

Older students may engage in more complex studies of the schoolyard by discussing water cycles and the school's location within its watershed (see chapter 5); studying solar geometry using shadows that shift on the playground over the course of a day (see chapter 9); or testing the nutrient levels of the soil to see if they are adequate for plant growth.

Schoolyard research can also be a good segue into career discussions. Teachers can invite available parents or local community members—cartographers, soil scientists, geologists, water resource experts, landscape architects and planners—to share their work with students, relating their jobs and career paths to the schoolyard design process.

Schoolyard design exercises

When the green schoolyard project reaches the design phase, teachers have further opportunities to engage students in creative thinking skills and art projects.

Student design workshops can be held either at the beginning of the planning process, when the adults are doing similar brainstorming work, or after the general spatial decisions and project parameters have already been defined by the adults. Student design workshops usually begin with a description of the task at hand and an introduction to what might be possible at their school with the aid of photographs or other visuals. Once that introduction is delivered, students typically work in small groups to collaborate on design ideas. As each small team of students presents their vision to the larger group, the adults should take notes—what is verbally expressed may not be immediately clear from the drawings. (Figure 2.5)

While it is best to allow creative ideas to flow, unconstrained by adult perspectives, some student ideas may need editing. For example, requests for amenities such as swimming pools, ice rinks, and zoos are fairly difficult to implement on most school grounds, while suggestions for a bench shaped like a dragon, a reading nook in the form of a fairy castle, climbing holds put on a bare concrete wall, or the school's name spelled out in flowers, are more easily translated to a schoolyard context.

Some schools use design contests, based on drawings or scale models, to gather student input. The resulting student



FIGURE 2.5 Students can express their schoolyard design ideas by drawing on a map of their school grounds, or by creating illustrative, annotated drawings of key features they desire (as shown here).

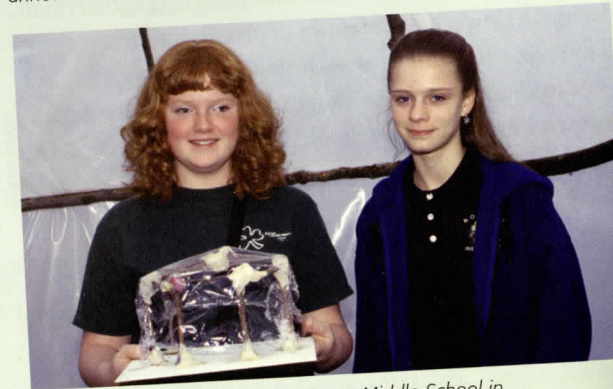


FIGURE 2.6 These students at Rowe Middle School in Milwaukie, Oregon, won a contest to design a greenhouse for their school's "Naturescape." The resulting structure, shown here in model form and as the backdrop for the picture, was created using recycled plastic sheeting and tree branches.

design ideas often help to make the schoolyard unique and memorable. (Figure 2.6)

Ultimately, the best student design process is the one that the school feels is most likely to result in a real, visible contribution from the students. Including students in the design phase empowers them, shows respect and recognizes them as creative, thoughtful individuals. This affirmation from adults helps to build students' self-confidence and acknowledges that their contributions are important for shaping their environment.

3 Design Guidelines for Ecological Schoolyards

Well-designed green schoolyards reflect their local ecology, the curriculum taught at the school, the play needs of their children, and the cultural context of their neighborhoods. They are comfortable environments, with a unique sense of place, and are inviting spaces for the school community to work, play, and gather year-round.

From school visits, from my professional practice and from many conversations with teachers, parents, principals, students, and landscape architects over the past ten years, I have distilled a set of best practices for designing ecological schoolyards. My design guidelines include site design characteristics that make schoolyard spaces more conducive to teaching and learning and that streamline schoolyard management; ecological principles that result in multifaceted, environmentally-sound outdoor spaces; and schoolyard characteristics that promote creative and well-balanced play options. Use these design principles as a flexible framework to guide your design work and then shape the landscape to fit your needs.¹

Site Design Principles

Where's the best place to put the garden? How can we keep the kick balls out of the plants? What should the outdoor classroom space look like? Questions like these come up at school design meetings right from the beginning. Site design for green schoolyards must consider many factors—microclimate, water availability, noise, emergency access right-of-ways and, inevitably, the big issue of how to share space with existing activities. As you launch your project, be sure to consider the following key issues regarding physical space and seek to create a schoolyard landscape that provides a diversity of experiences. Each of the

design principles is explored in greater detail in the chapters that follow.

Site selection

For your first project, select a schoolyard site that is close to the classroom building for easy access, consistent maintenance, and daily observation. Be sure to choose a site that is highly visible, but one that will not interfere with or get trampled by existing schoolyard activities. Pick a location with enough sunlight for vigorous plant growth and easy access to a water source for irrigation. Remember that project sites do not have to be large to be effective teaching tools. Projects can expand in area over time or grow with additional layers of complexity.

A school rooftop may also be considered as an outdoor teaching and/or garden space. Rooftop classrooms often have inspiring views and are more protected from vandalism. They also have some constraints that may make them somewhat challenging. Check with the school district to make sure that the rooftop is water tight, structurally sound, and can take the weight you wish to place on it. Make sure to install appropriate fences around the edge to prevent accidents. Rooftop environments are generally hotter, windier, and drier than the surrounding landscape, so select plant species with these factors in mind.

Multipurpose design

Everything in an ecologically designed schoolyard should serve more than one purpose to save resources and space. For example, design garden walls to be used as benches, too. Build a trellis that provides shade, defines schoolyard use zones, and also supports vines with edible fruit.

Space definition

Create clear boundaries around the entire project. Low walls or fences (without gates) around the edge will prevent trampling and help to clearly indicate where ball games should end. Defined boundaries also tell neighbors that someone is taking care of the interior space, even if it doesn't meet conventional standards of tidiness. Also define boundaries around portions of the project that require more protection or are managed by different classes. For example, add raised edges to any garden beds used by young children to prevent them from mistaking the beds for the pathways.

Place-making features

Make ecological schoolyards as memorable and compelling as possible by fostering a distinct "sense of place." Use visible entrance markers such as special gates, archways, or entry signs. Personalize the space with scarecrows, artwork, and other items crafted by the students. Build memorable structures—special seating areas or garden buildings with whimsical designs.

Use schoolyard artwork—tile mosaics, murals, sculpture—to reflect the school and community's culture(s) and neighborhood context. Consider including artwork that highlights the school's mascot, celebrates special people, or features programs taught onsite.

Find a way to incorporate themes that reflect school or neighborhood history. Use artwork to bring attention to a buried creek that flows nearby, or to highlight another natural feature that was changed by the school's construction. Enliven the site with a natural history theme by using logs or locally quarried stone, for example, that convey an environmental "story" about your geographic region.

Curriculum connections

Ensure that all built or planted elements of the green schoolyard are connected to the school's curriculum so they will be used regularly and receive appropriate maintenance. Try to connect all of the subjects taught at the school to the schoolyard landscape in some way.

Movement through the ecological schoolyard

Design the schoolyard circulation system to make pedestrians comfortable and to accommodate the daily flows of students,

school staff, and families to and from the building. Create pathways with a variety of widths to serve different purposes. Place wide paths to facilitate students' site maintenance work (for example, wheelbarrow width) and install narrow, winding pathways and stepping stones to encourage slow movement through other parts of the space. Make the green schoolyard wheelchair accessible and comply with related standards established by the Americans with Disabilities Act.

Include vehicle access routes through the schoolyard as required for emergency vehicles, routine deliveries, and maintenance equipment. Avoid using schoolyard space for parking if possible.

Avoid the use of locked gates. Make the green schoolyard accessible to students during and after school, for formal and informal activities. Not only will this help welcome the community, but the added "eyes on the schoolyard" may also deter vandalism, if that is a problem at the school.

Comfort

Design schoolyard landscapes to be comfortable places in all kinds of weather. For example, plant deciduous trees to provide dappled shade in warm weather and sunlight in the winter. Use shade cloths to protect heavily used spaces from direct sun. Install rain shelters in selected areas so classes can meet outside in all types of weather. Provide comfortable seating for relaxation and all types of gatherings.

Outdoor classroom spaces

Provide seating for individuals and small groups. Scatter small, informal seating areas of different heights throughout the site to create a restful environment for adults and children. Integrate writing surfaces with seating areas so that students can take notes and work on their assignments with ease or settle down to a pleasant outdoor picnic.

Include places for an entire class (30-plus students) to comfortably sit down together. Such areas are often used for formal instruction and discussion at the beginning and end of outdoor sessions. Group seating areas may take many forms including amphitheaters, covered gazebos, benches, collections of large rocks, picnic tables, or "council circles" made of logs, straw bales, or other materials. They can also be used during class, at recess, or for community gatherings.

Signage

Use signs to make members of the school and community feel at home in the schoolyard and to help them understand the spaces around them. Place welcome signs at school entrances to clearly mark them and to reinforce the school's identity. Place interpretive signs around the schoolyard to label distinctive project features so that students and neighborhood visitors will find the site interesting as well as attractive. Adequate signage is particularly important for sites with complex equipment, highly diverse plantings, or plants that foster wildlife habitat. They also explain elements the school has worked hard to create and display students' work for their parents and visitors.

Community participation

Involve students of all ages and ability levels in the design, construction, and ongoing stewardship of the site. Purchase child-sized tools so that children can participate comfortably. Design the project to evolve from year to year to encourage continual, active participation. Encourage school faculty, administrators, groundskeepers, and community members to take part in all stages of the project.

Ecological Principles for Green Schoolyard Design

The best schoolyard designs make the ecological systems onsite visible, compelling, attractive, and enjoyable for the students. They demonstrate how each system works and help to restore the balance of any systems that may have been disturbed by the school's construction.

Ecological schoolyards should reflect a school's immediate site conditions as well as the broader context of the surrounding ecosystems and climate. Design components such as food production, habitat restoration, stormwater runoff systems, greywater treatment wetlands, energy conservation and production, and "waste" reuse should enhance the schoolyard environment and help reduce the school's impact on municipal infrastructure and the surrounding neighborhood.

Wildlife habitat

Create viable habitat for a variety of local wildlife species. Be sure to include the four basic components (food, water, cover,

and nesting places)² essential for survival of the species you wish to attract. Use native plants to encourage species diversity.

Water systems

Teach students to monitor and evaluate the school's water supply, drainage, and purification systems. Seek to reduce the amount of potable water that is imported from municipal systems through conservation efforts and by supplementing that supply with rainwater or greywater where feasible.

Design the schoolyard landscape to reflect local precipitation patterns. Conserve water by using drought tolerant plantings and efficient irrigation systems. Use living roofs to moderate stormwater runoff from school buildings. Remove as much hardscape as feasible and create stormwater wetlands and swales to encourage rainwater percolation and purification. Retain stormwater by installing cisterns, stormwater ponds, and similar features.

Consider processing some of the school's wastewater onsite. Use purified greywater from the school building to irrigate non-edible landscape plantings or to flush toilets in the building. Consider processing blackwater from toilets in an onsite wastewater treatment wetland, and then reusing it onsite in some way.

Energy systems

Combine energy conservation measures in the school buildings and yard with onsite renewable energy production techniques. Plant deciduous shade trees and vines to demonstrate passive solar cooling of classrooms and outdoor areas. In hot climates, remove some asphalt from the site and paint rooftops a light color to reduce heat gain. Use solar panels, wind turbines, or other active energy production techniques to power fountains, pond circulation systems, lighting—and, possibly, the entire school.

Food systems

Start a culinary garden at school. Allow students to select the edible plants, maintain the garden, harvest the crops, prepare the food, and eat it at school. Include a variety of crops, some that are familiar to the students and some that will provide good educational opportunities if tied into history, geography, or social studies lessons. Plant enough food to share

with local wildlife. Maintain the garden organically, without the use of chemical pesticides or fertilizers, to protect the students, wildlife, and local stormwater quality.

Cook and eat with students in the schoolyard. Build outdoor ovens and barbecues, food preparation areas, and outdoor sinks to create informal kitchen spaces to be used for lessons and school festivals. Include nearby picnic tables and other amenities that make outdoor cooking and eating enjoyable.

Green building materials, building methods, and maintenance

Select building materials from local, sustainably harvested, natural sources whenever possible. Build with local wood, stone, and earth rather than resource intensive cement, metal, and plastic. Use simple, durable, construction techniques that students and community members can participate in and repair themselves, if needed.

Avoid the use of harsh, man-made chemicals in the materials you select. Do not use pressure treated lumber, railroad ties, old tires, or other industrial by-products that may leach chemicals into the soil or rub off on children's hands. Be sure to *always* exclude these materials from gardens with edible plantings and places students or wildlife frequent. Use organic agriculture methods and Integrated Pest Management techniques to manage any insect or rodent problems that arise, rather than relying on poisonous chemical solutions.

Use waste as a resource whenever possible. Reduce the school's waste stream by reusing things that are otherwise thrown away, composting organic wastes produced onsite, and recycling other items. Build schoolyard structures out of non-toxic used or recycled materials from the school or local community. (Do not reuse materials that may contain lead, asbestos or other hazardous substances!)

Play Principles

A green schoolyard should enhance the active and creative play value of the school grounds, in addition to supplementing its educational curricula and improving its ecological infrastructure. It should delight the senses and capture the imagination of the children who play there and the adults who spend time with them.

Balanced play options

Appeal to a wide variety of interests by providing open-ended play opportunities and imaginative play options. Balance traditional active ball games and monkey bar play styles with energetic *creative* play, relaxing quiet zones, and inspiring art options. Encourage children to make up their own games, use their imagination, and play in environments that mimic nature.

Moveable parts

Include "loose parts" in the playground design that children may use as play props to enhance their games and the imaginary environments they create. "Loose parts" may include trees with interesting pinecones, plants with nice seedpods, and moveable groundcovers such as mulch, gravel, and sand or other similar materials.³

Exploration, adventure, and challenge

Allow children to explore the schoolyard, take reasonable risks in their play, and develop their bodies as they develop their minds. Work as a school community to challenge overly strict interpretations of playground safety standards, which often deny children a full range of play choices and confuse liability concerns with safety. Add elements of challenge and mystery to the schoolyard design to enhance play and hold children's interest throughout their years on the same playground.

Play everywhere

Everything in the schoolyard will be played on, whether it is designated as a play area or not. Make it all beautiful, enjoyable, safe, and fun.

I hope that these schoolyard design principles will help you get started on your own ecological schoolyard project, establish your overall goals, and save you some time along the way. There are countless ways to implement these concepts and each will undergo some changes as you adapt it to your own school site.

Every school is unique, and its schoolyard should reflect its individuality—making each one memorable. An ecological schoolyard will be especially useful to students if it gives them a solid foundation in hands-on experiences they can understand and will remember, if it challenges them to think for themselves and find their own solutions to problems that arise, and if it teaches them how to participate in group processes to reach consensus about important decisions.

PART 2 Ecological Teaching Tools in the Schoolyard

INTRODUCTION

Every school has a unique ecological context—determined by its location, climate, soils, geology, and habitat types—which is a dynamic teaching tool that is frequently overlooked or underutilized. When school grounds are shaped to reflect the school's place within its larger ecological framework, the schoolyard becomes a hands-on laboratory for ecologically-oriented place-based education. This attention to local context ensures that each schoolyard is special: school grounds in dry Arizona do not look the same as schoolyards in verdant Virginia, or those in coastal California.

Most schools treat their indoor spaces as their formal academic classrooms and place much less emphasis on the educational potential of their outdoor landscapes. Schools that are home to ecological schoolyards, by contrast, possess a range of rich, educational resources right outside their doors. These environments can be harnessed to enhance a school's existing academic curricula in many different subject areas, and to expand the interdisciplinary nature of what is taught to include broader place-based lessons about environmental stewardship.

Schools use outdoor classrooms to teach science, math, art, music, history, and language in meaningful ways that connect these studies to their students' lives. A simple culinary garden, for example, becomes a teaching resource for a wide array of academic subjects, reaching deeply into a school's existing curriculum. Science students might observe plant growth in the garden on a daily basis, test the soil for nutrients, and study the water cycle firsthand. Math students might calculate the area of a garden path to determine how many bricks are needed to repave it, measure the length of hose needed to reach the farthest planting bed, or estimate the soil volume of a given planter box. For art students the garden becomes studio space for creating paintings and fertile ground for gathering plant-based art materials. Edible plants help teachers introduce unfamiliar cultures and time periods in social studies or history classes; garden produce provides cooking and nutrition

classes with healthy food that brings the school community together for shared meals.

Connections to Place-Based Learning

Green schoolyards are also ideally suited to teaching broader, interdisciplinary, environmental education topics and ecological design. For example, in the context of the same food-producing garden, organic "waste" materials from plant clippings can be composted so the nutrients will be returned to the soil, illustrating the process of nutrient cycling and the concept of waste reduction. Drainage systems in this garden can capture rainwater and supply planting beds with moisture they need. Solar energy can power a garden pond pump, demonstrating renewable energy techniques. Garden trellises and seating can be made from natural materials, sourced locally, to illustrate tenets of sustainable design and local self-reliance. Plantings for beneficial insects, pollinators, and other wildlife can be interspersed with food crops to increase wildlife diversity, improve food yield, and beautify the garden.

This type of place-based learning does not have to be confined to a school garden, however, since the entire campus, including the buildings and grounds, is a resource to be tapped for the broader application of green schoolyard themes. To engage in place-based curricula, school communities need to first understand their site's ecology. This process of research and discovery takes place over time in the context of coursework that may involve students as well as adults and local professionals, if desired. (Chapter 2 includes ideas for engaging students in site analysis research.)

Students can be enlisted to track and evaluate the school's energy and water usage inside and outside the buildings, consider how to reduce waste, assess their schoolyard's wildlife habitat value, research transportation options for the school community, study cafeteria food supply systems, and investigate