other displays of data.

F. Working with models and simulations—Learners use models to represent environmental relationships, patterns, and processes.

Learners are able to:

- Give examples of models or simulations and how they can be used to learn about what they represent. For example, use a diagram of a germinating seed to explain how plants grow.
- Identify ways in which a model differs from what it represents. For example, compare a map of the schoolyard to what they see and experience on the schoolyard.
- Use models to summarize observations of the environment. For example, diagram the roles plants can play in preventing or reducing soil erosion.
- Manipulate variables within a model to test for changes. For example, remove a producer or consumer from a model of a food web and observe the results.

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

Learners are able to:

- Compare findings and data analysis results to make inferences and report what they learned. For example, use locally collected weather data to describe the differences between climate and weather.
- Identify information that is not relevant to a proposed explanation and explain their reasoning.
- Use models and examples to explain their thinking. For example, working collaboratively, use a food web model to describe the implications of removing a keystone species.

GUIDELINES IN PRACTICE

The Kinder-Gardeners

Givins-Shaw Junior Public School in Toronto, Canada is a small neighborhood school in a very urban environment. It is nestled only one block from a major intersection, in a community that is seeing intense revitalization and demand due to its proximity to the city center. And with the concrete skyscrapers of Canada's largest city a mere ten-minute public transit ride away, the students are hunting snails and building birds' nests.

The children spend the vast majority of their school day outside in a program that is dominated by guided inquiry. Mornings are generally spent in The Courtyard, and the first half of the afternoons in a playground reserved for and shared with another class of kindergarteners. Facilitated by the educators, the students' natural curiosity drives their learning process, and the overarching topics are integrated across the array of subject areas.

One of many possible examples to illustrate is trees. Early in the school year, the children discovered a tree marked for removal. Guided discussion revealed a host of questions, and trees spontaneously became the extended focus of study. There were tree journals, tree stories, "My Favorite Tree" presentations, and tree science, but also plant and tree dramas, and tree art festooned the hallways of the school.

Later that year it was birds: Again there was art and language and science, even bird egg manipulatives in math—artificial of course! The children learned to identify birds by sight and call. The days a city hawk hunted the neighborhood, or a duck spontaneously came to visit, were fantastically memorable teachable moments. From the parent's perspective, the culmination was the children's much-beloved performance of their songs about birds at the annual spring fundraiser. Fueled by the children's natural curiosity, the outdoor-centered guided inquiry facilitates engagement not only with the necessary array of academic subjects, but also with the natural world in the heart of the city they are intrinsically a part of.

Given Canada's frigid winters, the children and families are well versed in the necessity of maintaining a full array of cold-weather gear. While they try to keep its use to a minimum, they have the luxury of a fully equipped indoor classroom to retreat to in the severest of conditions.

When asked about the development of this new program, its founder Kim MacIntyre—a kindergarten teacher for twenty-five years—shrugs humbly: "My kids have always spent more time outside. It just seemed right."

Adapted with permission from Green Teacher # 102, Spring 2014, DeBoer, M., The Kinder-Gardeners. For more information, visit www.greenteacher.com.

STRAND 2

Environmental Processes and Systems

2.1 Earth's physical and living systems

A. Earth's physical systems—Learners describe characteristics of Earth's physical systems, including air, water, and land. They explain how these systems interact with one another and identify changes in the physical environment over time. They provide examples of how physical systems affect living organisms, including humans.

Learners are able to:

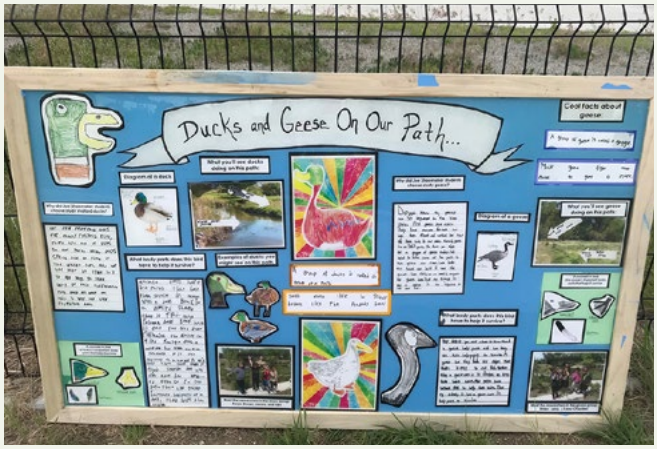
- Use maps to obtain information about the location of water on Earth (such as the ocean, lakes, rivers, and glaciers). Differentiate between water that exists as a solid and a liquid on Earth. Compare the locations of fresh water to the locations of towns and cities in their region.
- Explain the difference between weather and climate, using ideas such as time scale and predictability. Describe the characteristics of the local climate, including the likelihood of different types of severe weather occurring in the region, and provide examples of how humans adapt their behaviors (e.g., shelter, clothing, and transportation) to live in this climate.
- Describe the characteristics that are used to identify different biomes, such as precipitation, temperature, humidity, groundwater, wind, soil composition, and amount of sunlight. Describe the characteristics of the local biome and explain how it meets the needs of local plants and animals, including humans.
- Discuss the role that the ocean plays as a major influence on weather and climate in places both close to and far from the ocean. Trace the influence of the ocean on their local weather and climate.
- Identify some of the forces that cause erosion within the local region, pointing out factors such as freezing and thawing, wind, waves, and gravity. Identify evidence that demonstrates the effects of weathering and erosion, such as the movement of soil or rocks downhill, waves along a coastline, formation of potholes on roads, and breakdown of rocks or rock layers. Discuss how plants can help prevent or reduce erosion.
- Use maps and images to identify patterns of similarities and differences of some landforms, including bodies of water and mountains, within the local region and in other areas of the world. For example, compare the patterns of landforms and human development in their local region to another.
- Describe objects in terms of the materials they are made of and their observable properties. For example, describe buildings constructed with different materials (e.g., wood, metal, and concrete) and discuss why these materials may have been selected based on properties such as rigidity, ability to reflect or gather heat, and transparency. Working in small groups, design an environmentally friendly solution to protect buildings in areas that are prone to natural hazards such as flooding, hurricanes, wildfires, or sea level rise.

B. Earth's living systems—Learners identify basic similarities and differences among a wide variety of living organisms. They explain ways that living organisms, including humans, affect the environment in which they live, and how their environment affects them.

Learners are able to:

- Discuss various ways that changes in a habitat could affect the organisms living there. For example, describe how a city's expansion might affect the available food sources for animals living in the area. Or compare the consequences of depositing natural materials, such as leaves or branches, and refuse that contains plastics into a river or lake.
- Identify patterns in the basic needs between plants and animals, among various plants, and among various animals. Describe examples of patterns such as all living things need water, plants make their own food, and animals consume food.

- Identify some basic traits, including both internal and external structures, of plants and animals that help them throughout their life cycles. Give examples of how those traits may vary among individuals of the same species and how those differences may help with individual survival. Identify some similarities among offspring and parents that are inherited and others resulting from the organism's interactions with its environment or availability of resources.
- Describe ways in which an organism's traits and behavior patterns, including group behavior in animals, are related to its environment. Argue from evidence that human activity can affect an organism's behavior patterns.
- Construct an argument based on evidence that identifies ways in which organisms (including humans) cause changes in their own environments.
- Explain how most living organisms depend on the sun as the source of their life energy. For example, trace the energy in the food they eat for lunch back to the sun.
- Describe ways that plants and animals may respond to changes in the environment they live in, such as changes in the availability of food and water, temperature, other organisms in their area, and the land itself.



Joe Shoemaker School: Working With The Systems

Schools exist within systems—not just educational systems, but social, political, economic, and ecological systems as well. The Joe Shoemaker School in Denver, Colorado has made the most of the systems it's part of.

In an unusual partnership, Donny Roush is a water educator employed by the City of Denver to work with schools within the South Platte River watershed. The Shoemaker School is Roush's headquarters, offering storage space for his nets, waders, and other science equipment. When funding and time have allowed, Roush has conducted monthly teacher trainings at Shoemaker. "We want to make EE as common as breathing," he notes.

As it happens, two members of Denver's city council are environmental educators, and the council has helped make EE a priority. Roush attributes much of his program's success to the fact that school and city leaders communicate to ensure the systems work smoothly together.

Political, social, and ecological systems have all played their parts in the school's development. Shoemaker is a Title 1 school, receiving federal dollars to support its high percentage of students from low-income families. The school is home to many first-generation English learners (over 20 languages are spoken at home by Shoemaker students).

Meanwhile, the 11-acre school site includes access to Cherry Creek, the second largest stream in Denver. The property itself was formerly parkland and abuts parks and trails, and local leaders have been inspired to ensure that the school is ecologically sensitive and takes full advantage of its location.

A portion of the land is owned by Denver's public works department, and includes a pond that receives the city's stormwater runoff. With native plants that help filter the water, this "green infrastructure" was constructed with teaching in mind—surrounding concrete stairs are used for seating, and classes use the bench area almost daily.

Roush's work is funded through an education and outreach requirement in the law regulating stormwater systems, which are separate from sanitary sewage. About 7,500 such systems exist across the U.S. under the Clean Water Act. Rather than scrambling for EE dollars, Roush notes, his well-funded program is "a rounding error in the city's stormwater budget." Roush notes that both the city and school benefit from this synergistic arrangement: "The engineers don't want me designing their pipes, and they're happy I'm doing their education work."

The Shoemaker School uses the "Expeditionary Learning" (EL) model (one of eight such schools in Denver), which grew of out the Outward Bound program, and students are ideally outside for at least 90 minutes per day.

In her students' study of birds, K–1 teacher Annie Holyfield began with the national EL curriculum, but then zoomed in on the local. With help from Roush, her students explored Cherry Creek. Then her class spent time on the public paths that abut school property.

"The kids identified crows, sparrows, mallard ducks, geese, red-tailed hawks, bald eagles, and magpies," recalls Holyfield. As the students

learned about the birds' habits and diets, they realized that crows, which are natural scavengers, were eating litter left on the pathways.

"The kids said, 'Oh, no! Our birds will get sick because of what our community does!'" Holyfield recalls. Inspired, the students created an action plan to teach the community about birds and why they matter. With support from the city, the students planned colorful educational murals describing the lives and value of the local bird species.

Holyfield plans additional community service work with her students, including possibly installing extra trash cans and additional educational signage based on students' field work.

"I think this is what I'm most proud of in my teacher career," she says.

Given high teacher turnover in Denver, the need to inform educators about Roush's resources is ongoing. "In a sense, being a go-between to connect new teachers with Donny is my unofficial new role," Holyfield notes, adding that it's a job she's happy to fulfill. Thanks to the positive interactions among school, city, and ecological systems, she says, "kids can do more than anyone thought was possible."

For further information:
Denver, Keep it Clean – Neighborhood Environmental Trios (KIC-NET), http://www.keepitcleandenver.org
Joe Shoemaker School, http://shoemaker.dpsk12.org

STRAND 2

Environmental Processes and Systems

2.2 Human systems

A. Individuals, groups, and societies—Learners generate examples of how people act, as individuals, as members of a group, and as members of society, toward the environment. They articulate their own beliefs and the beliefs of family and community members about the environment and environmental issues.

Learners are able to:

- Interview an elder, a middle-aged adult, and a young adult about their participation in behaviors such as recycling, taking a reusable bag to the grocery store, or conserving energy. As a class, summarize and compare the attitudes and practices of these three groups about these behaviors.
- Construct an evidence-based argument explaining examples of influences on individual behavior, particularly behavior that affects the environment. For example, discuss why a person might choose to bike to school, recycle, or use a reusable lunch box. Consider influences such as financial costs, individual and group characteristics (e.g., race, ethnicity, gender identity, age, religion, and socioeconomic status), convenience, laws, and the opinions of friends and family members.
- Discuss reasons why students might choose to belong to school or afterschool clubs (such as environmental clubs or scouting troops).
- Discuss their beliefs about the environment in general and a selected environmental issue specifically.
- Based on their own research, describe the beliefs of family and community members and how those beliefs influence their perceptions of the environment and interpretations of environmental information.
- List some of the civic actions that they, their family, and other community members take. Discuss what motivates people to participate in civic activities, and how people's values are tied to these efforts.

B. Culture—Learners identify ways that people express different cultural backgrounds and how these can influence environmental perceptions and activities.

Learners are able to:

- Compare how different people reacted to a place or historical event—especially one with local significance.
- Research how people live in different climates and how different cultures meet basic human needs in those climates. For example, prepare a visual presentation that compares how people support themselves in different climates and discuss how those livelihoods can both affect and depend on the environment.
- Describe how people from different cultures interact with and express their beliefs about nature.
- Discuss how television, computers, and other forms of communication connect people with their environment and with other people around the world.

C. Political systems—Learners identify characteristics of political systems and how they help people by providing basic services, maintaining order, managing conflict, and caring for the environment.

Learners are able to:

- Discuss what might happen if there were fewer environmental laws in their area. Describe possible positive and negative effects of existing environmental laws on plants and animals, natural areas, landowners, businesses, water users, and others.
- Give examples of rules related to the environment at home, in school, or elsewhere that have changed and others that have stayed the same.
- Compare how their community and other communities in their region benefit from or are disadvantaged by laws that regulate clean air and clean water.
- Describe the possible reasons for establishing sustainable development goals, such as those adopted by the United Nations, and how they might help governments make progress toward creating a better world and a better quality of life.

D. Economic systems—Learners identify basic characteristics of economic systems that help people make choices about how to use resources, including natural resources, to satisfy human needs and wants.

Learners are able to:

- List jobs in their community that are related to the environment.
- Identify ways in which individual needs and wants are related to environmental concerns such as energy use, conservation, and environmental protection.
- Provide examples of how manufacturing is dependent on natural resources. Use maps to display the relationships between different types of manufacturing and the natural resources used.
- Compare examples of energy or water use in various sectors of the economy: agriculture, industries like mining and logging, manufacturing, services, and information technology and services.
- Describe some of their own consumer choices and how they affect the environment.

RESOURCES YOU CAN USE

"Water Safari" from Aquatic WILD K–12 Curriculum & Activity Guide

Association of Fish & Wildlife Agencies

"Water Safari" is an early elementary field investigation activity from the *Aquatic WILD K–12 Curriculum Activity Guide,* one of the offerings from the Project WILD family of programs. In this activity, students investigate wildlife and water sources at a local study site, such as in a school yard.

"Water Safari" is one of several field investigations found in Project WILD publications, including Aquatic WILD, Project WILD "Terrestrial," Flying WILD, and Growing Up WILD. This activity is also one of a subset of "expanded" field investigation activities in the WILD collection in which students take an active role in designing the investigation, including the formulation of investigative questions. At the early elementary level, the educator guides students in developing investigative questions that help learners collect data to describe their local environment, such as questions of where, what, and how many? These are questions students are likely to be able to answer by making direct observations at their study site.

"Questions to Investigate" could include the following: Where in the schoolyard or study site can water be found? What are the different kinds of water sources? Where on the study site will we find wildlife or clues of wildlife? and What animal is most commonly observed on the study site?

Using the "Wildlife and Water Source Note Cards" data collection form, students write names, descriptions, or make illustrations of animals (including small bugs and spiders) or signs of animals (tracks, scat, feathers, boroughs). They also record types and locations of water sources. With the educator's guidance, mapping wildlife and water sources on the study site then allows students to move their analysis from description to comparison. Students may begin considering relationships and possible patterns between the presence of wildlife and the presence of water.

Student explanations about the data collected are not limited to what was observed. Students may also explain what was not observed. Why, for example, might students not have found signs of wildlife or water on at the study site? Are there any actions we could take to help wildlife or improve water availability on our study site?

The activity "Water Safari" provides early elementary learners an opportunity to develop questioning, analysis, and interpretation skills by examining wildlife in their local environment while reinforcing the core idea that all living things need water.

STRAND 2

Environmental Processes and Systems

2.3 Environment and society

A. Human-environment interactions—Learners identify ways that people depend on, change, and are affected by the environment.

Learners are able to:

- Identify ways in which people depend on the environment. For example, create an artistic representation of how the environment provides food, water, air, minerals, and other resources that humans use.
- Explain how 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 produced within their community or region.
- Discuss how the environment affects human activities, using examples from their community or region, such as farming, recreation, and where people build their houses.
- Compare activities that people can do to reduce the impact they make on the environment.
- Describe an action they have taken or could take to reduce their environmental impact. Explain their reasoning.

B. Resource distribution and consumption—Learners describe ways people harvest, re-distribute, and use natural resources

Learners are able to:

- Explain what a natural resource is and give examples.
- Identify resources from nature that are used in daily life. Categorize which resources are renewable and which are non-renewable as well as flow resources (like running water or wind) that are available only in certain places at certain times.
- 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 their food, clothing, and household items are produced; where the raw materials come from; where products that are traded into and out of their region originate; and so forth.
- Locate sources of various natural resources on a map. For example, trace the origins of the local water supply or map another of the region's natural resources.
- Link patterns of human habitation and other activities with the presence of specific natural resources such as mineral deposits, rivers, wildlife, or fertile farming areas. Research the history of human habitation in their region and explain the role of resource availability on how it developed.

C. Places—Learners identify ways that places differ in their physical and human characteristics.

Learners are able to:

- 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 needs and wants. Illustrate with 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 or create a drawing that illustrates what makes one place different from another.
- Describe their favorite place or their community from a variety of perspectives, including their own. For example, compare the reasons a child likes a place and the reasons an adult likes the same place.

D. Change and conflict—Learners recognize that change is a normal part of individual and societal life. They describe examples of ways that conflict related to the environment or natural resources may be rooted in different points of view.

Learners are able to:

- Research aspects of family and community life that have changed over time, including transportation, food, recreation, and clothing. For example, interview elders in your family or community and develop a visual display of the findings.
- Discuss some basic ways in which individuals, groups, and institutions such as schools resolve conflict concerning the environment. For example, describe different ways of solving a school problem such as littering on the playground or in hallways.
- Identify tools used for food preparation, hygiene, or tending a garden that require batteries or electricity. Locate and examine pictures of tools that can do the same work with human power. Describe how the availability of electricity and fuel changed the daily lives of individuals and discuss both the benefits and disadvantages of these changes.
- Using primary and secondary sources of information, locate references to past fears expressed about new technologies, such as fears associated with the printing press, telephone, automobile, radio, and television. Discuss expressions of fear of technology that can be observed in the world today and their environmental implications.

GUIDELINES IN PRACTICE

Bridging the Gap: Connecting With Aboriginal Stewardship

One of the highlights of being an environmental educator is the sight of a student first discovering nature, be it a tiny insect or an entire forest. Stewardship implies accepting responsibility for the future of the planet. When we connect with the place we live, we can conceive of ourselves as part of and not separate from the Earth. This affects both our conscious and unconscious actions, and inevitably shapes our interactions with the environment.

This concept of stewardship is central in Aboriginal teachings, which generally take a holistic view of the world. In Canada, a Winnipeg, Manitoba program called "Bridging the Gap" brings together environmental science and Aboriginal concepts of stewardship, and gives fourth-grade students from inner-city schools the opportunity to visit local natural areas. Aboriginal elders and advisors from many different First Nations, including the Cree and Anishinaabe, are an integral part of Bridging the Gap, each bringing their own unique beliefs and knowledge to the program and maintaining an important link between past and present generations.

One Bridging the Gap field trip offers a fall outdoor habitat study in which students visit three habitats in Winnipeg that are accessible by public transportation. The study of each habitat is divided into three sections, beginning with discussion with an Aboriginal elder, followed by a hike, and concluding with the recording of information into data booklets.

Speaking with an elder gives students the opportunity to explore a different perspective on the role of humans in the natural world. The class learns about Aboriginal approaches to environmental stewardship, human interrelationships, and human reliance on animals, plants and Mother Earth for survival. Every talk varies, but the focus is always on responsibility and respect for Mother Earth and our fellow animals and relations.

During the hike, students are introduced to the resident animals, plants, and unique features of the habitat. The hike is taken slowly to give students time to notice small details and to stop and listen. Discovering signs of wildlife prompts them to think of the animals that make the habitat home. Breaks are taken to taste edible plants, such as licorice root and rose hip (which, students learn, has more vitamin C than an orange). This encourages discussion of local food sources and allows students to connect concepts with concrete examples. The hike concludes with a review and recording of information about the components of the habitat.

The data sheet is designed to reinforce the concept that humans are also animals. The habitat study engages students in a wide variety of areas, including science, social studies, mathematics, Aboriginal cultures, visual arts, language arts, physical education and health. Thanks to support from Aboriginal elders in both teacher and advisor roles, Bridging the Gap students benefit from the program's grounding in Aboriginal culture as well as in the outdoor environment. This combination both excites students' curiosity and enhances their learning capacity.

Adapted with permission from Green Teacher #86, Fall 2009, Kazina, D. and N. Swayze, *Bridging the Gap: Integrating Indigenous knowledge and science in a non-formal environmental learning program*. For more information, visit www.greenteacher.com.

STRAND 3

Skills for Understanding and Addressing Environmental Issues

3.1 Skills for analyzing and investigating environmental issues

A. Identifying and investigating issues—Learners identify and investigate issues in their local environment and communities.

Learners are able to:

- Identify and describe a current or historical environmental issue in the local community they wish to investigate. For example, trace changes in species diversity in a regional park or examine what happens to solid waste and recyclables once they are picked up.
- Use primary and secondary sources of information to explore an environmental dilemma confronting people.
- Apply ideas of past, present, and future to a local environmental issue of interest. For example, discuss how a selected environmental issue changes over time, describing what has changed, is changing, and could change in the future.
- Research a local environmental problem or issue and identify individuals and groups that are involved.

B. Sorting out the consequences of issues—Learners use their knowledge of how ecological and human systems are interconnected to describe the environmental, social, and economic consequences of local environmental issues.

Learners are able to:

- Observe and read about social, economic, and environmental effects of changes to the environment. For example, consider possible changes in a rural neighborhood if a highway exit is constructed and new businesses, such as a gas station, restaurant, or convenience store, are built.
- Describe short-term and long-term environmental, social, and economic effects of land use development in a local area or region. For example, discuss the historical effects of locating a factory next to a river to facilitate receiving supplies and shipping products to market or what might change if an old river barge is converted into a museum and restaurant.
- Discuss how a selected environmental issue affects different individuals and groups living in the community, including people of different races, ethnicities, gender identities, socioeconomic status, and ages. For example, compare the effects of air quality and asthma rates on people living in low traffic neighborhoods with those living in high traffic neighborhoods.

C. Identifying and critiquing alternative solutions and courses of action—Learners develop plans, including possible design solutions, for addressing selected local environmental issues.

Learners are able to:

- Identify proposed solutions to a selected environmental issue and discuss evidence-based arguments for and against each solution.
- 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 environment. Illustrate with examples from a specific issue.
- Describe some of the different levels at which environmental action can be taken—for example by individuals, families, school classes, government, or businesses. Identify ways that these groups might act on a specific issue alone or together.
- Based on the results of their investigations, propose at least two evidence-based solutions for a specific environmental problem. For example, working in a small group, consider possible solutions to littering on the school grounds or wasting water in the school bathrooms.

D. Working with flexibility, creativity, and openness—Learners demonstrate openness and receptivity while listening to and working with others who have perspectives about the environment that are different from their own.

Learners are able to:

- Ask clarifying questions during a discussion of an environmental issue. Explain why open inquiry is important, especially for environmental issues.
- Identify ideas about and interpretations of an environmental issue that differ from their own.
- Working collaboratively, ask questions about different perspectives, discuss their strong points and possible drawbacks, and consider whether the perspectives are based on opinion or evidence.
- Listen respectfully and actively to different perspectives about environmental issues.
- Engage in a discussion about an environmental issue with people whose lives, cultures, and viewpoints are different from their own.

STRAND 3

Skills for Understanding and Addressing Environmental Issues

3.2 Decision-making and action skills

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

Learners are able to:

- Express their own ideas about local environmental issues and possible ways to address them.
- Test ideas they are developing against what they know and believe, while remaining open to new information and ideas.
- Identify unanswered questions related to a local environmental issue they are investigating.
- Identify, clarify, and express their beliefs and values regarding the environment and the environmental issue they are investigating.

B. Evaluating the need for action—Learners determine whether action is needed on selected environmental issues and whether they should be involved. They describe their reasoning.

Learners are able to:

- Discuss why community members should or should not act 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 individual and community actions appropriate for a specific issue. Predict the outcomes of these actions, including possible unintended consequences.
- Discuss whether and how they think they would like to be involved in action taking to address an environmental issue of their choosing. Identify reasons for and against taking specific kinds of action.

C. Planning and taking action—Learners develop an action strategy or design solution for a specific local environmental issue of their choosing.

Learners are able to:

- Develop action plans or design solutions they can carry out individually, in small groups of learners, or as a class. Include clear reasons and goals for proposed actions or design solutions.
- Set realistic goals for action and measures of success consistent with their abilities. For example, make recommendations for walking to school or using scooters and skateboards.
- Analyze an action plan or design solution created by themselves or someone else and decide whether it should be implemented immediately or at another time, changed, or abandoned.

D. Evaluating the results of actions—Learners identify environmental, social, and economic consequences of design solutions and civic actions, including their own actions.

Learners are able to:

- Describe the apparent effects, both positive and negative, of their own actions and actions taken by other individuals and groups.
- Discuss why identifying the short-term and long-term effects of actions and design solutions may be difficult. Consider, for example, the time required to see impacts and the effect of actions of others.
- Describe the intended and unintended consequences of selected civic actions or design solutions. For example, research the long-term consequences of introducing the mongoose into the State of Hawaii as a method of controlling rats.

GUIDELINES IN PRACTICE

Wolverine Park, Anchorage: Students Serving Community

When we think of Alaska, many people envision white peaks and wilderness. But Campbell STEM Elementary School in Anchorage is like many urban schools across America, surrounded by stores, a steel manufacturer, a railroad, and all the other trappings of downtown America. The student body has richly diverse racial, ethnic, and language backgrounds (six of the most diverse schools in the nation are in Anchorage), and over 60 percent of students qualify for free and reduced lunch.

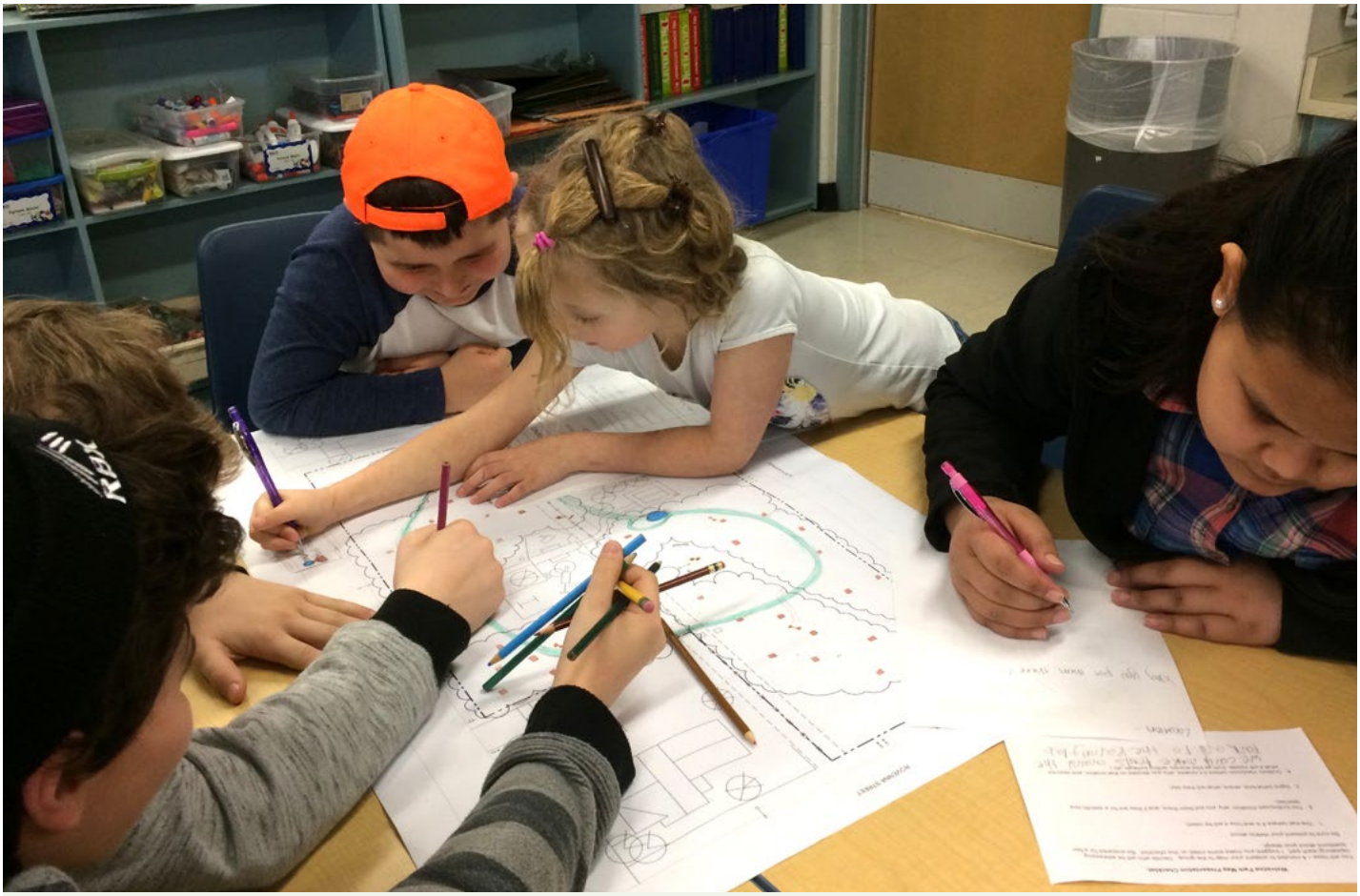
Wolverine Park, which abuts Campbell Elementary property, was originally conserved not because it held any special ecological value, but simply as a one-block green space. Perhaps the only thing setting it apart from urban parks in other states was the regular appearance of moose: "Anchorage has a lot of moose," laughs Campbell fifth-sixth grade teacher Virginia Gates. But the park was neglected and under-used.

Gates and her students, along with colleague Dawn Wilcox and her second graders, decided to take a closer look at Wolverine Park. Soon, they set out to change it.

Gates and Wilcox were inspired by the Iditarod Trail to Every Classroom training (iTREC). A year-long course, iTREC helps teachers develop curricula with an emphasis on community partnerships. The iTREC interdisciplinary, place-based model emphasizes ecology, civics, outdoor recreation, and volunteerism, connecting teachers with resources and offering peer support. It is based on the concept that students' understanding of their own "place" is key to developing ecological literacy and a stewardship ethic.

The students mapped Wolvrine Park, asking themselves, what is here now? What do people use the park for? What would we like to see here? The second and sixth graders did their work separately, but the classes came up with very similar findings. The students were intrigued by birds in the park, and wanted to build and install birdhouses. They prioritized creating interpretive signs to inform the community about local plants and animals, with a focus on birds. And with an interest in healthy activity, they decided to improve the pathways to encourage community use.

"Academically, my students are learning about interdependence and relationships in our science curriculum," says Gates, noting that the park upgrade was a good fit for her fifth-sixth graders. "Developmentally, they are exploring social relationships, their role in the community and impacts they can have on a larger scale." Gates and Wilcox also created an after-school STEM club to open the project to additional students and keep it moving.



As the project gained momentum, the students presented before Anchorage's community council, the parks department, and the school board. "They had a lot of opportunity to become better public speakers," recalls Wilcox. "The students were so passionate, people couldn't help but be excited."

Ultimately, the project received broad community support. The Anchorage Schools on Trails program of the Anchorage Park Foundation helped the teachers connect with community professionals to help with signage, trail building, and other elements. Not only did architects donate their guidance to student planners, but parents contributed time and construction supplies. With grant monies and volunteer effort, new paths and plantings make the park more welcoming. Birds have moved into the nesting boxes, student-created artwork adorns interpretive signage, and a learning lab has been built out of natural materials for student and community use.

The teachers agree that the project has fostered a strong sense of place. "I've called students over the summer to water trees; they are glad to do it," notes Wilcox. "The students understand the need to clean out nesting boxes once a year—they understand there is a need for stewardship. There is a true sense of ownership."

"All of these families live in the neighborhood, so it really is part of their lives," says Gates. "It is not just our students; Wolverine Park has become the whole school's park. We held our "Meet Your Teacher" event at the park this year. It really has just become, well, our park!"

For more information: The iTREC training is modeled after a Forest for Every Classroom and a Trail to Every Classroom (along the Appalachian Trail). For more information about iTREC, see https://www.iditarod100.org/itrec-education-program.html

Photos: © Campbell STEM Elementary School

STRAND 4

Personal and Civic Responsibility

A. Recognizing rights and responsibilities—Learners describe their basic rights and responsibilities as members of a community and the importance of these rights and responsibilities in promoting environmental quality and community well-being.

Learners are able to:

- Identify the rights afforded to members of their community, such as voting, police/fire protection, free speech, and education. Discuss whether they believe there is a right to a clean environment.
- Identify examples of the responsibilities members of a community might have, including paying taxes, following laws, and treating others with respect. Discuss how these responsibilities affect community well-being.
- Discuss rights and responsibilities in the context of local environmental issues.

B. Recognizing efficacy and developing agency—Learners describe how they can realistically and meaningfully contribute to their community and environmental quality.

Learners are able to:

- Examine ways in which individuals and groups act within their community to protect the environment, such as building silt fences at construction sites, purchasing non-toxic cleaning solutions, using biodegradable containers, and carpooling or walking to work.
- Compare cases where community action has had an effect on an environmental decision or policy, such as when community members attended a town hall meeting to voice their opinions concerning bicycle lanes, wildlife feeding, or curbside composting.
- Describe ways in which they have made a difference through their own actions. Give examples from situations over which they have some control (for example, in the classroom, at home, or in the community) and that are appropriate to their level of understanding and ability.

C. Accepting personal responsibility—Learners identify ways in which they are responsible for the environmental, social, and economic effects of their actions.

Learners are able to:

- Compare the positive and negative effects that they and the groups they belong to (e.g., family or school class) have on the environment, other people, and other living beings. Consider what, if anything, they can do personally to decrease any negative effects and increase positive effects of their behavior.
- List examples of personal responsibilities, including those that relate to the environment (e.g. treating others and the environment with respect, practicing self-care and care of pets, chores, and homework). Describe what might happen if these personal responsibilities are or are not carried out.
- Discuss the difference between short-term and long-term consequences of actions in terms of specific personal responsibilities. Predict the short-term and long-term consequences of acting or not acting on a specific environmental responsibility.
- Identify a specific environmental issue in their community and describe whether they feel responsible for helping to resolve it.

GUIDELINES IN PRACTICE

Photo: © Central Park School for Children

Central Park School: Project-Based Learning

First grade teacher Anna Morrison is a self-professed stickler for schedules. But one thing her schedule never includes is going outside. "It's not something I put on the list," she explains, "because I just do it all day."

Her students call the area just outside her classroom the "outdoor kitchen," which features benches, stumps, a table, and lots of pots and pans. The kitchen is great for imaginary play, but also a place for reading, math (counting and tallying collections of acorns and leaves) and science. Seedlings are nurtured here, since just down the steps a garden features vegetables, flowers, and herbs. "Each year I add a little bit more," says Morrison—like a bug hotel to introduce students to beetles and roly-polies.

At the Central Park School for Children in Durham, NC, teachers use the "project-based learning" model, working for extended periods of time on real-world topics generated by the students (usually three or four projects per year). Not surprisingly, Morrison's first graders' topics usually have an outdoors theme, ranging from farms and gardens, to rocks and minerals, to birds and even mollusks. ("We just had a lot of kids interested in sea life that year," she noted.)

A recent project on trees began with inquiry, as Morrison encouraged students to tell stories about trees in their lives—the one in their yard with the interesting pine cones, perhaps, or a magnolia tree at their grandmother's house. The first-graders generated a list of what they wanted to know about trees, as well as what they felt they knew already. Next, they brainstormed how to learn more about trees, eventually accessing not only the library but state parks, with a month of "Forest Fridays" that featured visits with park rangers. Finally, they planned how to share their learning with the community—in this case, hosting a tree seedling sale, with informational care and feeding tags they had researched with their fourth-grade book buddies.

Morrison uses social media to communicate her classroom's enthusiasm to the community. In fact, during an agriculture unit, her use of Twitter led to a connection with a local farm. Her 16-student class then created an onsite farmer's market, where farmers could sell their produce, and families could also sell their garden veggies to support school projects.

A public charter school, Central Park has an entrance lottery system that is weighted to ensure socioeconomic diversity, and the school also aims for racial diversity in the student body, with teachers undergoing extensive racial equity training.

Whatever the topic or the weather, Morrison's students are outdoors at least three or four times per day. "Traditionally, teachers may think there are too many obstacles to taking their students outside. I say, start small, and go for it. Use clipboards, and take the inside work outside!"

For more information: Central Park School for Children, http://www.cpscnc.org

Guidelines for **Grades 5-8**

STRAND 1

Questioning, Analysis and Interpretation Skills

A. Questioning—Learners develop, refine, and explain questions that help them conduct environmental investigations and learn about the environment

Learners are able to:

- Develop environmental questions based on experiences, observations and information gathered from newspaper and magazine articles, television and radio news, or videos. For example, generate questions that compare the school's energy or water use to other schools in the district.
- Summarize what is known about an environmental problem or situation to provide context for, or explain the origin of, a specific question. For example, working collaboratively, develop a presentation with maps of all the schools in the district, graphs of each school's water/energy use, and videos and written statements describing their thinking and other students' thinking about water/energy use.
- Pose clear questions and ideas to test. For example, formulate a question that would allow them to investigate the effectiveness of different energy reduction strategies in the school.
- Clarify their own beliefs about the environment and discuss how those beliefs are reflected in the questions they ask. For example, analyze their own beliefs about the effects of reducing food waste at their school and consider how those beliefs might affect their questions.

B. Designing investigations—Learners design environmental investigations to answer specific questions—often their own questions.

Learners are able to:

- Plan and select lines of inquiry appropriate to their questions. For example, working collaboratively, plan an investigation comparing their school's environmental impact to other schools in the district. Determine how data related to environmental quality (energy use, recycling rates), health (indoor air quality/asthmas rates), and/or economics (dollars spent on energy use and waste management) can be collected.
- Define the scope of an inquiry, identifying the main variables and phenomena to be studied.
- Choose appropriate methods of observation and measurement for an environmental investigation. For example, design an investigation of energy use across schools in their district that involves interviewing facilities managers.
- Select the appropriate tools for environmental investigations based on the question asked and the type of information sought. For example, use a spreadsheet and a simple journal to track telephone interviews with school facilities managers about energy use.

C. Collecting information—Learners locate and collect quantitative and qualitative information about the environment and environmental topics, using a range of methods and sources. They explain why they used selected information collection methods.

Learners are able to:

- Use field study skills to systematically observe, accurately measure, and keep thorough and accurate records of firsthand information about their own community.
- Use technology to access, collect, and store written notes, data tables, graphs, sketches, and photographs.
- Use various methods of measurement, including derived measurements such as rates of change.
- Assess, choose, and synthesize information collected about their environmental topic or question from resources such as aerial photographs, topographic maps, and satellite images; library and museum collections, historical documents, and eyewitness accounts; computerized databases and spreadsheets; and government records.

D. Evaluating accuracy and reliability—Learners compare the weaknesses and strengths of the information and the information sources they are using in their environmental inquiries.

Learners are able to:

- Examine and evaluate data and evidence, identify faulty reasoning, and apply other basic logic and reasoning skills in gauging information sources for accuracy, relevance, significance, appropriateness, and clarity. For example, identify and evaluate unsubstantiated claims about environmental topics they hear on television or through other media, including social media.
- Identify criteria that affect the credibility of information, including sources, 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 information. For example, examine the credibility of results of public opinion polling about environmental topics, including sampling methods, statistics used, logical conclusions, and appropriate analogies.
- Identify gaps in information that indicate a need for further discovery or inquiry.

RESOURCES YOU CAN USE

BEETLES: Science and Teaching for Field Instructors

BEETLES is a system of free outdoor science education resources, including student activities, professional learning sessions, and many other tools to support instructors and program leaders to improve their practice. All BEETLES resources are based on current research and understandings about how people learn, and are tested by dozens of programs.

Example Student Activity: Discovery Swap
This flexible student-centered exploration routine can be used in many different ecosystems. Find a full guide to lead the activity at: http://beetlesproject.org/resources/for-field-instructors/discovery-swap-2/.

The instructor introduces the ecosystem, and pairs of students discuss their ideas about the needs of organisms within the ecosystem. Next, everyone spreads out, catching organisms. Eventually, each pair chooses one organism to focus on. Pairs carefully draw their organism, while discussing what they're observing, questions, and ideas they have. "Are those legs or antennae?" "Look, it moves both backward and forward!" Some students are more focused on observing, some on drawing, some on writing, but they're all engaged. After about 10 minutes, the instructor passes out a field guide, which pairs use to learn more about their critter. Next, one member of each pair stays with their organism, while the other checks out the organisms other students have chosen to focus on. After a few minutes, students switch roles. The area is filled with students checking out each other's organisms, drawings and notes, and talking about the organisms.

Discovery Swap, like all BEETLES student experiences, incorporates five design principles for high-quality instruction (Note: these design principles are explained at http://beetlesproject.org/about/how-do-we-approach-teaching/):

- **Engage directly with nature.** All students actively explore, observe, draw, and ask questions about organisms they are observing.
- **Think like a scientist.** Students observe, document evidence, share reasoning, read informational text, and discuss with one another as they try to understand their organism.
- **Learn through discussions.** Students talk to one another and the instructor to share ideas, ask questions, and deepen reasoning. The instructor listens to students, then uses that information to guide instruction according to their interests, needs, and abilities.
- **Experience instruction based on how people learn.** Students access prior knowledge, becoming engaged, and then explore organisms in the ecosystem. They learn content through their own observations, discussion, informational text, and from their instructor. They apply what they learned as they talk about their organisms with others and as they expand their observations to include other organisms. And finally, through paired discussion, they reflect back on the experience, what they learned, and how they learned it.
- **Participate in inclusive, equitable, and culturally relevant learning environments.** During discussions, students have the opportunity to make connections to and share their lived experience as expertise. Every student plays an active role in the group's learning. Students get to follow their own interests, develop skills of independent learners, and learn academic language in context.

For more information: BEETLES: Science and Teaching for Field Instructors, beetlesproject.org

E. Organizing and analyzing information—Learners classify, organize, and display data and information they collect in ways that help them analyze and interpret their environmental investigations.

Learners are able to:

- Present environmental data in a variety of formats including charts, tables, plots, graphs, maps, and flowcharts. For example, chart streamflow, create a map of local businesses that require air quality permits, or use statistics to analyze survey results about driving habits.
- Explain why specific ways of ordering and displaying information were selected. Consider the question being answered, the type of information (e.g., qualitative or quantitative), the number of variables, 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 bird species and the prevalence of specific tree species or habitat types.

F. Working with models and simulations—Learners use models to analyze information that support their environmental investigations. They explain the purposes and limitations of these models.

Learners are able to:

- Describe how models and simulations are used to think about long-term processes. For example, describe uses of models of population growth or processes that are difficult to see such as bird migration or the movement of Earth in relationship to the sun.
- Use models to represent and investigate aspects of the physical world. Develop a model to demonstrate how the interactions of sunlight, the ocean, the atmosphere, ice, landforms, and living things influence weather and climate.
- Manipulate digital devices and hands-on models. For example, experiment with variables of an online carbon footprint model or change soil erosion variables (e.g., increase the slope) on a stream table model.
- 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. For example, working collaboratively, evaluate the use of a stream table model as a method of predicting soil loss on a large scale.
- Use a model that relates physical processes and patterns (such as climate, weather phenomena, and seasonal change) to the Earth/sun relationship. For example, use a model to develop explanations about how the Earth/sun relationship affects seasonal change.
- Develop a model, such as a diagram or diorama, to illustrate an environmental system. For example, create a model of interdependent relationships among organisms at the species, population, community, and ecosystem levels. Include humans in the model.

G. Drawing conclusions and developing explanations—Learners synthesize their environmental observations and findings into coherent explanations.

Learners are able to:

- Distinguish between description and explanation and give examples of each based on their own environmental investigations.
- Analyze and explain the relationships between two or more variables. For example, draw conclusions and construct evidence-based arguments about the amount of traffic at a location during different times of day or days of the week.
- Propose explanations based on direct observations from their own environmental investigations. For example, explain what happened in their investigation, including their specific observations, findings through research, and evidence.
- Synthesize and interpret information from a range of quantitative and qualitative sources, including direct observation.
- List strengths and weaknesses of proposed explanations. Respectfully discuss why a proposed explanation might be rejected or how its reliability improved.
- Use proposed explanations to form new questions and suggest new lines of inquiry.

RESOURCES YOU CAN USE

"Phenology at Play" from *Project WILD K–12 Curriculum & Activity Guide*

Association of Fish & Wildlife Agencies

"Phenology at Play," an activity from *Project WILD K-12 Curriculum Activity Guide* (4th edition), involves students in learning about phenology—the seasonal cycles of plants and animals—and the impacts of a changing climate to wildlife. Middle school and high school students build background knowledge by participating as a character in a skit—playing the parts of either the narrator, flycatchers (birds), or oak trees. The brief plot involves the importance of timing with the migration of the flycatchers to ensure their arrival to their summer territory coincides with the availability of a major food source—tent caterpillars. When the timing of the growth of leaves on oak trees changes, so too does the habitat for both the caterpillars and, consequently, the flycatchers.

Students then identify examples from the skit of phenophases, the observable phases in the annual lifecycles of plants and animals. Provided with hypothetical data sets on phenophases of flycatchers, caterpillars, and oak trees, students then graph and compare data over a three year period.

In Part III of the activity, teams of students write new scripts for the play that depict the changing phenologies indicated by their data analysis.

The activity concludes with discussion on challenges wildlife may face in response to climate change. How, for example, might different species respond?

"Phenology at Play" allows for opportunities to develop students questioning, analysis, and interpretation skills, as well as knowledge of environmental processes and systems. The activity requires students to apply systems thinking, but by starting with a very simple and small portion of the much larger and more complex ecosystem. "Phenology at Play" can also serve as a starting point for learning and discussion around the many complex phenomena and issues relating to climate change.

STRAND 2

Environmental Processes and Systems

2.1 Earth's physical and living systems

A. Earth's physical systems—Learners describe the physical processes that shape Earth, including weather, climate, plate tectonics, and the hydrologic cycle. They explain how matter cycles and energy flows among the abiotic and biotic components of the environment. They describe how humans affect and are affected by Earth's physical systems.

Learners are able to:

- Describe the basic elements of the water cycle including evaporation, transpiration, precipitation, condensation, and the effects on surface features and landforms. Illustrate how human activity has altered the water cycle.
- Construct an evidence-based explanation of how an environmental change in one part of the world can have consequences for other places. For example, develop a map or other visual presentation that shows the effects of air pollution in places distant from the source.
- Explain how atmospheric gases absorb and radiate solar energy. Provide an evidence-based explanation of how humans have changed Earth's atmospheric gases during the last two centuries and the consequences of those changes.
- Examine 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).
- Construct a representation of how Earth's major systems (geosphere, hydrosphere, atmosphere, and biosphere) interact with each other. For example, cite evidence that changes in the atmosphere result in changes to ocean chemistry; create a map for the local region that shows how average temperature and rainfall correlate 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.
- Identify a local natural hazard (such as soil erosion, flooding, hurricanes, droughts, and tsunamis) and construct an explanation based on evidence for how it has impacted a local ecosystem and human inhabitants. Predict the consequences of specific physical phenomena such as a hurricane in a coastal area or livestock grazing in an arid region.
- Consider historical evidence of changes in physical processes and patterns. For example, examine tree rings or the formation and melting of glaciers as evidence of climate change. Examine evidence (such as length of growing seasons, melting of glaciers and ice sheets, average global air temperatures, extreme weather, and sea level rise) to investigate the claim that global temperatures have increased since 1880.

B. Earth's living systems—Learners describe how living things, including humans, are dependent on their environment and are adapted to live in particular ecosystems under particular environmental conditions. They describe major interactions among organisms and populations of organisms and explain the importance of biodiversity to ecosystem health. They describe how humans affect and are affected by the biosphere.

Learners are able to:

- Explain the interconnected processes of life, growth, death, and decay of organisms within an ecosystem. For example, use a compost pile to model the cycling of matter and energy transformations.
- Distinguish between examples of adaptations in plants and animals that are behavioral (for example, bird migration) and physical (such as the physical structures that enable desert animals and plants to exist on minimal amounts of water).
- Construct an explanation based on evidence that describes why organisms may be vulnerable to rapid or significant environmental changes, including reasons why specific species became threatened or endangered.
- Explain competition between organisms for limited resources, predator/prey relationships, and parasite/host relationships and how they affect and are affected by ecosystem health.
- Describe the role played by organisms, including humans, in the global carbon cycle.
- Develop a model to represent how food webs transfer matter and energy among producers, consumers and decomposers. Research examples of how human activities interact with food webs.
- Cite evidence that variation among individuals of the same species can sometimes give certain individuals an advantage within a specific environment, eventually changing the distribution of traits and affecting the survival of the species.
- Compare the biodiversity of an aquatic or terrestrial ecosystem before and after the disruption of a physical or biological component. Discuss the implications of species loss in ecosystems and the impact on humans' resources (e.g., food, energy, and medicines).

GUIDELINES IN PRACTICE

Evergreen Community Charter School: Living the Dream

As a mission-driven charter school, the Evergreen Community Charter School in Asheville, NC has had the ability to put environmental literacy goals at the core of its work. From teaching to administration to facilities management, all efforts are supported by the school's mission statement emphasizing "the holistic education of mind, body, and spirit," with a commitment to "environmental stewardship, social responsibility, and service."

At Evergreen, the school facilities and campus are considered elements of the instructional "staff." Students are able to take advantage of the educational opportunities offered by solar installations, ponds, forest playgrounds, and gardens. Decisions about parking lot design, mowing, and other shared space such as eating areas are made collaboratively between educators, grounds staff, and the EE coordinator, and are viewed through a sustainability lens.

Environmental expertise is highly prized by teachers and administrators alike, so even as staff turns over, Evergreen's hiring practices strengthen the culture of environmental literacy.

Experiential learning is the focus of the school's "learning expeditions," a curricular structure that focuses on real-world, long-term studies. Environmental literacy is woven throughout, aligning Common Core and state standards while correlating with NAAEE Framework for Assessing Environmental Literacy. Frequently featuring a community or environmental focus, learning expeditions put the student in the driver's seat, emphasizing curiosity and critical thinking. Expeditions involve students in fieldwork, community education, and have a service-learning component.

Marin Leroy is the Environmental Education Program Coordinator at Evergreen. She notes that EE is woven into the very fabric of students' learning expeditions, adding, "There's no doubt that creating a culture of environmental literacy is supportive of student growth and achievement."

Dr. Susan Mertz is Executive Director of Evergreen, and is proud of the "strong academic performance, critical thinkers and leaders, and happy children" at Evergreen. (North Carolina's standardized testing shows 90% of Evergreen's fifth and eighth graders scoring at or above proficient in science, compared with the 72% statewide average.) Mertz is careful to say that there are many factors that make up these results, but she is confident of a strong correlation between Evergreen's focus on environmental literacy and positive results. Importantly, Evergreen uses a "Habits of Scholars" model to encourage character development, with emphasis on habits of relationship (such as collaboration and compassion), performance (such as perseverance and responsibility) and self (such as integrity, curiosity, and courage).

Mertz and Leroy are aware that not every school can take as holistic an approach as Evergreen's, but encourage educators to use the environmental literacy approach at any level. "A teacher who wants to create more of a culture of environmental literacy and respect and habits can work on creating a classroom culture. That's a great place to start," said Leroy.

"You don't have to do it all at once—you can start one grade, or one class, at a time," notes Mertz.

For more information: "Creating and Sustaining an Environmental Education-Focused Program": http://catalyst.greenschoolsnationalnetworkorg/gscatalyst/june_2018/MobilePagedArticle.action?articleId=1405314&app=false#articleId1405314

STRAND 2

Environmental Processes and Systems

2.2 Human systems

A. Individuals, groups, and societies—Learners explain ways that individual traits and group membership or affiliation influence perceptions of and actions toward the environment. They describe how their environmental beliefs and values are shaped by their community and the larger society. They compare their beliefs and values to those held by others in their community.

Learners are able to:

- Describe how a person's perspectives affect their interpretation and response to an environmental situation, event, issue, or opportunity. Examine the role of social influences and past experiences in the development of their own beliefs about the environment.
- Discuss how group membership—including family, religion, gender identity, race, ethnicity, and socioeconomic status—might result in different reactions and approaches to environmental issues.
- Express a clear personal perspective on an environmental situation, event, or issue and identify an influence on that perspective.
- Identify some of the shared values and principles that unite the local community. Discuss conflicting views about the meaning and application of shared values in specific environmental issues. For example, explore the conflict between individual rights and the common good when eminent domain is used to construct a pipeline or highway crossing private and public lands.
- Identify ways in which advocates appeal to values (e.g., individual freedoms, property rights, the public good, economic well-being, justice, and patriotism) as well as fears (e.g., fear of unemployment and fear of crime). For example, analyze speeches and writings on specific environmental issues or threats to sustainability.
- Give examples of the principles of justice, including environmental justice, and how they affect society. Discuss the siting of potentially hazardous operations (e.g., oil refining, chemical manufacturing, and hazardous waste transfer stations) in terms of environmental justice.
- Research how membership in or affiliation with a specific group, such as a historically marginalized community, may influence how people engage with environmental issues. For example, analyze group membership as an engagement factor in a public health issue such as the water crisis in Flint, Michigan.

B. Culture—Learners describe examples of the interconnection between cultural perspectives and the environment.

Learners are able to:

- Compare ways that the food, music, and art of different cultural traditions reflects the environment.
- Explain how the environment is perceived differently and similarly by diverse cultural groups, and how these perspectives may influence an individual's perceptions of the environment. For example, given a case study describing an environmental situation experienced by a cultural group different from their own, learners exercise perspective taking.
- Select and apply appropriate tools, strategies, and ways of communicating and collaborating to meet the needs and expectations of diverse individuals and groups.
- 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 affect the diffusion of ideas, cultural practices, and behavior patterns. For example, critique the influence of social media on perceptions or beliefs about environmental issues.

C. Political systems—Learners describe how political systems at varying scales account for, manage, and affect natural resources and environmental quality.

Learners are able to:

- Identify leaders and politicians at the community, state/provincial, tribal, and national levels, and describe how these actors can influence environmental decisions.
- Identify ways in which governments work to protect the environment including policies regarding energy use, forms of consumption, waste disposal, and resource management.
- Describe examples of laws, incentives, and penalties that affect people's behavior toward the environment and each other.
- Explain how political 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 public policy proposals to build large-scale dams such as the Three Gorges project in China, the Hetch Hetchy dam in the United States, or a similar project in the learner's region.

D. Economic systems—Learners describe how economic systems and economic decision-making influence natural resource use and management as well as environmental and human well-being.

Learners are able to:

- Describe how individual consumer choices such as the purchase of common household items (e.g., a piece of clothing, a lamp, a chair, or a mobile phone) drive resource extraction, manufacturing, and transportation around the world. Create a map showing where the raw materials for a selected consumer good originated, where it is manufactured, where it is eventually used, how it might be disposed of, and how it was transported at each stage.
- Evaluate ways in which economic systems work to protect the environment and distribute natural resources. Give examples of incentives and pricing that affect people's behavior toward the environment and each other.
- Analyze the environmental and social costs and benefits of allocating resources, goods, and services in different ways (e.g., through public or private sectors). For example, explain the long-term implications on environmental quality and social equity of the use of commonly owned and openly accessible resources such as forests, grasslands, and fisheries.
- Explain how the uneven distribution, extraction, and use of natural resources affect national economies. Analyze the economic implications of extracting or harvesting a natural resource in one country, using those natural resources to manufacture a consumer good in another country, and selling that consumer good back to the original country.

STRAND 2

Environmental Processes and Systems

2.3 Environment and society

A. Human-environment interactions—Learners describe human-caused changes that affect the immediate environment as well as other places, other people, and future times.

Learners are able to:

- 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 various irrigation methods, different ways of generating electrical power, or the use of synthetic pesticides.
- Explain how human-caused environmental changes result in 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 in some places.
- Provide evidence-based examples of how environmental changes impact some communities more than others.
- Describe the effects of a local environmental restoration effort, such as wetlands creation. Predict the long-term consequences of such efforts.
- Describe actions the learner has taken or could take to reduce their individual environmental impact.

B. Resource distribution and consumption—Learners explain that uneven geographic distribution of natural resources influences their use and perceived value.

Learners are able to:

- Describe how resource use differs across cultures, places, or climate and how it may have changed over the last 100 years. For example, discuss contemporary expectations for ownership of material goods, personal comforts, size and contents of a home, and convenience compared to 100 years ago.
- Explain why certain resources (such as fossil fuels, aluminum, silicon for glass, and nitrogen for synthetic fertilizer) have been key to the development of human societies and identify resources that were critical to development at different times in history.
- Analyze the benefits and challenges of progressing from carbon intensive fuels toward renewable energy sources.
- Investigate the factors that contribute to an uneven distribution of resources within a community or region. For example, consider the effect of spatial distribution of natural resources, climate change, and policies on access to food and clean water.
- Illustrate how resource availability has affected the development of human societies.

C. Places—Learners describe the meaning of "place" both close to home and around the world.

Learners are able to:

- Analyze physical and human characteristics of places and make inferences about how and why these characteristics have developed and changed over time. For example, use maps, satellite images, or drone photographs (e.g. Google Earth) to examine how cities change in response to natural disasters such as floods, hurricanes, wildfires, or earthquakes.
- Identify ways in which personal views, 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.
- Describe other places, either contemporary or historical, experiencing issues similar to those in their community or region.
- Compare current and historic photographs of a familiar place (such as their neighborhood or community's downtown district) and discuss how changes might influence how they would interact with the place.

D. Change and conflict—Learners explain that human social systems are dynamic and that conflicts sometimes arise over differing and changing viewpoints about the environment and natural resource use and management.

Learners are able to:

- 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 how a decision about where to site a landfill, build a chemical plant, or locate a new highway might affect different neighborhoods, businesses, workers, and people of varying socioeconomic status.
- Identify and analyze examples of tensions between individual benefits and the societal good. Illustrate with examples from the local community, such as 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 and taking public transportation.
- Consider the roles of scientific knowledge, personal beliefs, creativity, civic deliberation, and compromise in finding solutions to issues such as climate change.
- 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.

GUIDELINES IN PRACTICE

Cal Water H2O Challenge: Students Develop Water Solutions

Measuring the safety of drinking water. Applying intelligent planting techniques to conserve water in parched areas. Testing water and soil samples to help protect the local watershed. These are among the hands-on, solutions-based projects developed by California's fourth through sixth graders through a classroom competition.

Cal Water H2O Challenge's "Classroom Challenge" is a project-based, environmentally focused competition. It offers upper elementary teachers an opportunity to facilitate their students' learning of standards-based content, while developing the core understanding of environmental principles necessary to becoming science-literate citizens. Designed in conjunction with NAAEE, the WestEd K–12 Alliance, and Cal Water, the Classroom Challenge is aligned with the Common Core State Standards and complementary to the Next Generation Science Standards.

Through the Classroom Challenge, students initiate, develop, and implement a four to eight week project (or longer at teacher discretion) focusing on caring for water. This class-based project explores water as a global and local resource, while tackling a local water problem in an individual and community-based endeavor.

Students create a final portfolio documenting their work and submit it, along with student and teacher reflections, to the competition. Recent winning projects included:

Murdock Elementary School in Willows, CA: Mike Buckley's fifth grade students were inspired to measure the safety of local drinking water, establish a plan to protect the drinking water, and educate the community on how and why they should help. Students researched water and wrote essays, met with a local water expert, and visited a wastewater treatment facility. They applied their findings by installing 25 storm drain markers to ward off littering into the waterways; testing local water quality at 15 different locations; and designing, engineering, testing, and redesigning water filters. They spread their knowledge by presenting to 16 classrooms, creating and distributing a brochure to limit the impact of hazardous waste on the local water supply, and appearing in local newspapers.

Downtown Elementary School in Bakersfield, CA: Understanding the high percentage of local water usage attributed to watering lawns, sixth graders from Rachel Lenix's class were inspired to seek an alternative that could reduce this usage. To this end, they designed and conducted an experiment to test the impact of greywater on lawns versus freshwater. Students demonstrated the advantages of using a 50/50 greywater/freshwater mix as an alternative water source for keeping lawns green while meeting state-mandated water conservation targets. As part of the project, the class designed and built planter boxes for the experiment's sod, including a freshwater control and three variations using different percentages of greywater in order to find the best substitute. Students also created brochures and a presentation board to spread conservation awareness in their school and community.

Pittman Charter School in Stockton, CA: With guidance from their teacher Gerardo Guzman-Rico, these fourth and fifth grade students developed a two-prong water conservation project. Students researched, designed, and prepared a California-native garden with drought-tolerant plants for their school, and initiated a public outreach plan by writing to city officials to advocate for the replacement of grassy areas with native plants. The idea came to students while looking for ways to expand ongoing water conservation efforts. The classroom realized they could restore an existing school space that was overrun with weeds and debris. By creating the garden, students were able to conserve water while also beautifying their school and promoting greater water conservation efforts in their community.

Adapted with permission from Cal Water H20 Challenge website materials. For more information visit https://challenge.calwater.com/.

STRAND 3

Skills for Understanding and Addressing Environmental Issues

3.1 Skills for analyzing and investigating environmental issues

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

Learners are able to:

- Research the social and economic origins of a selected environmental issue as well as the actions taken to address the issue over the years. Describe the apparent environmental, social, and economic consequences of these actions.
- Compare areas of conflict and agreement for various environmental issues. Determine if the areas of conflict and agreement are associated with particular groups of people across different environmental issues. Use research results to summarize the differing perspectives of those involved.
- Select and use a variety of print and digital sources—both primary and secondary sources—of information to identify relevant evidence that addresses a local environmental issue. Include indigenous and traditional knowledge sources in the analysis.
- Examine how people in other communities have analyzed and understood similar local environmental issues. Identify the approaches and assumptions behind these investigations.

B. Sorting out the consequences of issues—Learners apply their knowledge of ecological and human processes and systems to describe the short- and long-term consequences of selected environmental issues on sustainability.

Learners are able to:

- Describe the effects of human actions on specific environmental processes and systems. For example, identify the major sources of point and non-point water pollution in the local community. Analyze how water pollution affects local aquatic life and whether natural processes can purify the pollutants. Discuss ways the community can minimize the pollution and its impacts on the environment.
- Examine the short- and long-term effects of human actions on the environment, including impacts on human health and well-being. For example, create a graph that compares air pollution levels against the number of visits to hospital emergency rooms for pulmonary distress.
- Provide an evidence-based explanation of how the negative costs or impact of environmental problems in a community might not be borne equally by all people in that community. For example, create a map that overlays the location of local infrastructure (e.g., garbage transfer station, sewage treatment facility, or elevated highway) with nearby housing developments, indicating the socioeconomic status of the people who live in these neighborhoods.
- Describe a current or historical environmental situation where the community or political response was inaction or delay of action. For example, for a selected environmental issue, predict the consequences to environmental and human health and well-being if no agreement can be reached to resolve the issue.

C. Identifying and critiquing alternative solutions and courses of action—Learners identify and develop action strategies, including design solutions, appropriate for addressing a range of environmental issues at community and regional levels. They describe how their action strategies and design solutions might impact environmental quality and other people now and in the future.

Learners are able to:

- Research different proposals for resolving an environmental issue, identifying and communicating differing perspectives on the issue. For example, describe the short-term and long-term social, economic, and environmental consequences of expanding an existing coal-fired power plant as compared to building a wind farm to meet the future energy needs of a community.
- Compare strategies used to address an environmental issue in different geographic, cultural, social, economic, and political contexts. For example, describe the effects of economic status or the availability of transportation options on food purchasing choices.
- Independently and in groups, propose evidence-based solutions to address a local issue. Evaluate the proposed solutions based on likely impacts on the environment and society, including human health, and likely effectiveness in resolving the issue. Critique proposed solutions using criteria such as available finances, time, and other human resources (e.g., personal and collective knowledge and skills).
- Evaluate the intended and unintended consequences of taking a successful environmental solution from one location and implementing it in another location. For example, predict the outcomes of importing seed and agricultural techniques from Europe to improve local agricultural harvests in Africa.

D. Working with flexibility, creativity, and openness—Learners demonstrate active listening, tolerance, adaptability, and openness as they work with others to gather a range of perspectives and information.

Learners are able to:

- Discuss how a variety of ideas and perspectives affects the process of inquiry and societal ability to address the needs of many groups of people living in the community. Give an example of how public participation and deliberation about a local environmental issue helped a government find a solution that benefited many community members, not just a few.
- Compare deliberative processes used by a variety of groups in various settings, including city planning and natural resource management. Describe the benefits and drawbacks of conducting wide consultation or public participation processes.
- Explain why it is not always possible to select one correct explanation or a single best approach to addressing an issue.
- Listen to and summarize questions and alternative explanations that others offer in discussions of an environmental issue.

RESOURCES YOU CAN USE

Engaging in Community Action

The Earth Force 6-Step Community Action and Problem Solving Process is a "How-To" guide to develop student-led action projects. Students at Lanier Middle School in Fairfax, VA have been using these steps to make positive changes in their school community for many years.

1 Students at Lanier begin by carrying out a variety of **environmental inventories (step 1**). They investigate their carbon footprint to help see how they impact the environment as individuals and within their families. All students then complete a WebQuest designed to educate about the Chesapeake Bay Watershed, its geography, its issues, and more. They also go on a watershed walk around their school to identify environmental strengths and issues.

2 After these initial environmental inventories, students **decide (step 2**) on an issue to work on. At Lanier, students self-select groups of three to six and they choose the issue they would like to address. This past year, students chose to tackle plastic water bottle use at their school. *Note: Many educators have an entire class work on one issue together while doing Earth Force and use a voting method explained in Earth Force materials to facilitate that.*

3 Once the issue(s) is/are chosen (plastic water bottles), students collaborate and **conduct research (step 3)** including speaking to administration and members of the community. They also begin working on a report that has them explain the issue, and organize their research as the final portion of this step. These reports are then presented to the class, usually as a slide show and/or essay.

4 After doing a deep dive into researching the selected issue(s), it is time to **pick a strategy** for taking action **(step 4)**. At Lanier, student groups can choose to move forward, or combine with other groups who have similar ideas to strengthen their teams. Those teams then need to develop a plan based on their research to tackle the issue they've identified. A few student groups remain at this point, all wanting to address plastic use in Lanier in different ways.

5 Now that project strategies have been chosen, Lanier students can now **Act (Step 5)**. During this step, students meet with community members, their school board, city council members and/or community experts to carry out their action plan. Students spoke to the Fairfax School Board and got permission to install nine water bottle refilling stations to reduce the use of plastic water bottles; other students started a collection center for plastic bags. These are just two examples of many great projects.

6 The grand finale is a **celebration** and **recognition of students' work (Step 6)**. This is the time to discuss next steps and how to move forward as well as "what can we do to keep this thing going?" This is the time to let students reflect on their experience and celebrate their successes.

For more information: EarthForce, EarthForceResources.org.

STRAND 3

Skills for Understanding and Addressing Environmental Issues

3.2 Decision-making and action skills

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

Learners are able to:

- Discuss personal perspectives on an environmental issue with peers, evaluating receptiveness to new ideas by giving an example of a perspective that changed because of the personal interaction.
- Summarize personal perspectives heard in group discussion or in public forums that are different from the learner's own perspective.
- Justify personal views on a community issue, such as curbside compost pick-up or building a sea wall, based on information from a variety of sources and clear reasoning.
- Explain their own beliefs and values regarding the environment and justify their opinion of environmental issues based on these beliefs and values.
- Identify ways in which others' views correspond with or differ from their own views on a local environmental issue.

B. Evaluating the need for action—Learners evaluate whether action is needed in specific situations, using environmental, cultural/social, and economic criteria. They decide whether they should be involved in that action.

Learners are able to:

- Discuss whether governmental action is warranted on a specific local environmental issue (e.g., lake algae blooms). Account for factors such as the scale of the problem as well as legal, social, economic, and ecological consequences of action.
- Identify different forms of action that individuals and groups can take to directly improve or maintain some part of the environment and construct a persuasive argument for others to act.
- Summarize and communicate, orally and in writing, predictions about the likely effects on society and the environment of specific actions. Analyze the likelihood these actions will resolve a specific environmental issue.

C. Planning and taking action—Learners use their research results to develop action strategies and design solutions at levels consistent with their maturity and preparation. As appropriate, they implement their plans.

Learners are able to:

- Develop action plans they can carry out individually, in small groups of learners, or with a class, school club, or their family. Include clear reasons and goals for action. Base these plans on an evaluation of a range of civic action strategies and the results of their environmental investigations.
- Set realistic goals for action and include measures of success consistent with learners' abilities and an understanding of the complexity of the issue. For example, consider the establishment of a no idling zone for cars and buses on school grounds.
- Decide whether their plan should be implemented immediately or at another time, changed, or abandoned. Carry through with action when determined to be appropriate.

D. Evaluating the results of actions—Learners analyze the effects of design solutions, their own civic actions, and actions taken by other individuals and groups. They describe the short- and long-term effects of these actions and design solutions in terms of environmental, social, and economic consequences.

Learners are able to:

- Analyze the effects, both intended and unintended, of decisions, policies, and actions taken by individuals and groups on a specific environmental issue. Describe the environmental, social, and economic consequences of actions taken.
- Analyze their own environmental actions, explaining apparent effects, both intended and unintended, and discuss them in light of established goals and reasons for acting.
- Using a selected environmental issue as an exemplar, 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 actions of others.

GUIDELINES IN PRACTICE

Centreville Elementary: Healthy Schools, Healthy Community

When it comes to helping students understand and address environmental issues, teacher Mary Ann Settlemyre thinks big. From individual behavior, to the school facility, to the community as a whole, Settlemyre's students at Centreville Elementary School in Virginia take the whole system into account.

Centreville Elementary is an ethnically diverse public school, and the student body speaks over 55 languages at home and at school. According to Settlemyre, the school's STEAM (Science, Technology, Engineering, Arts and Math) and Outdoor Education Specialist, the natural world is critical to weaving the students, school, and community together.

Each grade in the K–6 school maintains its own garden space. Second graders have a butterfly garden, while fourth graders study the state's indigenous plants in a garden they've created as a topographically accurate map of Virginia. Third and fifth graders grow produce that is sold at a weekly school farmer's market, a comprehensive undertaking that includes planting, weeding and harvesting, as well as running a cash register and scale, and doing bookkeeping. The market is a partnership with a local farmer, who helps the students with their agricultural efforts and sells her produce alongside the students'.

At seasonal "Family Fun Nights," the farmer's market expands to include free taste-testing of student-researched dishes featuring vegetables families might not be familiar with. These events also include open library with guest readers. "We want the whole family to be able to enjoy time together here," notes Settlemyre. "That's our growth area—from healthy schools to healthy communities."

Settlemyre's "Green Team" program involves over 100 students and 20 staff in a variety of environmental efforts. The school's ten outdoor learning areas include not only the gardens, but also a forest walking trail, a vernal pool, and, in partnership with the Virginia Bluebird Society, an on-site bluebird trail. On the school property, students have helped plan, build, and maintain wildlife habitat with multiple ecological purposes, including conserving water, increasing biodiversity, and acting as an outdoor classroom.

In partnership with National Wildlife Federation's Environmental Pathways and Green Flag program, students conduct a range of audits including energy, waste, water, food, habitat, biodiversity, health, and transportation, and then create follow-up action plans. Students meet with school custodians, cafeteria managers, and administrators to ensure their proposals meet with success.

In creating "TED-talk" style presentations on their work, notes Settlemyre, the students advance a variety of skills. "In one lesson, I'm teaching reading, writing, public speaking, social studies, science, art, and technology. When the kids are this actively engaged, there are no behavior issues."

All of the environmental education efforts are directly tied to Virginia's state learning standards. But authentic student engagement is the key; Settlemyre notes that the programs' success is due to the fact that "our number one priority is the response from the kids."

For further information: Centreville Elementary named one of the top 10 green schools by National Wildlife Federation https://www.nwf.org/en/Latest-News/Press-Releases/2015/9-28-15-NWF-Honors-Americas-Top-10-Eco-Schools

STRAND 4

Personal and Civic Responsibility

A. Recognizing rights and responsibilities—Learners explain the rights and responsibilities of community membership and their role in promoting sustainability.

Learners are able to:

- Analyze the personal, political, social, and economic rights and responsibilities associated with community membership, including personal and civic responsibilities that affect community well-being and sustainability.
- Describe ways in which commonly accepted rights and responsibilities of community membership motivate people to help resolve environmental issues and improve human and environmental well-being.
- Give examples of individuals respecting the environmental rights and interests of others.
- List activities they carry out and explain how these actions contribute to the common public good locally and globally.
- Research a local environmental issue in which community members exercised their rights. Analyze the short- and long-term consequences of their actions.

B. Recognizing efficacy and developing agency—Learners possess a realistic self-confidence in their effectiveness as community members to make changes in their community addressing environmental quality and sustainability.

Learners are able to:

- Explain the ways in which civic action and public opinion influence environmental policy decisions. For example, examine the efficacy of civic actions such as maintaining a sustainable lifestyle, persuading others, being inclusive of others, economic action (e.g., buying fair-trade chocolate or boycotting a product), writing elected officials and government agencies, and attending town meetings or hearings.
- Describe how individuals and groups act within society to create positive change, meet needs of individuals and groups, and promote the common good. Illustrate with examples from environmental issues that are inclusive of others of different races, ethnicities, gender identities, and socio-economic classes.
- Describe ways in which their actions have made a positive difference. Use examples that begin in the classroom and the home and extend beyond to encompass the broader communities in which students see possibilities for action.

C. Accepting personal responsibility—Learners describe the broad environmental, social, and economic consequences of their personal and group actions and as appropriate, accept responsibility for their actions.

Learners are able to:

- Analyze 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 both locally and globally.
- Describe the short-term and long-term effects of selected environmental actions, including their own.
- Compare their beliefs about personal responsibilities regarding the environment with commonly accepted societal views and behavior norms. For example, investigate how different restaurants, including their school cafeteria, address food waste (e.g., zero-waste policy, composting of food waste, disposing of food waste in the landfill). Compare their own beliefs about food waste to the actions taken, or not taken, by these restaurants.
- Identify ways they feel they are responsible for helping resolve environmental issues within their community. For example, critique actions to reduce their carbon footprint and air pollution such as walking to school or using their bikes rather than riding in a car.

GUIDELINES IN PRACTICE

Aka`ula School, Molokai, Hawaii

Mountains meet water, and human systems meet natural systems—these are the dynamic stories of the Hawaiian island of Molokai. With a dramatic coastline featuring the world's highest sea cliffs and extensive but endangered coral reefs, Molokai also has an inland landscape that is a study in contrasts, with both lush forests and large dry swaths that are denuded due to historic overgrazing.

Aka`ula School is a private school on Molokai serving grades 5–12. Some 70-80% of the student body is of Native Hawaiian heritage, and Aka`ula makes a point of examining issues from a traditional Hawaiian cultural perspective. Environmental education is a natural fit, and Aka`ula focuses on helping students grow into environmentally literate citizens through its middle school curriculum, Providing Resolutions with Integrity for a Sustainable Molokai (PRISM).

Inspired by the critical thinking and problem-solving approach of Harold Hungerford and colleagues, the award-winning PRISM model begins with study of the local ecosystem and the human systems coexisting with it, including people's positions and beliefs. Students are then encouraged to choose an issue important to them and their community. Recent investigations have included alternative-fuel vehicles, the effects of sunscreen chemicals on marine life, single-use water bottles, desalination, and coral gardening.

Learning to write research questions and crunch data are critical to their scientific investigations. Middle-school teachers are often hard pressed to find age-appropriate content on complex environmental issues, so the student-teacher collaboration to research and interpret sophisticated scientific materials is a cornerstone of PRISM's reading and math programs.

Photos: © Aka`ula School

GUIDELINES IN PRACTICE

Aka `ula School, Molokai, Hawaii, *continued …*

Aided by community surveys, field trips, and visits from experts, students develop specific action projects to address their target issues, including education (students hosted an electric vehicle show on Molokai) and advocacy (student research and activism helped create Hawaii's statewide bottle bill).

Aka `ula cofounder and educator Vicki Newberry recalls a sixth grader named Olana whose crusade against plastics not only led to a polystyrene ban policy at Aka `ula School, but a one-day awareness-raising polystyrene ban across the island of Molokai. Newberry notes that PRISM students carry their research and activism skills into high school and college, with many students going on to become biologists, botanists, and marine scientists. With such an integrated program, teachers also learn and are inspired alongside their students. "Olana went on to earn a degree in environmental studies," recalls Newberry. "She's certainly one of my heroes."

For further information: Aka `ula School, http://www.akaula.org

Hungerford, Litherland, Peyton, Ramsey and Volk (2003): Investigating and Evaluating Environmental Issues and Actions

© Wolf Ridge's SEAK program (Scientists Eagerly Acquiring Knowledge), Finland, Minnesota

Guidelines for **Grades 9-12**

STRAND 1

Questioning, Analysis and Interpretation Skills

A. Questioning—Learners develop, modify, clarify, and explain questions that guide environmental investigations of various types. They describe criteria that influence the questions they pose and explain their reasoning.

Learners are able to:

- Pose and evaluate researchable questions and design problems.
- Examine environmental phenomena or topics to be studied from multiple perspectives (e.g., gender perspective, historical perspective, scientific perspective and intergenerational perspective), using scales ranging from local to global.
- Propose a research question and/or define a problem, identifying and defining key variables. For example, propose a research question (or define a design problem) about land use in a specific region by drawing from maps, newspaper articles, weather data, and careful observations.
- Compare historical and current ideas and beliefs about the environment, human perceptions of the environment, or the nature of knowledge to inform their research questions or design problems. For example, analyze historical maps of development in their region, identifying key variables (e.g., vegetative cover, wildlife distribution, human habitation, landforms, watershed boundaries, employment trends). Construct questions for further investigation.

B. Designing investigations—Learners design investigations to explore environmental questions, problems, issues, phenomena, and models. They explain their reasoning.

Learners are able to:

- Select appropriate means of inquiry, including scientific investigations, historical inquiry, and social science observation and research for the environmental question under investigation.
- Evaluate the appropriateness of using quantitative and qualitative methods of researching the question. Working collaboratively, use census data, historic maps, and newspaper accounts from a selected region to investigate population shifts and settlement patterns over time.
- Design a detailed research strategy for investigating a selected environmental question or design problem.
- Identify a range of information and data gathering tools and technologies and, as appropriate, incorporate selected tools into their research strategy. For example, use maps, measurement instruments (e.g., tape measures, recording weather stations, traffic meters), and data analysis tools.
- Critique their strategy for investigating a selected environmental question, detailing their reasoning.

RESOURCES YOU CAN USE

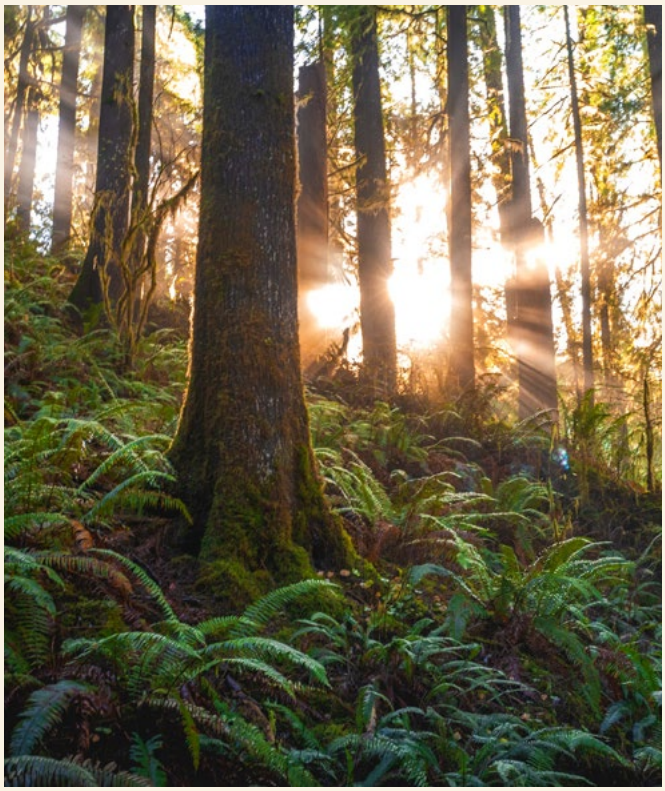
"The Nature of Fire" from Project Learning Tree's *Focus on Forests*

"The Nature of Fire" is one of nine activities in Project Learning Tree's *Focus on Forests* curriculum, in which high school students explore the environmental, economic, and social benefits that forests provide. Through classroom studies and field investigations, students develop an understanding of and appreciation for informed decision-making about issues that affect forests both now and in the future.

In the "Nature of Fire," students investigate the role of fire in forest ecosystems and examine fire issues in the wildland-urban interface, the zone where human development meets or intermingles with undeveloped lands.

Parts A and B focus on wildfires in forest ecosystems. Students analyze a case study of Yellowstone National Park. They compare how fires in 1988 and in 2009 affected the organisms and landscape within the park and reflect on why the outcomes were so different. They research a plant or animal from a fire-adapted natural community (such as Douglas-fir or jack pine forests, tall grass prairie, or chaparral) to determine the relationship between their selected species and fire.

In Part C, students explore the issue of fire in the wildland-urban interface. They examine the potential impacts of wildfire by assessing their own homes, schools, or communities for wildfire danger, and they identify what could be done to make those areas wildfire safe.



In Part D, students identify challenges forest professionals face when communicating about wildland fires, and then develop educational materials or media presentations to inform the public about the role of fire in the forest ecosystems and the importance of wildfire safety.

"The Nature of Fire" enables students to gain an understanding of how Earth's physical and living systems interact with not only one other but also society as a whole. Students also practice critiquing alternative solutions to an environmental issue, identifying courses of action, and communicating those actions to others. Through these experiences, students learn about their role in making their communities—and the ecosystems that surround them—more sustainable.

C. Collecting information—Learners use established protocols to locate and collect information for environmental investigations of many types. They use increasingly sophisticated methods and technology to access, gather, store, and display the information they collect.

Learners are able to:

- Evaluate the effectiveness of available technology to access, collect, and store data and other information.
- Apply observation and data collection skills in field situations. Working collaboratively, conduct an energy audit of school buildings and grounds, interview community members about environmental concerns, or sample water in a local stream.
- Use basic sampling techniques such as spatial and random sampling. Evaluate when these techniques are appropriate.
- Gather information from a variety of sources including historical archives, censuses, tax records, economic indicators, interviews or surveys, and other data banks. Evaluate the appropriateness of each information source in light of their questions.

D. Evaluating accuracy and reliability—Learners apply logic and reasoning skills to evaluate the completeness and reliability of a range of environmental information and information sources.

Learners are able to:

- Explain flaws such as faulty or misleading use of statistics, misrepresentation of data that are presented graphically, or biased selection of data to support a claim. For example, analyze the public debate over an environmental issue of national interest.
- Identify logical inconsistencies and unsubstantiated statements in everyday situations such as political speeches about the environment or commercial advertising. For example, examine speeches, advertisements, websites, news releases, and other resources presented by groups on various sides of an environmental issue.
- Analyze and synthesize examples of research literature related to their environmental questions and communicate their findings.
- Explain why some research results are determined to be more credible than others. Provide examples of possible sources of bias and discuss their reasoning.
- Differentiate between biased and unbiased data in online and other sources of information. For example, compare the factual accuracy of information presented on websites sponsored by differing groups, including government agencies and non-governmental organizations, concerning the use of chemicals in agriculture or extraction of fossil fuels.
- Identify potential sources of bias or inaccuracy in selected information sources and propose alternative data collection strategies, techniques, or sources to reduce bias or inaccuracy.

E. Organizing and analyzing information—Learners organize, analyze, and display data and information from their environmental investigations for a variety of audiences and purposes.

Learners are able to:

- Evaluate the strengths and weaknesses of the methods of presentations and/or displays (e.g., written, graphic, visual, verbal) for different purposes and audiences. For example, consider the type and precision of data, scale, accuracy of representation, and ease of interpretation when presenting time series data of average commute times by transportation mode for a large metropolitan area.
- Use available technology designed to organize and display data, such as graphing and mapping software. For example, create and display maps showing animal migration patterns and potential conflicts with human settlements.
- Integrate and summarize information using a variety of methods such as written texts, graphic representations (e.g., graphs, charts, sketches, and photographs), maps, and digital media.
- Perform statistical analyses to describe data using quantitative measures such as ratios, rates, mean, median and mode. For example, use statistics to analyze water quality data collected at a local stream, river, or lake.

F. Working with models and simulations—Learners create, use, test, and evaluate models to analyze environmental questions, problems, issues, or phenomena.

Learners are able to:

- Use mathematical models to represent processes. For example, use a model of the movement along earthquake fault lines, traffic flows, or population growth to answer the learners' questions.
- Using technology, create models and simulations. For example, project the effects of habitat fragmentation on species diversity, the impact of a new factory on local air quality, the economic impacts of proposed water quality regulations, or the visual changes a new housing development will make on the landscape.
- Compare the applicability of models for particular situations, giving the models' assumptions. For example, explain how a single model may apply to more than one situation and how many models might represent a single situation.
- Analyze how evidence has been incorporated, or not, into a selected environmental model or simulation. Evaluate and report the limitations of the model or simulation analyzed.
- Use a model, such as NOAA's Sea Level Rise Viewer, to compare predicted changes in sea level height, including possible causes and impacts.

G. Drawing conclusions and developing explanations—Learners propose explanations that address their initial environmental questions using quantitative and qualitative data and evidence that has been collected and analyzed.

Learners are able to:

- Apply basic statistical analysis and measures of probability to make predictions and develop interpretations based on data. For example, describe changes in water quality measurements taken before and after a spring snow melt, a prolonged drought, or a flood.
- Draw evidence-based conclusions to differentiate between causes and effects and identify when causality is uncertain.
- Explain the varying degrees of confidence and uncertainty within proposed conclusions or explanations. Distinguish between error and unanticipated results in formulating explanations.
- Consider the assumptions of models and measuring techniques or devices as possible sources of error. Propose criteria for determining when the level of error has become unacceptable and would interfere with drawing a valid conclusion.
- Based on experience, develop new questions to stimulate further inquiry. For example, draw on the results of a stream-monitoring project to develop questions that guide a broader investigation into water quality issues in the local community or the watershed.

STRAND 2

Environmental Processes and Systems

2.1 Earth's physical and living systems

A. Earth's physical systems—Learners describe the major processes and systems that form Earth and relate these processes, especially those that are large scale and long term to characteristics of Earth. They explain how changes in one system (hydrosphere, atmosphere, geosphere, and biosphere) result in changes to another. They describe how human sustainability depends on Earth systems.

Learners are able to:

- Explain the relationship between Earth's carbon cycle and the ocean. For example, describe the chemical reactions resulting from burning fossil fuels, the impact of the products of these chemical reactions in the atmosphere, and resultant changes in ocean chemistry. Using published data, graph changes in these relationships since the beginning of the Industrial Revolution.
- Illustrate the cycling of water between the atmosphere, land, and ocean. Provide evidence-based examples of how human activities are affected by and affect the distribution, quality, and availability of fresh water. For example, using published data evaluate the effect on human health of ongoing exposure to specific chemicals (e.g., pharmaceutical drugs, heavy metals) found in fresh water.
- Using global climate data for a specific region, map changing patterns of precipitation, air temperature, ocean temperature, and evaporation. Predict changes in sea level, the occurrence of droughts and floods, and the intensity of hurricanes or other severe storms for that region. Discuss ways humans can reduce their vulnerability to these changes.
- Explain how ocean currents affect local and global climates, the distribution of marine organisms, and the redistribution of nutrients and oxygen. Analyze a map of the global ocean conveyor belt and predict how disruptions to the conveyor belt could impact marine biodiversity or the climate of Europe.
- Diagram patterns of atmospheric circulation across the globe. Explain how heat exchanges between the air, the land and the ocean fuel atmospheric circulation. For example, map how air pollutants in one part of the world circulate globally.
- Explain the physical processes that result in changes to Earth's surface (e.g., erosion, rock cycle, plate tectonics), formation of distinctive landforms (the physical processes such as erosion, rock cycle), and distribution of continents (plate tectonics). Provide evidence, at different scales, of how specific landforms and natural hazards shape human activities, including historic and current human settlement patterns.
- Illustrate how changes in one system (e.g., geological, hydrological, chemical, and biological) resulted in changes to another. Construct an evidence-based explanation of how changes in one or more of these systems might be affected by and affect human sustainability.

B. Earth's living systems—Learners describe basic population dynamics, genetic mechanisms behind biological evolution, and the importance of diversity in living systems. They explain how changes in the hydrosphere, atmosphere, and geosphere affect the biosphere. They describe how human sustainability is dependent on the biosphere.

Learners are able to:

- Discuss the relationship of habitat changes and species interactions to the growth rates of plant and animal populations. Consider variations in habitat size, fragmentation, introduced species, and resource availability in relation to fluctuations in pH, dissolved oxygen, temperature, available light, or precipitation. For example, describe the effects of lake eutrophication on plant, insect, bacteria, and fish populations, or why organisms might be vulnerable to rapid or significant climate changes.
- Explain why biodiversity is critical for ecosystem resilience. Give examples of how human activities have affected the biodiversity and stability of an ecosystem.
- Describe the mechanisms of natural selection using concepts such as mutation, gene flow, and genetic drift to account for the adaptation of species to specific environments and the effects of environmental change. Consider how natural and artificial selection impacts agricultural production.
- Explain succession and equilibrium in ecosystems and resultant changes in constituent plant and animal communities. Illustrate these ideas with examples such as the slow transformation of a volcanic island from barren rock to rain forest, or the more rapid changes that occur after beavers dam a stream or a forest is logged.
- Apply the concepts of ecosystem and ecoregion to illustrate the multitude of relationships among organisms, including humans, and environments.
- 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 carbon dioxide is released to the atmosphere by the interaction of plants, animals, and non-living matter in the global carbon cycle.
- Illustrate how human activities affect the biosphere and how changes in the biosphere affect human activities. For example, explain how marine debris impacts aquatic organisms or how the loss of biodiversity impacts human well-being.

GUIDELINES IN PRACTICE

Triangle Lake: Starting Where You Are

Photo: © Triangle Lake Charter School

Nestled in the foothills of the Oregon Coast Range in the small, unincorporated community of Blachly, Triangle Lake Charter School is a rural school serving its K–12 students all under one roof. With a total of 245 students, this community-based school teaches many students who are the children, grandchildren, and even great-grandchildren of former students.

Serving a large percentage of low-income students, Triangle Lake educators and staff have named integrity, compassion, ingenuity, and collaboration as their core values, and are proud of their safe, nurturing environment and personal attention to each student. The school focuses educational programming on information technology, health and fitness, and natural resources.

Triangle Lake is one of over fifteen schools working with Oregon State University as a "Stewardship School," trained through the Oregon Natural Resources Education Program (ONREP). The faculty and staff of schools in the program work with ONREP for three years to integrate natural resources into their classes and programs. ONREP's place-based approach focuses on comprehensive content, strategies, and skills to support meaningful natural resource-focused classrooms and outdoor experiences for every subject and at each grade level.

As in any rural area, the populations in these programs are relatively small. They range from a training 120 teachers in a larger district, to ten or fewer in more remote areas. In a state where forests and natural resources are central to both the culture and the economy, an environmentally literate public is all the more valuable in ensuring wise stewardship.

"We work with schools in many different stages, from building a mission statement and determining where natural resources fit in, to providing local content and resources—not as an extra, but as an integrated element," explains LeeAnn Mikkelson, ONREP Program Coordinator.

At Triangle Lake, educators took on the added challenge of creating Landmark Outdoor Learning Experiences (LOLE) for each grade level. LOLE feature a progression of natural resource-focused events and field trips anchored in the community, addressing topics including local agriculture, land development and preservation, and natural resources' role in literature. Innovation isn't always easy: Educators have struggled to find funding and planning time, while working to identify strong links to standards. Many of the ninth- to 12th-grade educators are also middle school educators in this small school, and the field experiences have to tie into many subject areas at each grade level. Educators and administrators have collaborated to shift both students' and teachers' schedules to accommodate the field experiences.

Photo: © Oregon Natural Resource Education Program (ONREP)

ONREP facilitators know that it's critical to build trust within the whole school system. "Getting your administrators and groundskeepers on board is key," notes Mikkelson. "They can be your best friend or your worst enemy. After all, to the uninformed, sometimes native flowers can look a lot like emerging weeds."

Triangle Lake's team of secondary educators identified a number of advantages to integrating natural resources throughout the grade levels. They appreciate the continuity among grade levels, with a shared K–12 focus and shared language. They value the challenge of expanding their own knowledge, classroom boundaries, and students' experience. Students develop citizenship and a deeper understanding of their community, and increase their personal confidence and excitement about school.

While not every school retains the natural resource-based programming over the years, ONREP hopes the focus becomes part of the institution. "Some schools have written natural resource education into their mission or charter, which then affects teacher hiring," notes Mikkelson.

"It's difficult work. But this engagement can be life changing for some students," said Mikkelson. "It brings the learning to life."

For more information: Oregon Natural Resource Education Program (ONREP) at Oregon State University, http://onrep.forestry.oregonstate.edu

STRAND 2

Environmental Processes and Systems

2.2 Human systems

A. Individuals, groups, and societies—Learners observe and describe ways that individual and group action affects the environment, and how each can work to promote the common good. They analyze differing beliefs and values within the same community and the larger society and explain how sustainable solutions rely on reconciling diverse perspectives.

Learners are able to:

- Analyze the environmental impacts of personal actions with particular attention to variables such as technological advances and lifestyle changes. Deliberate the ongoing tension between meeting individual desires and gains, working for the common good of society, and environmental quality.
- Construct an evidence-based argument explaining examples of influences on individual behavior, particularly behavior that affects the environment. For example, discuss why a person might choose to purchase a hybrid or electric vehicle, install photovoltaics on their house, participate in nature-related activities such as backpacking, or eat a vegan diet. Consider influences such as financial costs, individual and group characteristics (e.g., race, ethnicity, gender identity, age, religion, and socioeconomic status), convenience, laws, and the opinions of friends and family members.
- Examine how particular groups such as conservation organizations, organizations of professionals in environmental or resource management fields, community associations, or businesses balance individual needs, group goals, and the common societal good.
- Analyze social expectations and pressures to conform, especially those that relate to environmental quality.
- Identify shared values and principles that unite the local community and analyze conflicting views about priorities when applied to an environmental issue. For example, use articles about a land use issue published in the local newspaper to identify the values underlying community members' perspectives.
- Compare how societal institutions, such as banks, corporations, nonprofit organizations, faith-based organizations, lobbying groups, government agencies, and the courts, reflect and shape societal values and principles. Provide examples related to the environment.
- Analyze the societal values and principles underlying the idea of environmental justice. Provide examples from the local community.

B. Culture—Learners recognize and describe examples of different cultural perspectives and dynamics and apply their understanding to current and historical environmental situations.

Learners are able to:

- Analyze a specific example of how cultural change and environmental change are related. For example, examine how the shift away from a largely rural society to a predominantly urban one might change environmental perceptions, behavior, and knowledge, especially across generations.
- Apply research and analytical skills to describe diverse cultural perspectives about human relationships with the environment. Anticipate ways in which people from different times in history and different cultures—including indigenous groups—might approach land management, events, or policy proposals.
- Compare historical and contemporary societal strategies for preserving and transmitting culture while adapting to environmental change. For example, describe ways resource-dependent communities (those whose economies traditionally rely on activities such as mining, fishing, or timber harvest) work to maintain their identities in the face of mine closures, or declining fish or timber harvests.
- Examine the roles of culture, tradition, religion, and technology in determining how communities around the world are adapting to environmental change such as coastal flooding and desertification.

C. Political systems—Learners analyze how political systems and political decision-making, from the local to international levels, impact environmental quality and long-term sustainability.

Learners are able to:

- Analyze selected local, state/provincial, tribal, or national governments' environmental policies and the amount of public funding allocated for those same policies. Examine the annual budget of a selected local community and determine how much is spent on environmental protection and restoration. Evaluate whether budget allocations align with publicly identified policies.
- Evaluate the costs and benefits of environmental policies (e.g., solid waste, storm water, greenhouse gases, air pollution, sea-level rise, public lands, carbon neutrality) at a state/provincial, tribal, or local level. Consider whether some groups are advantaged or disadvantaged more than others by the implementation of these policies.
- Compare the processes that inform public decision-making about the environment (e.g., legislation, town halls, voting, media, and social media).
- Describe how international agreements have incorporated sustainable development as an overarching principle to address global issues. For example, using the Sustainable Development Goals, consider the implications of the United Nations 2030 Agenda for Sustainable Development for countries around the world in addressing environmental issues.
- Compare ways that individuals address environmental issues, at varying scales, through the executive, legislative, and judicial branches of government.
- Research an example of individuals or groups working to address local, regional, or global environmental problems; describe the political context and relevant power dynamics (e.g., among community members, political parties, interest groups, and the media).

D. Economic systems—Learners analyze how economic systems and economic decision-making affect environmental quality and long-term sustainability at local, tribal, national, and global levels.

Learners are able to:

- Examine the origins, purposes, and impact of laws, treaties, and international agreements on the distribution of resources. For example, evaluate the impact of international trade on food availability.
- Compare the goals of economic development and environmental sustainability. Provide examples of how specific nations are working to address both goals.
- Apply research and analytical skills to describe how economic activity can result in costs that are external to the producer. For example, provide specific examples of who or what bears the externalized costs of air and water pollution.
- Use examples to explain the idea of ecosystem services. Analyze the costs, benefits, future consequences, and possible difficulties of assessing the value of selected resources.
- Prioritize the major economic drivers and sectors of the local community, state/province, or tribal area, and describe how environmental decisions can be influenced by these economic systems and actors.

National Park with Local Connections

Visitors to the Marsh-Billings-Rockefeller National Historic Park in Woodstock, Vermont are greeted by a welcoming plaque: "Stewardship: People Taking Care of Places."

This deceptively brief statement represents years of effort creating the only US national park whose mission is to "interpret the history and evolution of conservation stewardship in America." Brand-new by national park standards (the park opened in 1998), Marsh-Billings-Rockefeller's innovations include launching an unusual community partnership in education called "A Park for Every Classroom" (PEC).

PEC has been piloted in eight northeastern parks, adapted to the unique needs and culture of each park. At Marsh-Billings-Rockefeller, educator Kat Robbins' role as Partnership Coordinator is funded by a cooperative agreement between the park and Woodstock Union High School. Her position includes coordinating summer interns and youth work crews, while her time during the school year is dedicated to serving as a bridge between the park, teachers, students, and the community at large.

Robbins' PEC colleagues work closely with elementary students, both in the classroom and on regular field trips to the park. "So by the time students get to high school, I can say, 'you now have the skills and knowledge you need—so how do you want to put them to use, to make the world a better place?' "

Most of the initiatives Kat works on are teacher- and student-inspired. When a 10th-grade geometry class was interested in the applied role of triangles, Kat connected the class with local architects and engineers. Field trips included trips to Woodstock's famous assortment of historic covered bridges, where exposed truss systems revealed both the art and science of traditional construction. Students were also engaged in considering how to design an outdoor classroom on a donated parcel that was on a steep slope. Not only did students need to factor in the geometric constraints and opportunities of the landscape, but they also created a budget for the construction. "The learning experience the students went through was authentic—that's what made it so powerful," noted Robbins.

In another creative connection of school, park, and community, every year juniors and seniors studying Spanish and French are challenged to create an interpretive unit on some part of the park in their language of study. Since Marsh-Billings-Rockefeller includes not only hundreds of acres of field and forest, but also the built legacy of the three families the park is named after, students have presented on everything from the Hudson River School painting collection, to dairy management, to the property's 1950s-era fallout shelter. The public is invited, and Robbins helps find native speakers to enjoy the students' efforts.

"No two weeks or two days are the same for me," Robbins notes. "Luckily both the school and the park are very understanding, and flexibility is key."

By partnering the school system with a mission-based stewardship institution, PEC has helped embed an environmental ethic in the community. It is probably no coincidence that when Woodstock's school leaders convened educators and community members for a recent retreat to envision their "profile of a graduate," a key trait that emerged from their brainstorming was: "Stewardship."

For more information: National Park Service, Northeast Regional Office, A Park for Every Classroom: 8 Case Studies, https://www.nps.gov/mabi/learn/education/development/upload/Park-for-Every-Classroom-Case-Studies-Final-Report.pdf

PEC was inspired by the "Forest for Every Classroom" course: https://www.nps.gov/mabi/learn/education/forest-for-every-classroom.htm

See also the sister initiative "Trail to Every Classroom." Teachers blog about their Appalachian Trail education adventures here: http://trailtoeveryclassroom.blogspot.com

STRAND 2

Environmental Processes and Systems

2.3 Environment and society

A. Human-environment interactions—Learners analyze ways that humans interact with their environment and how these interactions change with technological developments. Learners determine costs and benefits to different groups in society as well as unintended consequences.

Learners are able to:

- Apply research and analytical skills to examine the relationship between environmental quality and human health. For example, discuss the concept of disease burden (e.g., the costs of a health problem) in relationship to specific environmental risks (e.g., malaria in tropical climates and asthma and other pulmonary problems in urban areas with high levels of air pollution).
- Evaluate the cumulative effects, positive and negative, of human actions on a specific species or environmental system, such as a stream or a watershed.
- Using examples of particular technologies (such as advancements in photovoltaic solar cells and batteries) or technological systems (such as 3D printing and additive manufacturing, and ultra-lightweight alloys), discuss the social and environmental costs, benefits, risks, and possibilities associated with the technologies humans use to shape and control the environment. Consider whether some groups are advantaged or disadvantaged more than others by using these technologies.
- Provide evidence-based examples of ways in which technological advances have lessened the adverse environmental impacts of selected human activities. Describe any unintended consequences of these technological advances and efforts to lessen those consequences.
- Illustrate the links between individual and community-based decisions that affect the environment and community well-being. For example, illustrate the relationships among traffic congestion, poor air quality, and availability of public transportation.
- Construct an evidence-based argument describing specific cases where low-income and historically marginalized communities have been differentially affected by environmental decisions such as the location of landfills, factories, Superfund sites, and highways.
- Examine actions the learner has taken or could take in the future to reduce their environmental impact.

B. Resource distribution and consumption—Learners analyze ways that the perceived value and use of natural resources change over time and vary under different economic, political, social, and technological systems.

Learners are able to:

- Predict differences in the future consumption of resources among nations using statistics, including population size of the country, birth rate, and energy use in kilograms of oil or equivalent as an indicator of consumption. Analyze projected use of resources over the lifetime of a child born in countries with various GDP levels.
- Map and discuss the distribution patterns for specific resources, such as metals, fresh water, or types of forests. Note the rate of depletion for each resource, any projected impact of climate change on the rate of depletion, and ways the resource is being managed for long-term sustainability.
- Compare management systems that promote sustainable use of resources using environmental, social, and economic indicators.
- Analyze resource distribution around the globe and its social, economic, cultural, and political impacts on human development. For example, consider why some countries have low GDPs even though they are rich in natural resources.
- Graph time series data for several indicators of human activity on Earth (e.g., CO2 in the atmosphere, human population, fisheries catches, agricultural production of wheat and rice, number of acres of paved surface). Compare the slope and change in slope of the graphs over time.
- Use the concepts of carrying capacity, carbon footprint, and minimal caloric intake, to analyze the sustainability of current trends in world population growth and natural resource consumption as well as energy consumption and agricultural output.

C. Places—Learners describe "place" as humans endowing a location with meaning and that this meaning can be created through individual and group interactions with that environment.

Learners are able to:

- Explain the importance of places to human identity. For example, analyze 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 a change in population (such as growth or decline) or a change in land use development affects sense of place.
- Analyze how places change over time as the physical environment changes, and as human use and perceptions change.
- Research community efforts to adapt to changes in the environment, such as flooding, sea level rise, drought, or wildfires. Describe how these adaptations change the community and how people interact.
- Using news reports, examine the tension between groups of people when land use conversion threatens places some people consider sacred or religiously significant.

D. Change and conflict—Learners analyze the functioning of public processes for promoting and managing change and conflict, and evaluate their effects on the environment, society, and the economy.

Learners are able to:

- Evaluate various governmental and non-governmental strategies for promoting social change related to the environment. For example, trace the strategies used by different groups to reduce the carbon miles associated with food production and consumption or to meet other greenhouse gas reduction goals.
- Compare the role of social, political, and economic institutions in forging cooperative agreements around environmental issues. Account for the influence of institutions, closely held values, and organizations (e.g. nonprofit groups, banks, corporations, and special interest groups).
- Analyze the economic, health, and social impacts of environmental change on different groups of people. For example, evaluate the effect of drought and other possible impacts of climate change on vulnerable members of a community. Consider the possible roles played by different organizations and institutions that build community resilience and promote adaptation.
- Apply research and analytical skills to evaluate the conditions and motivations that lead to conflict, cooperation, and change among individuals, groups, and nations. Look particularly at the effects of conflict on natural resource quality, control, and availability. For example, examine the origins and consequences of international treaties and accords on wildlife trade, water, or climate change.
- Research instances where environmental disruptions, such as drought, have contributed to war and other regional conflicts.
- Discuss ideas of environmental justice and social equity in relation to a specific threat to local or global sustainability.
- Provide evidence-based examples of human-wildlife conflict and the resultant impact on people, resources, wild animals, and habitat. Research conflict management strategies that have been used to allow for sustainable coexistence.

STRAND 3

Skills for Understanding and Addressing Environmental Issues

3.1 Skills for analyzing and investigating environmental issues

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

Learners are able to:

- Define and clearly describe environmental issues to be investigated. Describe the historical and contemporary bases (i.e., physical/biotic, social/cultural, or economic contexts) for the issue. Characterize the issue considering influences such as connections with other issues, geographic scale, spatial distribution, and time span.
- Identify key individuals and groups involved with a specific issue. Use research results to describe different perspectives on the issue and approaches to resolving it. Articulate assumptions, goals, priorities, and values that underlie each position.
- Examine the environmental, social, and economic contexts that shape an issue and possible courses of action. Consider whether the issue advantages or disadvantages one group of people more than another.
- Investigate the broader geographic and historical influences of a selected issue using multiple print and digital sources, including secondary sources of information as well as differing indigenous and traditional knowledge sources.
- Determine when and how to conduct original research, applying 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.

B. Sorting out the consequences of issues—Learners evaluate the consequences of a broad range of environmental changes, conditions, and issues on environmental quality and long-term sustainability. They identify environmental justice and social equity implications.

Learners are able to:

- Analyze major risks and possible consequences of an issue to natural/environmental systems and human systems, including human health.
- Assess the economic implications, across different groups, of a selected environmental issue.
- Apply research and analytical skills to evaluate the consequences of an environmental issue, bringing to bear historical perspectives, an understanding of the impacts of different technological developments, and knowledge of similar issues. Consider who is most advantaged or disadvantaged by the environmental issue.
- Compare the social, political, economic, health, and ethical implications of environmental issues. For example, research a community's solid waste management system and its implications for different groups of people in the community and elsewhere.
- Predict the likely consequences for specific human and environmental systems of failure to resolve a selected environmental issue.

C. Identifying and critiquing alternative solutions and courses of action—Learners identify and propose environmental action plans, including design solutions, and evaluate their likely effectiveness in specific environmental, cultural/social, and economic contexts. They identify ways that these action plans and design solutions might affect different groups of people, including possible environmental justice and social equity implications.

Learners are able to:

- Compare solutions to an identified environmental issue proposed by local governments, NGOs, and other interested parties. Apply knowledge of functional relationships, modeling, and statistical analysis to evaluate issues and different approaches to resolving them. For example, conduct basic traffic flow analyses to project the likely effects 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 the proposed approaches to resolving projected traffic issues on the environment and different groups of people.
- Critique proposed solutions using gauges such as likely impacts on society or the environment, and likely effectiveness in resolving the issue.
- Use differing methods such as cost/benefit analysis; triple bottom line of environment, social, and financial accounting; cumulative effects analysis; multiple perspective approach; environmental impact analysis; ethical analysis; and risk analysis to evaluate proposed solutions to an environmental issue. Describe the strengths and weaknesses of each method, considering the main ideas behind each approach including which effects merit further study and which values or societal goals it tries to protect.
- Investigate and evaluate the effectiveness of individual and community action specific to proposed solutions.

D. Working with flexibility, creativity, and openness—Learners engage each other in evidence-based peer review and work collaboratively and cooperatively in the spirit of open deliberation, especially in contexts that bring to the surface deeply held priorities and values.

Learners are able to:

- Formulate questions, offer possible explanations, and seek out perspectives, facts, and proposed solutions from majority and minority stakeholders. Defend interpretations in group discussions.
- Explain the importance of such characteristics as honesty, openness, skepticism, and suspending judgment in the process of building knowledge. Give examples of each of these four characteristics from local and national news sources.
- Discuss when and how characteristics such as openness and decisiveness are valuable in addressing environmental issues. Identify at what points in the decision-making process they are most applicable.

RESOURCES YOU CAN USE

Arizona Project WET: Taking a Systems Approach

Humans' complex relationship with water in arid regions has been evolving for millennia. In Arizona, the Hohokam civilization began building canals in 500 AD near present-day Phoenix—an agricultural irrigation system that guided the water infrastructure still in use today. Arizona's teachers study this history and more as they examine today's water struggles. As development in desert areas has increased, raising awareness about this critical resource has become a top priority for environmental educators.
Arizona Project WET (Water Education for Teachers), based at the University of Arizona, features a three-pronged approach focusing on teacher training, working directly with students, and training community volunteers. Municipalities and water companies work as partners to create programs specific to this arid region.

In grades 6–12, the "Aqua STEM" program is designed to engage students through units on School Water Audits, Rainwater Harvesting, and Riparian Exploration. An additional program encourages students to bring water conservation practices and technology into their homes. The Riparian Habitat Exploration Unit specifically introduces students to a range of environmental careers, and has them completing a "job application" for the careers that pique their interest. Students are then grouped into "careers" and develop scientific field investigation questions exploring aquatic or terrestrial biology, water chemistry, botany, and other areas of interest. Students are matched with volunteer scientists as mentors and pursue the river investigations they have identified.

The three-day Aqua STEM Academy teacher training features a full day on systems thinking. Trainers work to deepen teachers' (and ultimately, students') understanding by highlighting four key cognitive skills: making Distinctions; recognizing part-whole Systems; identifying Relationships; and understanding different Perspectives (DSRP).

DSRP's four root-thinking skills were identified by Dr. Derek Cabrera. Rather than simply presenting content, DSRP is used to teach students how to think. This focus helps students transform information into applicable knowledge.
Educators recognize that broad-based, reflective thinking is critical to effective STEM (Science, Technology, Engineering and Math) literacy, notes Arizona Project WET Director Kerry Schwartz. "We now use DSRP thinking as a way to do good STEM training," Schwartz says. "It helps us teach integrated thinking across the board—for all humans, at all grade levels."

While everyone unconsciously uses DSRP, bringing the system to light deepens learners' understanding and problem solving. Schwartz notes that using DSRP as a water stewardship teaching tool makes teaching easier, and improves students' ability to comprehend, analyze, and apply the material.

One study of an Aqua STEM training using DSRP indicated successes in several areas: an increase in awareness of, and improvement in, thinking skills (metacognition), as well as in students' understanding of water training materials. And the program gets high marks from teachers. "Systems thinking has been really crucial to get [students] thinking about parts of a system and how those parts all work together and tying that back into the system of the water cycle," notes middle school teacher Steve Wallgren. "It gets to the interconnectedness of everything."
"No matter what grade or what subject I'm teaching," Wallgren says, "I try to think about how to get my kids to think more critically.... [It] gets them thinking, 'In the future how could I affect the world around me?'"

For more information: Arizona Project WET Aqua STEM program (based at the University of Arizona and part of the Project WET Foundation worldwide network): https://arizonawet.arizona.edu/programs/aqua_stem

STRAND 3

Skills for Understanding and Addressing Environmental Issues

3.2 Decision-making and action skills

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

Learners are able to:

- Articulate a position on an environmental issue and a proposed solution. Justify the position based on the synthesis of information gathered from a variety of sources, recognition of personal beliefs and values, and clear reasoning.
- Evaluate personal beliefs and values using criteria such as personal well-being, social equity, economic prosperity, environmental justice, and environmental quality.
- Articulate elements of their own environmental ethic and discuss whether personal positions on an issue are consistent with this ethic.
- Consider viewpoints that differ from their own viewpoint and information that challenges previous positions. Evaluate how such information might or might not affect their viewpoints.

B. Evaluating the need for action—Learners apply their research and analytical skills to systematically determine whether action is needed in specific environmental, cultural/social, and economic contexts and whether they should be involved.

Learners are able to:

- Evaluate whether personal or group action is warranted in specific situations, accounting for availability of evidence about the issue and proposed solutions; the scale of the issue; legal, social, political, economic, and ecological consequences; and alternatives to civic action.
- Evaluate whether personal action is warranted in specific situations, considering an individual's values, skills, resources, and commitment.
- Speculate about the likely effects of specific actions on society and the environment, and the likelihood these actions will resolve a specific environmental issue.
- Communicate decisions clearly, articulating well-reasoned explanations supporting learners' viewpoints and decisions.

C. Planning and taking action—Learners develop action strategies and design solutions based on their research and analysis of an environmental issue. If appropriate, they implement plans that are within the scope of their rights and consistent with their individual abilities and responsibilities as members of the community.

Learners are able to:

- Develop plans for individual and collective action involving groups, such as a small group of classmates, a school club, a community organization, or a faith-based organization. Include clear reasons and goals for action. In planning, refer to their evaluation of a range of possible 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 the action plans or design solutions should be implemented immediately or in the future, modified, or abandoned; and carry through with action as appropriate.

D. Evaluating the results of actions—Learners evaluate the intended and unintended consequences of design solutions, their own civic actions and actions taken by other individuals and groups, including long-term environmental, social, and economic implications for sustainability.

Learners are able to:

- Discuss the intended and unintended effects of actions carried out by others related to specific environmental issues. Consider the apparent effects of individual and group action on environmental well-being, social equity, economic prosperity, and the political climate. Evaluate the impact on the individuals involved in the action. Illustrate with examples such as a habitat improvement project, a local watershed festival, a curbside compost pick-up project, or a lobbying effort against proposed environmental regulations.
- Analyze their own actions, evaluating apparent effects in terms of their goals and ethics, broader societal goals (e.g., environmental, social, and economic) and threats to local and global sustainability. Develop a "lessons learned" document or presentation.
- Evaluate evidence-based examples of how the actions of organizations such as businesses or community groups may have unintended environmental, social, health, or economic consequences that go beyond the published aims of the organization.
- Describe some of the difficulties encountered in evaluating the results of their actions with particular attention to environmental, social, and economic impacts.

RESOURCES YOU CAN USE




NAAEE's Environmental Issues Forums (EIF)

Individuals and groups continually wrestle with the ramifications of environmental issues. As members of communities, we have important choices to make—from individual and community actions to corporate policies and government regulations. Each of these choices will impact our community's well-being, sustainability, and resilience. But, how can we go about the work of making responsible decisions? How can we encourage communities to come together, avoid polarization, and instead build room for common ground?

With the goal of creating safe, productive places for individuals and communities to deliberate, NAAEE, in partnership with the Kettering Foundation, created the Environmental Issues Forums (EIF). EIF provides tools, training, and support for engaging adults and students in meaningful, productive discussions about sticky issues that affect the environment. EIF is modeled on the National Issues Forums (NIF)—a nonpartisan, nationwide network of locally sponsored public issues forums. NIF is rooted in the simple notion that democracy requires an ongoing deliberative public dialogue. People need to come together to reason and talk—to deliberate about common problems. Understand together. Decide together. Act together.

Through EIF, community members actively engage in essential environmental issues through deliberation and participation in democratic practices. They listen to one another and consider alternative perspectives. They deliberate about the choices they can make and the actions they can take in their own communities to address controversial issues. They discuss in a nonpartisan, non-confrontational manner.

In productive deliberation, community members examine the advantages and disadvantages of different options for addressing a difficult public problem, weighing these against the things they hold deeply valuable. EIF issue guides provide a framework for these discussions, describing three or four options and providing a means for avoiding polarizing rhetoric to keep the discussion moving forward. Each option is rooted in a shared concern, proposes a distinct strategy for addressing the problem, and includes roles for community members to play. Equally important, each option presents the drawbacks inherent in each action. Highlighting these drawbacks allows the participants to see the trade-offs they need to consider in pursuing any action. It is these drawbacks, in large part, that make coming to shared judgement so difficult—but ultimately, so productive.

For more information and to download issue guides and supporting materials, visit: https://naaee.org/eif.

STRAND 4

Personal and Civic Responsibility

A. Recognizing rights and responsibilities—Learners describe the relationships between exercising their individual rights and responsibilities and addressing environmental quality and long-term sustainability.

Learners are able to:

- Explain the importance and evaluate the usefulness of civic dispositions such as trust, patience, self-discipline, tolerance, civility, respect, adherence to law, opposition to tyranny, standing up for the rights of others, and open-mindedness to individuals and to society.
- Analyze the effect of community members exercising their rights and expressing their opinions on policy decisions that impact environmental well-being.
- Evaluate potential conflicts between individual rights and other societal interests such as environmental quality, social equity, and economic prosperity.
- Identify a specific example of when an individual's civic obligations to work in the interest of the common public good might conflict with an interest in promoting individual gain.

B. Recognizing efficacy and developing agency—Learners exhibit personal agency by working independently and making choices to bring about change in their community that addresses environmental quality and long-term sustainability.

Learners are able to:

- Articulate the impact of civic participation and service—particularly their own—related to environmental sustainability and community well-being. For example, consider to what extent volunteer efforts contribute to resolving a local water quality issue or to providing equal access to green spaces.
- Examine the current and potential impact learners, individually and collectively, have in maintaining or improving environmental quality and resolving problems and issues. Provide examples from various groups and communities (e.g., family, club or group, school, town, state/province, tribe, nation, world) in which learners see themselves as members.
- Recognize the mechanisms that may prevent some individuals and groups from participating in environmental decision-making processes. Propose strategies for meaningfully incorporating diverse stakeholders and traditionally underrepresented groups.

C. Accepting personal responsibility—Learners evaluate the broad environmental, social, and economic consequences of their actions. They accept responsibility for recognizing those effects and changing their actions when warranted.

Learners are able to:

- Evaluate the impacts of their actions, and the actions of the larger social groups of which they are members, on the local and global environment.
- 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 describe how actions of previous generations limited or enhanced their current opportunities.
- Consider some of their own environmental actions and predict how these actions might affect a future generation. Explore the degree to which they believe they should be held responsible for how their actions impact future generations.
- Provide examples of how to work individually and collectively toward the resolution of environmental issues and to participate thoughtfully on an ongoing basis in environmental and community decision-making.

GUIDELINES IN PRACTICE

Photo: © Wolf Ridge Environmental Learning Center

Wolf Ridge: A Pathway Into the Field

"That summer inspired me to think strongly on pursuing a future career in environmental science. I switched my schooling focus to more science based and soaked in as much knowledge pertaining to the outdoors as I could."

Aimee is a student in Wolf Ridge's SEAK program (Scientists Eagerly Acquiring Knowledge), and her comment would be music to the ears of any environmental educator. It is all the more powerful because the program serves students from urban and underserved populations, where students from diverse ethnic, racial and socioeconomic backgrounds often struggle in the classroom.

Educators at Wolf Ridge Environmental Learning Center have found that keys to success for these older students include offering students diverse opportunities to experience nature in a hands-on way; plenty of freedom to choose their own exploration topics; and extended, face-to-face interaction with professionals in the field.

Kim Swanson, the Academic Programs Coordinator at Wolf Ridge, notes that the program is often students' first opportunity to spend significant time outdoors. "We try to offer a great variety of study opportunities," said Swanson, "whether it's forestry, soils, fish, the physical and chemical properties of water, macro-invertebrates, or just giving them their first up-close encounter with a chipmunk or vole." The extensive choices are exciting to students, and result in a wide range of research projects.

Wolf Ridge partners with professionals from the Forest Service, Department of Natural Resources, and many other organizations. These scientists work directly with the students to engage them in authentic field science experiences.

"Students are immersed in a culture of being a scientist for a few weeks," said Swanson. "It's powerful for them to see what science is, and how science works. They discover they can ask any question—and then find answers to their question."

Wolf Ridge's SEAK program, which is entirely grant funded, serves 40 students per year in grades 8–12, in a program that runs throughout the school year plus a two- or three-week intensive residential segment in the summer. Students receive high school science elective credit, and can receive college credit for their work in grades 11–12.

Their senior year, students apprentice in a STEM-related position offering real-world skills and a path to employment after graduation.

"SEAK has made my interest grow into becoming a wildlife biologist or possibly a biochemist," commented Audrey, another program participant. "There are so many possibilities of what I can become."

For more information: Wolf Ridge Environmental Learning Center, www.wolf-ridge.org

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North American Association for Environmental Education

The National Project for Excellence in Environmental Education

The North American Association for Environmental Education (NAAEE) launched the National Project for Excellence in Environmental Education in 1993 to help educators develop and deliver high-quality education programming. The project works to create a more environmentally literate citizenry with the knowledge, skills, and inclinations to make informed choices and exercise the rights and responsibilities of members of a community.

To date, NAAEE has published six sets of guidelines that promote the use of balanced, scientifically accurate, and comprehensive environmental education materials and programs that advance environmental literacy and civic engagement.

Publications

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

- *Environmental Education Materials: Guidelines for Excellence*. A set of recommendations for developing and selecting environmental education materials.
- *K-12 Environmental Education: Guidelines for Excellence* (2019). A comprehensive framework for environmental education, demonstrating benchmarks towards environmental literacy.
- *K-12 Environmental Education: Guidelines for Excellence Executive Summary* (2019). An easy-to-use outline listing the guidelines that can be used to compare performance expectations across grade levels.
- *Professional Development of Environmental Educators: Guidelines for Excellence* (5th edition, 2019). 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* (2016). A set of recommendations to be used in the development of comprehensive early childhood environmental education programs or to trigger improvements in existing ones.
- *Community Engagement: Guidelines for Excellence* (2017). This set of guidelines focuses on community wellness and is designed to help environmental educators create inclusive environments that support effective partnerships and collaborations.

Hard copies and free downloadable pdfs of the *Environmental Education Guidelines* publications can be ordered from NAAEE at https://naaee.org/our-work/programs/guidelinesexcellence

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North American Association
for Environmental Education

Education We Need for the World We Want

NAAEE is the professional association for environmental educators in North America and beyond.

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