Photographs by Patrick Praetorius

A Permaculture School Garden

Applying the principles of permaculture in schoolyard projects reinforces values of resourcefulness, stewardship, and sustainability

by **Patrick Praetorius**

THE GREAT LAW OF THE Iroquois Confederacy states that "we must consider the impact of our decisions on the next seven generations." This law speaks to the importance of considering how our actions affect the natural world and in what condition we will leave the world to our descendents. Proponents of permaculture are substantially motivated by the same goal. In today's world of depleted natural resources, species extinction, and other widespread damage to the environment, we must look for ways to lessen our impact on the Earth. Permaculture is a design methodology that seeks to do this through the observation and mimicking of patterns and relationships found in nature. It can be described as a way of living in harmony with the rest of nature by designing landscapes and human habitats based on principles of ecology. Lee Barnes, former editor of *Permaculture Connections* writes, "Permaculture is the use of ecology as the basis for designing integrated systems of food production, housing, appropriate technology, and community development. Permaculture is built upon an ethic of caring for the Earth and interacting with the environment in mutually beneficial ways."

Whether applied to food production, land stewardship, urban planning, or social and economic structures, permaculture is based on a set of principles for working in harmony with natural systems. At Oak Grove School in Ojai, California, faculty and staff decided to follow those principles in their school gardening projects. They felt that if students could experience permaculture practices first hand, they would develop a greater awareness of the subtlety of nature and learn the values of resourcefulness, stewardship, and sustainability. Examples follow of the application of permaculture principles in the creation of Oak Grove School's gardens, pond, straw bale greenhouse, and seating area. It is hoped that these ideas with inspire other educators to incorporate principles of permaculture in their own schoolyard "greening" projects.

Principle 1: Work with nature, not against it

Working with nature requires looking at what nature is already doing successfully and planning components that will work in conjunction with it. This takes careful observation, as nature's ways are often subtle. In creating a permaculture garden, for example, important considerations are the environmental conditions of the site and the selection of plants. Consider the following: What is the weather like? How much sunlight does the area receive? How's the soil? What will grow here? Rather than choosing plants you would like to have and then trying to alter the conditions to meet those preferences, look at the natural conditions and select plants that are suited to that environment. Especially interesting are native plants that have played fascinating roles in the human civilization of an area.

The climate of Ojai is mostly dry and sunny, and we planted herbs, squash, beans, peas, citrus trees, and many other species of plants that thrive easily in these conditions. The Chumash Indians, who have occupied the area for centuries, used many of these plants for food and medicine. In keeping with the principle of working with nature, we also chose as a garden site an area with a gentle south-facing slope so that we could take advantage of maximum sunlight and natural soil drainage.

Working with nature: native and other drought-tolerant plants on a south-facing slope.

Principle 2: Get the most gain from the least effort

The first step in successful permaculture is a well thought-out design. This principle could be paraphrased "Think twice, lift once!" — a variation on the carpenter's rule of "Measure twice, cut once." Anyone who has ever worked a farm or garden can appreciate the importance of getting as much work as possible out of every action. In designing a garden, for example, consider how much care a plant needs and how often its leaves or fruits will be harvested. Plants that will be attended to most often should be planted in the most accessible locations, while those with slower growth patterns or fewer needs can be planted further away. Consider whether one garden building might serve more than one purpose. For example, a greenhouse can make an excellent classroom. Are inexpensive materials available and close at hand? In building a straw bale greenhouse, we needed to coat the walls with layers of mud; at the same time, we knew that we wanted a pond in the garden. We decided to dig soil from an area about 5 meters (15 feet) south of the greenhouse site, so that while obtaining dirt for the greenhouse walls we were also excavating for a pond.

Getting the most from the least effort: a straw bale greenhouse doubles as a classroom and workshop where students raise seedlings and study plant biology.

The goal of getting the most gain from the least effort often gives rise to creative ideas that not only reduce work but also save money and resources. For example, a greenhouse might be built as an extension of an existing structure, with the two buildings sharing a wall (one less wall to build and pay for!). We plan to grow grapevines up fruit trees. This will save the money, materials, time, and labor needed to build trellises.

Principle 3: Seek energy efficiency and use natural materials

In permaculture, we seek energy efficiency (which is also economic efficiency) as much as possible. In addition, we seek to use natural materials whenever possible. These two goals reflect the fundamental motivation for permaculture: the need to live in harmony with nature. In keeping with this principle, we decided to build a straw bale greenhouse at Oak Grove. Straw bale construction is affordable, and therefore realistic for widespread use; the materials are renewable and environmentally benign; and it produces a well-insulated, energy-efficient structure.

Since the climate in Ojai is generally mild throughout the year, we chose a passive rather than an active climate control system, which meant that we had no need for a cooling or heating system. This required careful design to take advantage of winter light and to limit summer heat, as well as to ensure good air circulation. To provide heat in winter, we have considered having chickens roost in the greenhouse! To reduce summer heat, the glazed windows can be shaded during the hottest time of day.

Another example of efficient design at Oak Grove is an automatic drip irrigation system. The system required an initial investment of money and labor, but these inputs are more than balanced by savings in water and in time spent watering. A drip irrigation system keeps the soil moist rather than flooding it, and so prevents erosion. By setting the system on a timer, we ensure that water isn't wasted in accidental overflows. A timer also makes it convenient for the garden to be watered in the early morning, when loss through evaporation is minimal.

Left: Students working on an irrigation system in the forest garden. Right: Meandering edges and varying depths create a diversity of pond habitats, while aquatic plants oxygenate the water and provide cover for mosquito fish and frogs.

Principle 4: Make use of the edge effect

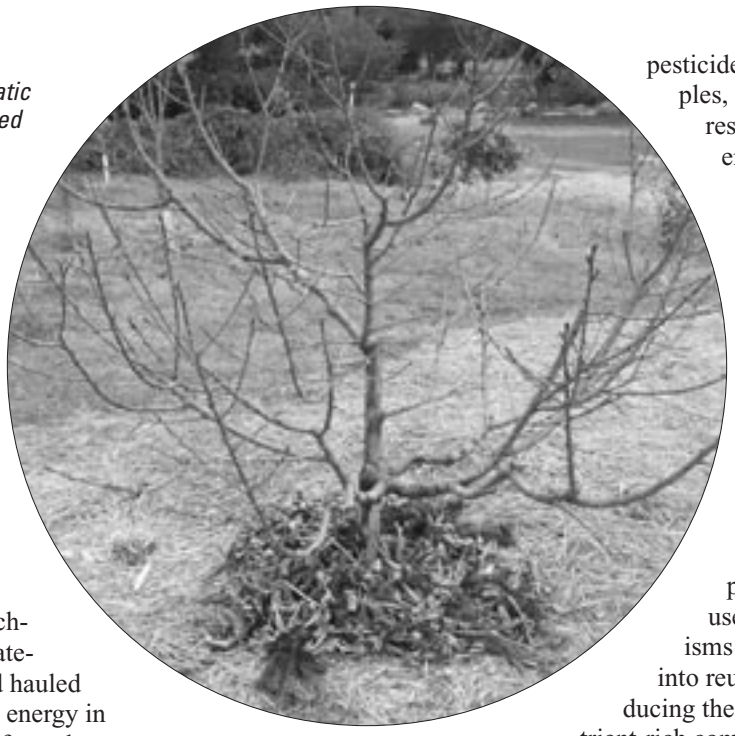
In ecology, the "edge effect" is the tendency for boundary areas where two ecosystems come together to have a greater diversity of plants and animals than either of the adjacent ecosystems. Making use of the edge effect in designing natural areas promotes the biodiversity that is necessary for a self-sustaining system. One way to take advantage of the edge effect in a schoolyard is to create a pond. A pond invites an abundance of life, from the smallest microbes and insects to fish, amphibians, and birds. All of these organisms contribute to the garden, whether by reducing pests, nourishing the soil through their waste, or pollinating plants. Encouraging such diversity is thus a means of ensuring that elements in the garden make functional connections that are mutually beneficial.

At Oak Grove, we created a pond with an amorphous shape rather than one that is geometrically perfect. With many points jutting out and coves going in, the edge of the pond is a varied and hospitable environment where life can flourish. Similarly, the variety of depths in the pond invites a diversity of plant and animal species to co-exist. The pond is also a great outdoor science project. It provides a living demonstration of several different natural processes — photosynthesis, the food chain, and the water cycle — and students are fascinated by the microbial life of the pond.

Permaculture is based on a set of principles for working in harmony with natural systems.

Principle 5: Plan for beneficial relationships

It is not enough to have a diversity of life in the garden. Stability occurs only when these diverse organisms have beneficial relationships. Under these circumstances, a balance can emerge such that different elements both enhance and regulate each other. With this in mind, we are creating a forest garden. The garden consists of a variety of plants — trees, vines, small shrubs, and herbaceous annuals and perennials — grown together so that they serve the needs, and accept the products, of one another. Trees create shady microclimates for plants that enjoy partial shade. They also provide habitat for predators that keep rodent populations in check. Nitrogen-fixing annuals grow between rows of fruit trees, increasing the fertility of the soil. Umbelliferous plants such as carrot, dill, and fennel host insect predators, and marigolds naturally repel certain types of nematodes. Perennials are used to create natural borders and pathways, as well as to provide food. We use native species as much as possible, not only because they grow more easily than non-natives do, but also to contribute to the natural self-regulation of the environment.



Turn problems into solutions: 'Weeds' and overzealous aquatic plants are harvested and placed around fruit trees as mulch.

Principle 6: Take advantage of cyclic opportunity

Closely related to principle #5, the principle of cyclic opportunity states that cyclic events increase the yield of a system by retaining energy and nutrients within the system. In a typical garden where lawn trimmings, branches, and other excess plant material are neatly bagged up and hauled away, all of the nutrients and energy in those materials are removed from the system. The eventual result: barren soil that cannot support plant growth without the application of chemical fertilizers. Similarly, when pesticides are used to control insects, many natural cycles are interrupted. Pollination and plant yields are reduced because beneficial insects are eliminated along with pest species; and animals that eat insects become scarce, so that when the pests return (as is inevitable) there are fewer natural predators to help keep them in check. The result: further reductions in yield and increased need for pesticides. In both of these examples, disruptions of natural cycles result in a loss of nutrients and energy from the system and a greater need for inputs from outside the system.

In contrast, when energy and nutrients are cycled locally, the result is a resilient, self-sustaining natural web. In the Oak Grove School garden, plants produce food for humans, and food scraps and other excess plant materials go to the compost bin. In the compost bin, the plants' energy is used by decomposing organisms that break down the plants into reusable elements while producing their own rich wastes. The nutrient-rich compost is returned to the soil where it nourishes plant growth and supports a diversity of beneficial soil organisms. The pond is a habitat for frogs and other animals that eat herbivorous "pest" insects, and is a source of nutrient-rich water for irrigating crops. By taking advantage of natural cycles such as these, permaculture seeks to create "closed loops" of nutrients and energy in the garden, thereby reducing reliance on outside sources and lessening the burden placed on outside sources for waste disposal.

Building a Straw Bale Greenhouse

A straw bale greenhouse needs "good boots and a good hat." The foundation is made of cement blocks fitted with rebar. The straw bales are then poked down on to the rebar, staggered, in the pattern of a brick wall. Then the straw bales are wrapped with chicken wire, which helps the mud stick to the walls. Before mudding, a timber frame is built around the walls to add stability to the structure.

Mudding the walls is labor intensive, but it is simple enough that everyone can get involved. We had children as young as five slathering it on! At least three layers of mud (soil with added sand and cement) should be applied to new structures, and, over the years, it is a good idea to occasionally add a new layer. The process takes time and is ongoing, but the payoff is that the building is very well insulated and will last until you knock it down (and if you do knock it down, the remnants are harmless to the environment).

Besides keeping the inside dry, the roof should also channel water away from the building. We chose a slanted shed roof made of clear, corrugated fiberglass so that water would flow toward a rain catchment system into barrels and into a French drain, which diverts water into the pond.

While a project like this can be expensive, it is often possible to scrounge free materials from local construction companies and businesses. Families, too, are usually more than happy to donate supplies left over from home renovations. If the cost of glass is prohibitive, consider asking for donations from a local glass company and then designing and building your greenhouse to fit it. You will likely find that many principles of permaculture make good economic sense. For example, the natural materials used in building a straw bale greenhouse are not only biodegradable but also cheap (straw) or free (mud). Making use of materials that are at hand locally not only saves money, but also conserves the resources that would otherwise be required to produce, package, and ship new materials.

Left: Outdoor seating area made of natural materials. Right: Young students show off their lettuce harvest.

Principle 7: See problems as potential solutions

When energy and nutrients are cycled locally, the result is a resilient, self-sustaining natural web.

This principle is more about our attitude toward our work than about the work itself. If we look upon each resource in the garden as offering either an advantage or a disadvantage, depending on the use we make of it, then our challenge lies in discovering the potential benefits of each resource. We bemoan the insects and weeds as the "enemies" of our garden, but they serve a purpose too. Insects provide food for small animals, and their wastes and remains nourish the soil. At Oak Grove, we pick soft weeds before they go to seed and use them as mulch around other plants, thereby making them part of the cycle. We have planted lawn chamomile (*Chamaemelum nobile*) in open areas to inhibit the growth of less controllable weeds. Similarly, weed-barrier plants such as lemongrass, comfrey, and arrowroot can be planted around the edges of a garden to stop the spread of invasive grasses (when they get too big, cut them back and use them for mulching).

The task in permaculture is to design components so that the garden can flourish even with the challenges posed by insects, weeds, and other "enemies." By selecting a diversity of plant species and placing them in such a way that each serves the needs and accepts the products of others, we work with nature to create a strong and resilient system. Permaculture challenges our traditional measure of what a healthy garden looks like: neat, well weeded rows of segregated species. To take advantage of the balance of nature, we must mimic her, and that means overlapping and overgrowing plant species, and allowing natural cycles, including death and decomposition, to be fully present.

Principle 8: Take care of people

Our needs for food, shelter, education, work, play, and social interactions must be met if we are to be healthy. Therefore, our permaculture garden is more than a food production area. It is a welcoming place where people can gather to talk, play, observe, meditate, and work in a pleasant environment. Since we are a school, we felt it was important to create an outdoor classroom that would fit into the natural surroundings and be an inviting space.

We chose a spot under a tree on one end of the garden with a good view. Rather than building up, we went down. We dug out an area that is about 60 cm (2 feet) deep at the back end, but, since it is on a slope, levels out to about 20 cm (8 inches) at the front, creating a horseshoe shape. The back end is lined with dirt-filled grain bags covered with plaster. These are layered like coils on a clay pot to create a circular seating area for resting and instruction. The front end opens to the garden. This outdoor classroom illustrates several principles of permaculture. First, by building into the ground, we worked with nature, not against it, in the sense that we created a smaller visual impact on the landscape. Second, we used natural materials, thereby limiting the environmental impact of the project in both the production and eventual disposal of those materials. Third, by taking advantage of the natural slope, we got the most gain from the least effort. In essence, half the work was done for us.

The principles of permaculture are closely interrelated and all are based on the idea that we human beings need to change how we interact with our environment. Our ecological footprint grows bigger every day, and much of what we call progress is harmful to the environment. When we use the principles of permaculture as the basis for design decisions, we act and progress with nature. Doing so reminds us that we, too, are part of nature, and since we cannot survive outside of it, it behooves us to act in harmony with it.

Patrick Praetorius is an educator, writer, and permaculture enthusiast living in Ojai, California.

Resource

Mollison, Bill. *Introduction to Permaculture*. Australia: Tagari Publications, 1991.