

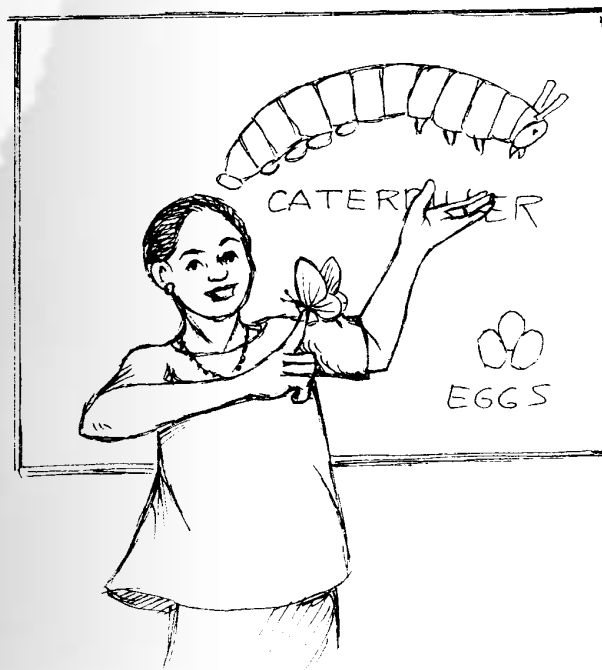
# Reaching High Academic Standards on the Schoolyard

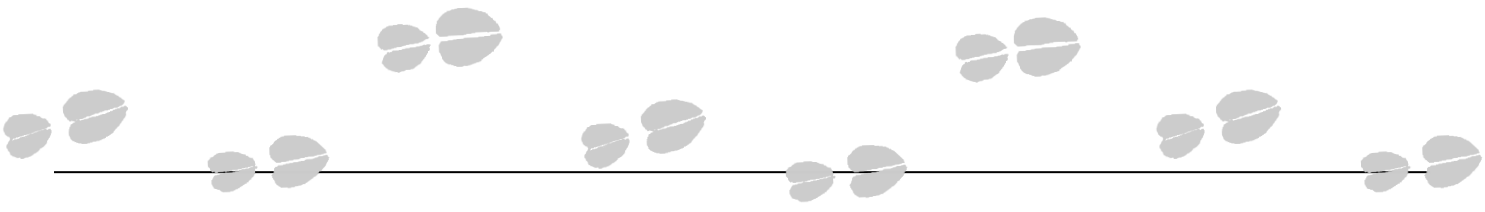
The planning, design, implementation, and on-going monitoring and maintenance of a Schoolyard Habitats project provide endless opportunities to meet and exceed high academic standards across the curriculum. Teaching with the Schoolyard Habitats site as an integrating context across the subject areas can both support and deepen the quality of instruction and student engagement.



From pre-school through high school, Schoolyard Habitats projects enhance the teaching and learning of science, math, social studies, and English in many ways. Using a habitat-based learning site makes learning more real, fun, hands-on, interdisciplinary, and relevant. “Young people learn most readily about things that are tangible and directly accessible to their senses — visual, auditory, tactile and kinesthetic. With experience, they grow in their ability to understand abstract concepts.... Concrete experiences are most effective in learning when they occur in the context of some relevant conceptual structure.” (Benchmarks for Science Literacy)

In today’s learning environments, where schools are striving to meet and exceed high standards of learning, teachers must be creative in presenting content. The schoolyard can provide a valuable avenue for reinforcing concepts for students. The following pages illustrate how creating and utilizing a Schoolyard Habitats site can help teachers use the outdoors to meet various standards. In fact, teachers can feel confident that time invested in a Schoolyard Habitats project is a wise investment for students’ immediate educational needs and future development as good citizens.





## **Outdoor Learning = Increased Student Achievement**

In 1999, a consortium of education agencies from 12 states, called the State Education and Environment Roundtable, published a groundbreaking study. Entitled *Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning*, this study quantified and legitimized that which teachers had been observing and noting anecdotally for years—the academic value of using the environment as a framework for instruction.

The roundtable studied schools nationwide that are using the environment as the context for interdisciplinary, student-centered, hands-on learning and teaching across all subject areas.

The study reports that students in such programs:

- perform better on standardized tests
- earn higher grade point averages (in language arts, math, science, and social studies)
- improve their attendance record
- improve their behavior in school
- demonstrate an increased ability to think creatively
- demonstrate increased problem-solving abilities

*Lieberman, Gerald A. and Linda L. Hoody, eds. Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning. State Education and Environment Roundtable San Diego, 1999. (Download report: [www.seer.org](http://www.seer.org))*

### **Core Subjects and the Schoolyard Habitats Program**

Schoolyard Habitats projects serve as living laboratories where students engage in hands-on science inquiries and design investigations into the natural world. They provide students with the opportunity to apply math concepts to the real world; whether estimating numbers of plants in an on-site plant

community or tracking and graphing ongoing wildlife observations, the outdoors is full of mathematical wonders. Schoolyard Habitats sites provide a quiet space for creative writing about nature or a research laboratory where students can develop strong English skills through research, writing and communication skills. The Schoolyard Habitats program can be applied successfully to help teach about connections between people,

social constructs and the environment. These concepts of geography and social studies come to life as students gain real-life experience of their local community in a global context.

## Science Standards and Schoolyard Habitats Projects

National standards documents referenced: *Benchmarks for Science Literacy*, Project 2061, American Association for the Advancement of Science, 1993, New York, NY; National Science Education Standards, National Research Council, Washington, D.C. 1996

### ELEMENTARY APPLICATIONS

#### Benchmarks K-2: Interdependence of Life

“Students should investigate the habitats of many different kinds of local plants and animals including weeds, aquatic plants, insects, worms and amphibians, and some of the ways in which animals depend on plants and on each other.”

- Classify plants and animals in different parts of the schoolyard to discover similarities and differences.
- Determine the number of habitats on the school property, making note of the plants and animals found in each.
- Discuss the pollination process and how specific plants are dependent upon specific pollinators; survey the schoolyard and look for pollinators at work.

#### NSES Life Science Standard K-4 :

“During elementary grades, children build an understanding of biological concepts through direct

experience with living things, their lifestyles and their habitats. Characteristics of organisms; Life cycles of organisms; Organisms and their environment.”

- Study the life cycle of butterflies first-hand by creating a native plant garden that provides plants for all stages of the cycle.
- Conduct ongoing field observations of schoolyard wildlife; create field guides for the wildlife that visit the schoolyard.
- Study lifecycle of certain plant from seed to mature adult. Record observations, measurements, etc. over time.

#### Benchmarks 3-5: Scientific Inquiry

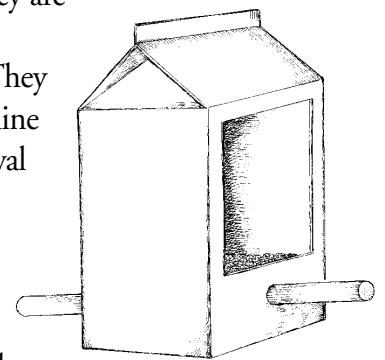
“Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments.”

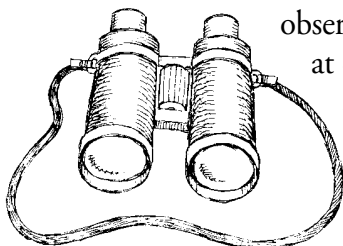
- Study insect populations in the habitat area over time. What plants serve as “hosts”? What factors affect population size?

- Collect soil cores at different sites around the schoolyard to determine the best site to plant a native prairie or other native ecosystem type. Compare soil samples and consider factors which could account for differences between samples. Design experiments to test hypotheses.

#### Benchmarks 3-5: Interdependence of Life

“Students should explore how various organisms satisfy their needs in the environments in which they are typically found. They can examine the survival needs of different organisms and consider how the conditions in particular habitats can limit what kinds of living things can survive. Their studies of interactions among organisms with an environment should start with relationships they can directly observe.”





- Compare wildlife observations in the habitat area to observations made at different sites around the schoolyard. Which site had the most biodiversity and why?
- Research a natural ecosystem (i.e. prairie) that compares to that in the habitat area. What are the main differences between the ecosystem in nature and the ecosystem on the schoolyard?

### MIDDLE SCHOOL APPLICATIONS

#### NSES Life Science 5-8;

Students can investigate “populations and ecosystems” and “diversity and adaptation in organisms.”

- Study your schoolyard ecosystem. How does this ecosystem function? Who are the predators and who is the prey?
- Observe birds visiting feeders and fruit/seed bearing shrubs in the schoolyard. How have the beaks of the species adapted to their different feeding strategies?

#### Benchmarks 6-8: Interdependence of Life

“In all environments...organisms with similar needs may compete

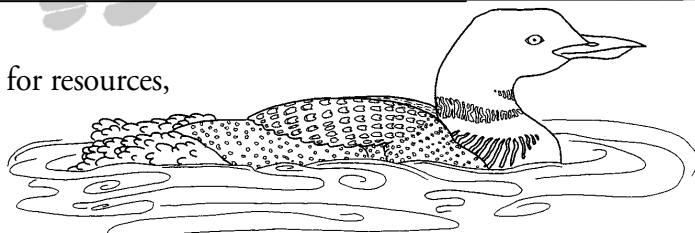
with one another for resources, including food, space, water, air and shelter...”

Two types of organisms may interact with one another in several ways: They may be in a producer/consumer, predator/prey, or parasite/host relationship...”

- Study the Schoolyard Habitats site and identify examples of predator/prey relationships.
- Find an example of parasitism in your habitat area.
- Identify native “host” plants for butterfly species in your area and add them to your habitat area.

### HIGH SCHOOL APPLICATIONS

Students will gain an enhanced sense of the scientific process; become comfortable with scien-



tific inquiry; and see the benefit of applying science, math and technology in their daily lives. The Schoolyard Habitats Program exposes all students to the exploration of local ecosystems and habitat types. Though content areas depending on the scope and scale of the project will vary, every Schoolyard Habitats project will include: observing; measuring; comparing; forming, testing, confirming, invalidating, and refining hypotheses; analyzing the impact of variables; concluding; recording, collecting and interpreting data; identifying causes and effects of change; and evaluating and communicating findings to others.

#### NSES Science as Inquiry Standard 9 –12:

Students should develop “abilities necessary to do [and understand] scientific inquiry.”

- Identify a problem or design an opportunity. Communicate the problem, process, and solution in a variety of ways, such as orally, in writing, and in other forms such as demonstration projects.

■  
*“The physical environment in and around the school can be used as a living laboratory for the study of natural phenomena. Whether the school is located in a densely populated urban area, a sprawling suburb, a small town or a rural area, the environment can and should be used as a resource for science study.”*

(NSES, p.45).  
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“Students also need to learn how to analyze evidence and data....Determining the range of the data, the mean and mode values of the data, plotting the data, developing mathematical functions from the data, and looking for anomalous data are all examples of analyses students can perform.”

- Conduct regular site inventories to determine population counts within the Schoolyard Habitats site. Chart the data, and use it to predict growth and changes in the various populations. Explain any anomalies.

### **NSES Life Science**

#### **Standard 9 -12:**

Students should understand that “Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.”

- Identify the interrelationships and interdependencies of the vegetation/wildlife found in the Schoolyard Habitats site.
- Investigate invasive species that potentially threaten your habitat. Why are these plants and animals able to thrive unchecked?

“...Early science experiences can be designed to bring out one aspect of the belief in the unity of nature. Students should sometimes repeat observations and investigation in the classroom, and then, when possible, do so again in the schoolyard and at home.”

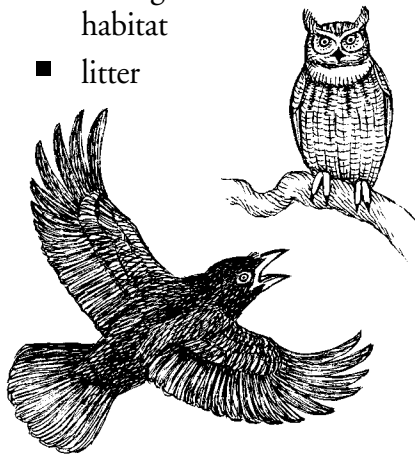
(*Benchmarks for Science Literacy*, pg. 6)

### **Benchmarks 9 –12:**

#### **Interdependence of Life**

“By the end of 12th grade, students should know that human beings are part of the earth’s ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems.”

- Identify human influences that affect your Schoolyard Habitats site. Predict how these factors will affect the stability of the schoolyard ecosystem. Examples include:
  - pollution
  - traffic patterns/foot traffic through the habitat
  - litter



- climate changes (increased temperature, water levels, etc.)

### **NSES Science in Personal and Social Perspectives**

#### **Standard 9 –12:**

Students understand how “Natural ecosystems provide an array of basic processes that affect humans.”

- Use your Schoolyard Habitats site to investigate how vegetation and wildlife maintain atmospheric quality, recycle nutrients, and affect water and nitrogen cycles.
- Illustrate concepts such as carrying capacity, food webs, and competition by looking at the predator/prey relationships on the schoolyard.

# Mathematics Standards and Schoolyard Habitats Projects

National standards document referenced: *Curriculum and Evaluation Standards for School Mathematics*, National Council of Teachers of Mathematics, Reston, VA, 1989.

## ELEMENTARY APPLICATIONS

### Math Standard 4:

#### Mathematical Connections K-4

Students should use math in their daily lives; "...measurement situations should continually be part of the program."

- Research migration routes and calculate number of miles traveled for butterflies and birds visiting the habitat area.
- Create a base map of the school property; calculate the total area of the habitat site.
- Determine the depth and volume of water bodies.

### Math Standard 4:

#### Mathematical Connections K-4

Students should use math in other curriculum areas.

- Graph results of ongoing habitat observations, such as



number of bird species visiting feeders in a day, month and year.

- Start a plant from seed; observe and measure shoot and leaf growth.

### Math Standard 9:

#### Geometry and Spatial Sense K-4

"Geometry helps us represent and describe in an orderly manner the world in which we live... Spatial sense is an intuitive feel for one's surroundings and objects in them."

- Look for patterns in nature such as tree shapes, leaf shapes and colors of flowers.

### Math Standard 10:

#### Measurement K-4

Use measurements in problems and everyday situations.

- Count the number of trees and shrubs found on the schoolyard; "adopt" one tree and calculate height, age, and girth.
- Calculate the cost of buying plants for the habitat project.
- Measure growth of certain plants over time. Create charts to illustrate differing rates of growth between species.

## MIDDLE SCHOOL APPLICATIONS

### Math Standard 4:

#### Mathematical Connections 5-8

"Many opportunities to show the connection between mathematics and other disciplines are missed in school. For example, the study of maps is an excellent time to also study scaling and its relation to the concepts of singularity, ratio and proportion."

- Develop a map of the schoolyard. What is the ratio of paved areas to unpaved areas?
- Make numerical predictions about the future growth of plants after collecting data.

### Math Standard 8:

#### Patterns and Functions 5-8

"Students should be encouraged to observe and describe all sorts of patterns in the world around them; plowed fields, haystacks, leaves on trees."

- Use field guides and a key to classify leaves and flowers.
- Have students develop their own field guides and keys for the habitat area.



## HIGH SCHOOL APPLICATIONS

### Problem-Solving Standard for Grades 9 –12:

All students should be able to “apply appropriate techniques, tools, and formulas to determine measurements.” Specifically in high school, “students should make decisions about units and scales that are appropriate for problem situations involving measurement.”

- Map the school grounds using length, width, and height measurements. In drawing the map, use a scale that will be manageable in size but large enough to highlight the features of the site. Convert measurements from English to metric, and vice versa.
- Use hand tools such as meter tapes, calculators, compasses and other measurement tools for collecting quantitative data about the Schoolyard Habitats site.

### Connections Standard for Grades 9 –12:

“Recognize and apply mathematics in contexts outside of mathematics.”

- Incorporate mathematics into the scientific and artistic aspects of Schoolyard Habitats design. Students consider total site area, area needed per plant, symmetry, spacing, and other mathematical concepts in laying out a design for the site.

### Algebra Standard for Grades 9 –12:

“Approximate and interpret rates of change from graphical and numerical data.”

- Track the growth or decline of

a certain species found in your Schoolyard Habitats project area. After compiling the data, calculate the rate of change. Hypothesize about the reasons for any changes.

### Communication Standard for Grades 9 –12:

“Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.”

- Investigate community views on Schoolyard Habitats planning process and implementation and communicate mathematical and statistical data using graphs, charts, and pictures.

“The opportunities to use the site will greatly increase as we transform it into a habitat area. We anticipate that the garden will be used regularly by all grades to observe, record and create. The students will be involved in replanting the site, as well as placing and caring for the bird feeders, nesting boxes, and birdbath.

*This spring we have started a pilot “Science in the Garden” series, which seeks to integrate learning from the garden and learning from the science lab and classroom. Using the D.C. Public Schools draft Science Performance Standards as a starting point, the first grade has studied birds (in addition to the study of butterflies as part of their regular curriculum); the third grade has studied the life cycles of plants, and the fourth grade has studied soils.”*

*Watkins Elementary School, Washington, D.C.,  
Schoolyard Habitats Site #1424*

## English Language Arts Standards and Schoolyard Habitats Projects

National standards document referenced: *Standards for the English Language Arts*, National Council of Teachers of English and International Reading Association, Urbana, IL, 1996.

### ELEMENTARY APPLICATIONS

#### English Standard 7

“I believe that every child begins with the drive to explore the world he or she is born into, that curiosity is indeed native. Speech becomes its principle instrument.” — James Brittan (*Standards for the English Language Arts*, pg. 38)

“Everyday life provides abundant raw materials from which students develop their investigative language competencies.”

- Move reading time outdoors to the habitat area
- Write poems or haikus about plants and animals found on the schoolyard
- Create a Schoolyard Habitats journal that includes observations on one side of the page and questions on the other

### MIDDLE SCHOOL APPLICATIONS

#### English Standard 7

“Students conduct research on issues and interests by generating ideas and questions and by posing problems. They gather, evaluate and synthesize data from a variety

of sources ... to communicate their discoveries in ways that suit their purpose and audience.”

- Turn the Schoolyard Habitats site into a site for research and understanding of larger societal issues such as population growth, pollution and use of resources, issues which can then be communicated through posters, presentations and collaborative reports.
- Compile results of schoolyard investigations in written reports; students present findings to other students for peer review.
- Students design and write a Schoolyard Habitats newsletter to share with other classes, students and the general public.
- Create an interpretive habitat guide for use by younger students and school visitors.

### HIGH SCHOOL APPLICATIONS

#### English Standard 5

“Students employ a wide range of strategies as they write and use different writing process elements to communicate with different

audiences for a variety of purposes.”

- Create and write work plans for the design, construction, and maintenance of the Schoolyard Habitats site.
- Present Schoolyard Habitats work to students, administration, and parents through use of prose, multimedia, and other visual aids. These different media and audiences require different writing styles (e.g. marketing/advertising, formal, journalistic, etc.).

#### English Standard 12

“Students use spoken, written, and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information.”

- Recruit other students to construct/maintain the habitat area through school-wide advertising campaigns.
- Promote the successes of the Schoolyard Habitats project through articles in the school or local newspapers.
- Use written surveys to poll schoolwide opinions on the habitat project’s necessity and design.



## Social Studies/Geography Standards and Schoolyard Habitats Projects

National standards documents referenced: *Curriculum Standards for Social Studies: Expectations of Excellence*, National Council for the Social Studies, Bulletin 89, Washington, DC, 1994; *Geography for Life: National Geographic Standards*, Geography Education Standards Project, National Geographic Research & Exploration, Washington, DC, 1994.

### ELEMENTARY APPLICATIONS

#### Social Studies Strand III: People, Places and Environments

“This area of study helps the learner make informed and critical decisions about the relationship between human beings and their environment.... In the early grades, young learners draw upon immediate personal experiences as the basis for exploring geographic concepts and skills.”

- Study the history of the school property to find out what it was before the school was built; students interview neighbors and other community members.

#### Social Studies Strand III: People, Places and Environments—Middle Grades

“Describe physical system changes such as season, climate, weather and the water cycle.”

- Set up a weather station in the habitat area; track rainfall, temperature, and other elements over time; students

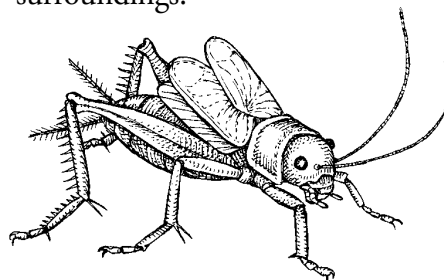
identify patterns and how they affect the habitat. Create temperature profiles by measuring air temperature at different areas of the schoolyard and at different times of day.

- Study topography and water-flow on the schoolyard. Where does the water go? How does your schoolyard affect the watershed?

### MIDDLE SCHOOL APPLICATIONS

#### Social Studies Strand III: People, Places and Environments—Early Grades

“Describe how people create places that reflect ideas, personality, culture, and wants and needs as they design homes, playgrounds, classrooms and the like.... Describe personal connections to a place, especially place as associated with immediate surroundings.”



- Students conduct a school-wide survey to determine priorities for property use that could include play areas, playing fields, future buildings for expansion of the school population, and the protection of natural areas.

#### Social Studies Strand VIII: Science, Technology and Society — Early Grades

“Suggest ways to monitor science and technology ... to protect the physical environment, individual rights and the common good.”

- Join an on-line wildlife monitoring program; have students share data collected in the Schoolyard Habitats area with other schools and scientists. (See [www.nwf.org](http://www.nwf.org) for a list of programs).

#### Geography Standard I: The World in Spatial Terms — Grades 5-8

“The geographically informed person knows and understands how to use maps and other geographic representations, tools and technologies to acquire,



process and report information from a spatial perspective.”

- Research different types of maps including topographic maps, geologic maps, GIS maps, and biological cover maps; have students create their own maps depicting what is found on their schoolyard; create a 3-D topographical map of the schoolyard.
- Using GIS software, students collect, report and map data on their schoolyard, community and watershed.

## HIGH SCHOOL APPLICATIONS

### Geography Standard I: The World in Spatial Terms— Grades 9 -12

“The geographically informed person knows and understands how to use maps and other geographic representations, tools and technologies to acquire,

process and report information from a spatial perspective.”

- Use maps such as topographic maps, geologic maps, GIS maps, and biological cover maps to research local habitat types and Schoolyard Habitats issues.
- Create a base map of the Schoolyard Habitats site, overlaying new site plans over existing topography.
- Use GIS software to have students collect, report, and map data on their schoolyard, community and watershed.

### Geography Standard 8: Physical Systems— Grades 9 -12

“The geographically informed person know and understands the characteristics and spatial distribution of ecosystems on the Earth’s surface.”

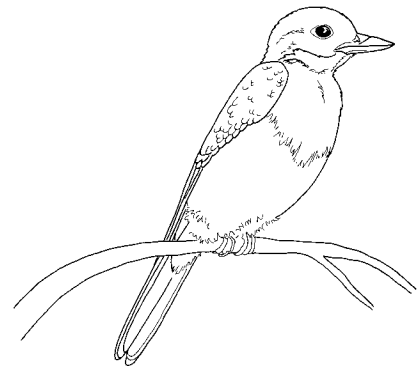
- Research local native plants and wildlife, soil types, and

watersheds that affect your Schoolyard Habitats site. Compare findings to those in different regions of the country and explain any differences.”

### Geography Standard 14: Environment and Society— Grades 9 -12

“The geographically informed person knows and understands how human actions modify the physical environment.”

- Research the pre-settlement, pre-industrial, and recent uses of your school grounds/the potential Schoolyard Habitats site.
- Determine human-induced factors that may make your site unsuitable for supporting wildlife and vegetation.
- Using your Schoolyard Habitats site as an example, develop a case study of the positive and negative human influences on school grounds.



## Technology Standards and Schoolyard Habitats Projects

National standards document referenced: *National Educational Technology Standards for Students*, International Society for Technology in Education, 2000.

### HIGH SCHOOL APPLICATIONS

#### Technology Standard 5:

#### Technology Research Tools

“Students use technology to locate, evaluate, and collect information from a variety of sources.”

- Use hand tools such as meter tapes, calculators, thermometers, compasses, and other measurement tools for

collecting quantitative data about the Schoolyard Habitats site.

#### Technology Standard 4:

#### Technology Communication Tools

“Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.”

- Organize and communicate Schoolyard Habitats measurements and experimental data by computer-generating charts, base maps, and graphs.
- Use desktop publishing software to create a Schoolyard Habitats newsletter or column.

“These habitats will strengthen the children’s understanding of life’s interdependency and provide hands-on opportunities to learn life skills and reinforce curriculum expectations...Our students learn many life skills as they develop and implement the plants necessary to create our Schoolyard Habitats. They learn and apply the skills necessary to budget, cooperate with others, respect the rights and views of others, share responsibility, time management, and effective expression of ideas. These habitats provide a natural, real-life, hands-on learning experience to enhance many of our K-5 science learning outcomes. Students will be able to learn about living/non-living things and how different weather conditions affect the plants. They will be able to observe habitats, adaptation of plants and animals, food chains/webs, and life cycles of plants and animals. Higher grades study the impact humans have on ecosystems and how a community of living things changes over time. All grade levels learn about the quality of air, water, and land and to incorporate and apply their knowledge as they recycle. Our students will use their written language skills to write sentences, paragraphs, stories, compositions, and position papers about what they have seen and learned in their Schoolyard Habitats site...Math skills and problem solving are applied as students graph and chart the growth of many plants, temperature changes, and the number of plants animal species either planted in or attracted to our schoolyards. Students also incorporate social studies as they study the different habitats and ecosystems native to our community and the importance of native habitats to the community.”

Johnson Elementary, Schoolyard Habitats site #1423, Milford, MI

## Conclusion

Schoolyard Habitats sites provide teachers of all subject areas with unique, hands-on opportunities for meeting and exceeding standards of learning requirements. This document merely scratches the surface as to the many ways in which a habitat-based learning area can be utilized to meet

educational requirements, while offering students unique learning opportunities that cannot be duplicated in the traditional, indoor classroom setting. Many students need more than books, worksheets and carefully contrived experiments; they need hands-on experience in a vibrant

setting that illustrates to them the “real world” context of their education. A Schoolyard Habitats project can provide the setting, the subject material and the process skills to make learning come alive for students.

*“Science in the Oakdale Bohemia Schoolyard begins with sixth grade study of weather and ecology, including biotic and abiotic factors of the environment. Seventh grade botany focuses on plant forms and functions. Eighth grade classes use the schoolyard to examine physical and chemical processes and construct a weather station to study precipitation, temperature change and wind speeds. Study of topography, soil and ground water analyses lead to the lab activities of ninth grade regents Earth Science and Biology. Computer technology provides tools for Internet and library research, measurement and classification of data, as well as publishing the various products of classroom activity.*

*Math classes practice computational, algebraic, geometric, and trigonometric skills with real world data. Adaptation in methods of teaching word problems to students working as field researchers enables full inclusion of students of varied experiences, developmental levels, and learning styles.*

*Social Studies begins in sixth grade with the story of the ancient inhabitants of Long Island and continues through seventh grade, learning about maps and finding clues to the human impact on our locale in Long Island history. Students begin mapping the schoolyard in eighth grade, using data collected from sixth and seventh grade explorations and adding the new features explored in science classes. Ninth graders link the map of the schoolyard to boundary features impacting the school and catalog current events that relate to its microenvironment.*

*English classes capitalize on the rich opportunities for note-taking, developing ideas, and writing that connects to student work in other disciplines. Experiences in listening, speaking, reading, and writing are many and varied, according to the learning standards implemented in each classroom across the grade levels. A guidebook to the history and environment of the schoolyard is produced in parts by all classes submitting material to be edited and published by ninth grade cooperative learning groups. Students evaluate local environmental issues to create and implement an environmental action plan.”*

*Oakdale Bohemia School, Oakdale, NY, Schoolyard Habitats site #1440*