



Gardening With Kids — Classroom Activities in Horticultural Science

Children's Gardens in Which to Learn and Grow¹ **A Guide to Planning, Designing, and Building** **an Outdoor Garden Classroom**

David Hillock

Assistant Extension Horticulture Specialist

Matthew Kirkwood

Assistant Professor of Landscape Architecture

Douglas Needham

Professor of Floriculture and 4-H & Youth Programs

Brenda Sanders

Assistant Extension Horticulture Specialist

Oklahoma Cooperative Extension Fact Sheets
 are also available on our website at:
<http://osufacts.okstate.edu>

Throughout the U.S., schools are discovering the benefits of outdoor classrooms, where their students can explore the environment through native and/or created habitats for various plant and animal life. Although some schools border native prairies, woodlands, or other wild areas that can be easily adapted for outdoor classrooms, many urban schools have little space to create an outdoor garden classroom. This publication along, with videotape VT882 available through the Oklahoma Cooperative Extension Service (OCES), will serve as a guide to planning, designing, building, and maintaining an outdoor garden classroom. Bear in mind that an outdoor garden classroom does not need to be large to accomplish its goals; it may be as small as a single, raised bed or even an array of pots or planter boxes. Also, many botanical gardens and arboreta have specific programs and gardens that are developed especially for schools and children. Contact the American Association of Botanical Gardens and Arboreta (AABGA) at <http://www.aabga.org> for names and locations of gardens in North America.

Following the framework below will ensure that an outdoor garden classroom develops into a functional space that is utilized year-round.

Step 1—Form a Garden Committee

If the project is more than a grouping of potted plants, it is important that the person initiating the project has a committee of individuals to assist with fund raising, scheduling, volunteer training, curriculum development, etc. as well as designing, installing, and maintaining the garden. Teachers will most likely initiate the outdoor garden classroom project for a school and, thus, will want to identify responsible, knowledgeable people with expertise in these various areas, who are committed to the success and longevity of the project.

¹ This project was sponsored by a grant from Learn and Serve America through the Oklahoma Higher Education Partners in Service-Learning, funded by the Corporation for National Service. Oklahoma Higher Education Partners in Service-Learning is dedicated to building and strengthening the foundations of service-learning in higher education institutions throughout Oklahoma.



Parents, members of local garden clubs, Master Gardeners, and faculty or staff are potential sources of volunteers to serve on a garden committee. A successful garden is typically the result of several teachers' sharing their common goals, ideas, and dedication to the project. It is imperative to collaborate with other teachers.

For large outdoor garden classroom projects, consider having subcommittees address and coordinate areas such as financial support, garden maintenance, curriculum development, etc., each chaired by a member of the garden committee.

Step 2—Garner Funds and In-kind Gifts

Regardless of its size, an outdoor garden classroom requires resources to purchase tools, seeds, plants, mulch, pots, irrigation equipment, edging, etc. There are many donors, either individual or corporate, from whom to request financial or in-kind support. Donors may include granting agencies,

private foundations, corporate partners, local businesses, and individuals. Before soliciting gifts, consider the project's short- and long-term needs. One-time gifts are great for getting started; however, continued growth and development of the project will require sustained solicitation of gifts.

Remember, all gifts are made by people, even if not from their own money. When soliciting support bear in mind why donors will give to a project: the donor 1) believes in the community and its school system and takes pride in association with them, 2) believes that your goals and curricula support the need for the project, 3) has a respect for the teaching profession, and 4) considers the tax benefit of the gift.

Granting Agencies

Grants are available from many sources and typically require an application specific to the granting agency. Although grant writing can be a time-consuming process, the successful proposal often leads to subsequent grants from the same and other granting agencies. The following is an abbreviated list of granting agencies with focus on environmental education.

- **Corporation for National Service—Learn and Serve America (202-606-5000, <http://www.learnandserve.org>)** sponsors **Service-Learning Grants** ranging from \$1,200-15,000 to schools for efforts that engage students in environmental and other community activities. Some outdoor classrooms and habitat programs have been started through this program.
- **Environmental Protection Agency (800-887-6063, <http://www.epa.gov/>)** sponsors **EPA Environmental Education Grants** of \$5,000-250,000 to support environmental education efforts at the grassroots level. Local educational institutions, state agencies, and non-profit groups are eligible to apply.
- **Oklahoma Department of Agriculture—Forestry Services (405-521-3864, <http://www.state.ok.us/~okag/forestry/forhome.html>)** sponsors **Urban and Community Forestry Challenge Grants** in cooperation with the US Forest Service and the Oklahoma Urban and Community Forestry Council, providing grants of \$1,000-10,000 as a 50% match for projects to establish, expand, and promote urban and community forestry in the State of Oklahoma.
- **Oklahoma Department of Environmental Quality (405-271-7353, <http://www.deq.state.ok.us/>)** sponsors **Environmental Tag Grants**, providing \$500 grants to promote new enthusiasm for the practice of environmental education for Oklahoma teachers or youth leaders. The program must benefit the youth of Oklahoma through the programs developed or enhanced by the grant. Applications are generally due the end of October with winners announced in December. Funds may be used for classroom educational materials, supplies for specific lesson plans, films and videos, continuing education, resource trunks, outdoor classroom setup, etc.
- **Oklahoma Project WILD (405-521-6704, <http://www.state.ok.us/~conscom/projwild.html>)** sponsors **OKWILD School Sites**, providing grants up to \$500 for K-12 Oklahoma public and private schools for development or improvement of outdoor educational sites on school property. Funds must be used for habitat improvement or wildlife education areas. Funding for this program is provided by Phillips Petroleum and is administered by

the Oklahoma Department of Wildlife Conservation.

- **OSU Center for Environmental Education (405-744-7233)** awards **Phillips Environmental Partnership Program Grants** of \$500-5,000 from the Phillips Petroleum Company to members of the North American Association of Environmental Education and to Project WET, Project WILD, and Project Learning Tree facilitators. Awards are given to projects involving primary and secondary schools, adult, non-profit community organizations, and nature centers.

Private Foundations

The Chronicle of Philanthropy: The Newspaper of the Non-Profit World is a useful resource for identifying the funding priorities of many national foundations. Check the local library for a copy of this publication or consult <http://www.philanthropy.com/>. Regional or local foundations fund a variety of projects aimed at improving the quality of life in particular areas, usually within their home state. The following is an abbreviated list of foundations with focus on environmental education.

- **Kirkpatrick Family Fund (405-840-2882)** awards grants up to \$1,500 for support of outdoor classrooms in the Oklahoma City area that have a strong educational component.
- **National Environmental Education and Training Foundation (NEETF) (202-628-8200, <http://www.neetf.org/default.htm>)** awards one-year challenge grants through **Partners in Resource Education, The Funders Forum for Environmental Education, National Conference on Educational Excellence, National Communications Program for Environmental Education, Competitive Challenge Grants**, and others.
- **National Fish and Wildlife Foundation (202-857-0166, <http://www.nfwf.org/>)** awards grants of \$10,000 and up to projects that emphasize innovative and effective wildlife conservation activities in an urban or rural settings.
- **National Gardening Association (800-538-7476, <http://www.garden.org>)** sponsors Youth Garden Grants to gardening programs involving at least 15 children between the ages of 3 and 18, with consideration given for educational, social, or environmental programming; sustainability; community support; strong leadership; need; and innovation.
- **National Institute of Environmental Health Sciences (919-541-3345, <http://www.niehs.nih.gov/home.html>)** awards grants for K-12 Environmental Health Science Education.
- **National Tree Trust (NTT) (202-628-8733, <http://www.nationaltreetrust.org/>)** sponsors **Growing Together, Community Tree Planting, Partnership Enhancement Program**, and other supporting programs. The NTT mobilizes volunteer groups, promotes public awareness, provides grants, and unites civic and corporate institutions in support of local tree planting and education projects throughout the United States.
- **Oklahoma City Community Foundation (405-235-5603, <http://www.occf.org/>)** sponsors the **Margaret Annis Boys Trust Fund**, providing grants for butterfly and outdoor classroom gardens in Oklahoma County.
- **The PEW Charitable Trusts (215-575-9050, <http://www.pewtrusts.com/>)** awards grants to projects in areas of Education, Environment, Health & Human Services, and others.

- **Wal-Mart Stores (501-277-1905)** awards **Make a Difference Day Grants**. Contact the local Wal-Mart store manager for information.

There will be many opportunities during the project to recognize donors. Some of these include: upon making the gift and/or anniversary of the gift; upon ground breaking, ribbon cutting, and/or dedication of the garden; at year's end; and at campaign's end. "Thank You" notes from teachers, students, and committee members, as well as a printed list of donors and/or plaques recognizing donors are ways to express appreciation for their financial and in-kind gifts.

Step 3—Define the Purpose and Objectives for the Garden

Work with a committee to define a purpose and to list objectives for the school's outdoor garden classroom. A school's project may be similar to another outdoor classroom, but it will be unique because it is in a different environmental location and is the result of the commitment of a different group of people. Consult the section "What to Plant" later in this fact sheet to help focus the purpose and objectives of the project. Is the garden going to emphasize environmental issues; habitat; human health; food; or associations with literature, art, geography, history; etc.? Addressing needs will help develop a focus on how to build an outdoor garden classroom.

In addition to academic needs, the garden may provide personal development opportunities. Projects that grow food crops in the garden might include donating the produce to a food bank or selling it for fund-raising. Such activities extend lessons learned in the classroom and introduce students to other skills such as critical thinking, communication, teamwork, civic responsibility, mathematical reasoning, problem solving, public speaking, vocational training, computer skills, scientific method, research skills, and analysis.

Step 4—Layout Students' Gardening Activities

After identifying a list of objectives, develop lesson plans to coordinate with activities in the garden. Students might participate in many of the garden care activities such as watering the plants, weeding the garden, making soil improvements, planting cover crops for fallow periods, protecting plants when weather threatens to damage them, mulching the garden, cleaning up, and planting. Adult volunteers can help with these activities during the school year, and they become especially valuable during the summer months when school is out. Utilize a garden committee to schedule which groups of students will be doing what and when and determine how garden space will be allocated. This is a teacher's opportunity to schedule specific activities at specific times or assign certain tasks to volunteers.

Consider establishing a service-learning relationship with the community's high school FFA, art, and/or horticulture programs. Students in these classes could assist with design of the garden space, selection of plants to be grown in the garden, and production of transplants from seeds and cuttings.

Step 5—Define a Year-round Garden Plan

As spring approaches, it is easy to get excited about planting a garden; however, an outdoor garden classroom



is a year-round project. The garden committee can develop strategies to ensure the garden is fully utilized throughout the academic year.

Fall

Fall is the time to plant winter-flowering annuals such as pansies, flowering cabbage, and flowering kale. It is also one of the best times to plant a tree in or near the garden. Spring-flowering bulbs, such as tulips, hyacinths, daffodils, and crocuses should be planted in the fall so their root systems can grow prior to the onset of winter. A crop of cool season vegetables can also be planted and harvested during the fall.

Start a composting program to return valuable organic matter and nutrients to the garden soil. Discuss microbial decomposition of organic matter.

Notice the color of fall foliage and discuss what accounts for this change from green to vibrant yellows, bronzes, deep reds, and purples.

Winter

Winter is the time to discover what creatures are resting in the garden. Dig up samples of soil and look for dormant insects and seeds. Discuss the benefits of freezing and thawing on soil structure, how plants prepare for winter, and what prevents overwintering buds on trees from opening until spring. Winter is also a good time to examine and sketch the structure of trees.

In late winter, start seeds of plants to be transplanted into the garden once spring arrives. Seeds need to be started in a sunny windowsill or under a bank of fluorescent lights. See Extension Fact Sheet HLA-6401, "Growing Under Lights" for additional information.

Spring

Spring is the time of rejuvenation. In early spring, plant cool season vegetables, *e.g.* peas, broccoli, lettuce, cauliflower, etc. from seed or transplants. Enjoy beautiful bulb flowers and discuss their growth and development. Discuss methods of pollination—wind and insect. Spring is also a good time to plant a tree in or near the garden. Late spring is a good time to establish bermudagrass or zoysiagrass turf within a classroom garden. Bermudagrass requires nearly full sun and is very wear tolerant; however, it is invasive. Zoysiagrass requires full sun or bright shade, is also very wear tolerant, and less invasive than bermudagrass. If the garden is somewhat shaded, tall fescue turfgrass would be a better choice. Be sure that the garden beds are secured with edging to prevent turfgrass' encroachment.

Spring is also the perfect opportunity to study animal reproductive life, whether it is the tadpoles in the pond, the eggs in the bird nest, or the clutch of bunnies beneath the garden gate.

Summer

Unless employed by a year-round school, an educator's main question is probably, "Who is going to maintain this garden until school starts?" Most communities are well equipped with dedicated and enthusiastic parents and a number of volunteer and civic groups. A good place to begin is with the PTA or parents of the children in the classes involved. They have a sense of ownership in school projects and facilities and will be willing to put some effort into the garden in order to make it successful. Other resources might include volunteer organizations, civic groups and clubs or just an avid gardener in the community. Groups noted for their community services include Master Gardeners, Boy Scouts and Girl Scouts, civic clubs (Lions, Elk's, Moose Lodge, Jaycees, Rotary, etc.), societies (Audubon, Wildlife, Horticulture, etc.), local garden clubs, fraternities and sororities, other university/college clubs, high school clubs (FFA), 4-H clubs, church youth groups, etc.

Scheduling what activities need to be done and what time commitment is required by each volunteer is the next step. Typically only basic care, weeding, and watering is needed during the summer. Just prior to school starting, other assignments may need to be made to make sure the garden is in shape for the first day of school. Time commitments will vary from one situation to the next. One dedicated volunteer might be willing to manage the garden all summer. However, more than likely a schedule for several people willing to take care of the garden will be needed. Consider requesting one family per week during the summer break to volunteer in the garden. That way one single person or family is not committed for the whole summer, which could interfere with family vacation plans.

Step 6—Choose a Permanent Garden Site and Design the Garden

Site selection is extremely important, but one is often limited to a site that may be less than ideal. Several things need to be considered when choosing the right site. Evaluate the soil texture, depth, fertility, drainage, slope, as well as sunlight and air movement within the garden site. Any adjustments that could lessen a potential problem should be considered.

Most plants prefer moist, well-drained, loamy soils. Too much sand leads to increased moisture stress and increased irrigation costs. Too much clay leads to drainage problems and greatly limits crops that can be planted on a particular site. Added nutrients and/or amendments may be necessary to improve soil tilth and are best added before planting begins. A soil test can be conducted through the Cooperative Extension Service to help determine what nutrients or amendments, if any might be needed. (See improving soils below.)

The area should have good drainage. A slope between 1% and 10% is acceptable. Slopes greater than 10% can lead to excessive runoff, erosion, and special management. If drainage is poor because of soil type or low pockets in the grade, care should be taken to correct these problems before beginning the garden's construction. If soil type is heavy clay or the area is low in grade, consider bringing in additional soil to raise the area, or build raised beds. Compacted soils may also drain poorly and should be tilled thoroughly to improve drainage. Simple drainage systems can also be installed to help divert or drain water away from the gardening area. Avoid constructing a garden in areas where large volumes of water are diverted from buildings.

Some air movement is desirable in the garden. Too little air movement can promote insect and disease development. Too much air movement and plants will tend to dry out faster or may be blown over and damaged. Thus protection from prevailing wind patterns with fences, barriers, covers, etc. should be considered when selecting the garden site.

The garden site should be in an area that receives plenty of sunlight, at least 6 to 8 hours a day. There are many plants that will tolerate less than six hours, but most prefer at least six. Sometimes very little can be done to increase the amount of sunlight that a garden site receives. If there is no way to provide additional sunlight, consider growing only plants that are shade tolerant. The types of plants educators wish to grow may determine where the garden is located or vice-versa.

Additional considerations should include availability of water and electricity, accessibility, and size of the desired garden. Be sure to locate the garden in close proximity of water. If water is not easily accessible, plants tend to be neglected and suffer during dry, hot periods. If there is no water source near the garden area, then installation of a water line to the garden site may be necessary. If the garden is small, hand watering may be sufficient; however, if it is too large for one person to water by hand in a short amount of time, consider drip irrigation, soaker hoses, or conventional irrigation systems. All can be set up on timers for ease of watering but should still be monitored and reset based on weather conditions. Drip and soaker hoses are the most efficient and cost effective irrigation methods. Be sure to locate the garden near an electrical source to handle electrical needs.

The garden should also be located where it is accessible to students, volunteers, and teachers. The size of the area needed will also play a roll in choosing the site. Based on the needs and activities identified earlier in the planning process, the size of the garden can be determined. The site should have enough room for a garden, tool storage, and students. Maintaining a large garden is very time-consuming, so select a relatively small area and allow it to "grow" as time and resources permit. Consider locating the garden in an area that will allow for future expansion. The demonstration Children's Garden at the Oklahoma Botanical Garden and Arboretum in



Figure 1.

Stillwater, Oklahoma, measures about 20' x 40' and is actually made up of several smaller gardens (Fig. 1), a vegetable and fruit garden, butterfly garden, water garden, and potting garden. The size selected for a garden will be determined by the overall objectives of the teaching program, the number of students that will use the garden at one time, and the amount of support and volunteers involved.

Garden Design

There are four steps to follow in designing a garden. These steps help guide the design process, especially when large groups of people are to be involved in the process.

The first step is to inventory and analyze the garden site. Note where existing elements, such as trees and shrubs are located along with views and access to the garden. Find out how much sunlight the garden will receive. Are there elements that need to be removed or changed before a garden can be installed? Determine if the area has proper drainage. Also consider possible liability issues that the site may impose. Physical hazards for students and visitors should be considered as well as the possibility of vandalism. In such cases, lighting or fencing may be needed. A garden site in a secluded area on campus, such as an enclosed courtyard, may also be an effective deterrent to vandalism.

The second step is to decide what should be included in the garden. It is a good idea to draw the garden on paper or with the aid of a computer drawing program to plan for proposed locations of elements. Starting with a list of elements to include in the garden (bird houses, water features, potting benches, trees, shrubs, planting beds, etc.), consider how they will be used to form a theme. Once the theme for the garden is set, it becomes easier to add other ideas.

The next step is to strategically place elements in the garden. Examples: place bird nest boxes in an area that will not be constantly disturbed; locate the garden entry in a highly visible location; place vegetable gardens in an area that will allow for planting and maintenance. Some activities will be passive in nature, such as observation assignments and others will be active, such as potting plants, so group like activities together. Some of the proposed elements will need to have room to accommodate large groups or several classes at one time, so take this into consideration. When proposing plant material consider future growth and seasonal changes. Since safety is an important concern, especially when children are involved, sharp objects and poisonous plants should be

avoided. Keep the garden simple so yearly maintenance requirements are kept to a minimum.

The final step is to draw the plan to scale and add notes for where programmed activities will take place. Note on the plan what elements and materials will be needed to construct the garden. The plan of the garden will help others visualize the layout, aid in the installation, and provide a checklist for supplies. Type of materials needed and their cost should be considered during this step. Sturdier materials often cost more initially but will last much longer than cheaply constructed materials. Pathways can be constructed from permanent materials such as bricks or pavers if the budget allows, or cheap, readily available materials such as clean hay or straw, wood chips from a local pruning company, grass clippings, etc. If some elements will be added over time, show on the initial plan with a note what will be added in the future. This allows for an understanding of how the plan will come together.

What to Plant

As plant material is chosen for the garden, the life cycle, mature size, and cultural requirements should be considered. Plant material is often classified as herbaceous (annual or perennial) and woody (shrubs and trees). A true annual will complete its life cycle in one year and will need to be replaced the following year. If the whole garden is made up of annual plants, the cost of replacing them may become a burden. Therefore, herbaceous perennial plants (flowers or groundcovers that last three or more years) and woody plants should be utilized along with some annuals. By incorporating many plant types into the garden, visual interest as well as utilization of the garden becomes year-round.

Select plants that are adapted to the region to ensure success. Consider the temperature tolerance, soil type tolerance, moisture requirements, etc. of plants selected. Trying to grow plants that are not adapted to an area can result in disappointing failure. It is also necessary to know the mature sizes of the plants chosen for the garden. Spacing of plants and garden placement will be determined by their mature height and width. Avoid overcrowding plants because this can result in problems such as increased disease or insect incidence. Place taller plants toward the back or middle of the garden and shorter plants in front.



Class curricula and planned activities will also play a roll in the overall design of the garden and plant selection. By using class curricula, ideas for theme, concept, or topic gardens can be identified. Plant material to be used in these gardens should then be determined based on the overall theme, concept, or topic. The following list of ideas may be helpful.

Theme gardens

- | | |
|------------------------|------------------------|
| Persian Carpet Garden | Friend's Name Garden |
| Butterfly Garden | Dinosaur Garden |
| Water Garden | Alphabet Garden |
| Imagination Garden | Sunflower House Garden |
| Sundial Garden | Herb/Scent Garden |
| Fiber Garden | Prairie Garden |
| Native American Garden | Peter Rabbit's Garden |
| Barnyard Garden | Teeny Tiny Garden |
| Companion Garden | Literature Garden |
| Root Garden | Giant Garden |
| Pizza Garden | Tall & Short Garden |
| Safari Garden | Chocolate Garden |
| Lemon Garden | Native Plant Garden |
| Color Garden | |

Topics

- | | | |
|-----------------------|------------|--------------------|
| Seeds (monocot/dicot) | Roots | Soils |
| Beneficial Insects | Leaves | Drought-resistance |
| History | Literature | Mathematics |

Concepts

- | | |
|---------------------------|------------------------|
| Plant Life Cycles | Plant Form & Function |
| Food Production in Plants | Regeneration of Plants |
| Biodiversity | Seasonal Cycles |
| Adaptation | Wildlife Habitat |

As indicated previously, our Children's Garden is divided into four sections, each having a different theme or garden type (Fig. 1). One side of the garden is divided between a vegetable garden in one corner and a bird/butterfly garden in the other corner. The other side of the garden has a water garden/reflection area in one corner and a potting area in the other corner. The potting area contains plants that root easily and a potting bench. The center of the garden is open and contains a to-scale concrete map of the state of Oklahoma. This map can be used for any number of lessons including



geography, math, history, etc. (See Extension Fact Sheet HLA-6405.)The open area in the center of the garden also ensures that groups of children can be in the garden without trampling the plants in the theme garden areas.

Vegetables

Vegetables are commonly used in children's gardens since they afford children hands on time in the garden. It is important to choose vegetables that will give quick results, so the children will not lose interest in the garden. Problems with a vegetable garden include crops that mature in the summer after the children are out of school and not having a site with enough sun to grow vegetables. The following tables offer vegetable suggestions that should alleviate these problems.

Quick-growing Vegetables

<i>Vegetable</i>	<i>Approximate Days to Maturity</i>
Beet	50
Broccoli (transplants)	50
Bush Bean	50
Leaf Lettuce	45
Radish	25
Spinach	50

(note: The number of days to maturity may vary with variety. Check the seed packet for each individual variety.)

Vegetables That Can Be Planted in the Spring to Mature Before School Is Out

<i>Vegetable</i>	<i>Spring Planting Dates for Oklahoma</i>	<i>Approximate Days to Maturity</i>
Cabbage (transplants)	Feb. 15 – March 10	60 – 90
Leaf Lettuce	Feb. 15 – March 10	40 – 70
Radish	March 1 – April 15	25 – 40
Spinach	Feb. 15 – March 10	50 – 70
Swiss Chard	Feb. 15 – March 10	50 – 70
Turnip	Feb. 15 – March 10	50 – 60

Vegetables That Can Be Planted in the Fall to Mature Before a Killing Frost

<i>Vegetable</i>	<i>Fall Planting Dates for Oklahoma</i>	<i>Approximate Days to Maturity</i>
Bush Bean	Aug. 10 – 20	50
Cucumber	Aug. 10 – 20	60 – 70
Cabbage (transplants)	Aug. 1 – 25	75 – 90
Mustard	Sept. 10 – Oct. 10	40 – 50
Radish	Aug. 15 – Oct. 10	20 – 40
Spinach	Sept. 5 – 25	50 – 60
Summer Squash	July 15 – Sept. 1	40 – 50
Swiss Chard	Aug. 1 – Sept. 15	50 - 60

For additional information on planting a spring or fall vegetable garden, see Extension Fact Sheets HLA-6004, "Oklahoma Garden Planning Guide;" HLA-6009, "Fall Gardening;" and HLA-6032, "Vegetable Varieties for the Home Garden in Oklahoma."

Most vegetables grow best in full sun; however, a nice vegetable garden can be grown even if an area receives less than six hours of sun a day. Keep in mind that those vegetables that bloom and bear fruit (corn, tomatoes, okra, etc.) take the most sun and will require at least 8 hours a day. Root crops

require less sun and leafy crops require the least amount. Some of the vegetables that will work in a garden area with 6 hours of sun or less include beets, carrots, green onions, radishes, and turnips. Leafy vegetables that can be grown in a shady area include arugula, leaf lettuce, and spinach. Growing vegetables in containers is another way to take advantage of sunny spots in the garden.

Schoolyard Ecosystems and Habitat

When considering overall goals of the garden, assess the local flora and fauna and the natural habitats in the area. Fountains, pools, birdhouses, and feeders are additions to the garden that provide character as well as learning opportunities. Different wildlife will be attracted to the garden depending on the plant material used.

Water features in a garden can also be a valuable learning arena. Here, students can observe plant and animal life in relation to aquatic environments. Avoid large, deep ponds or pools for reasons of liability.

A butterfly garden is one of the easiest ways to attract wildlife to the garden. A successful butterfly garden will have:

- A mixture of perennials and annuals, including native plants.
- Nectar plants (such as marigolds, pentas, and petunias)
- Plants for larvae (such as parsley and other herbs, tomatoes, and milkweed)
- A sunny location
- Shelter from the wind
- Other features such as mud puddles or fruit
- Few insecticides and no bug zappers

Nectar plants are the primary source of food for adult butterflies and should be planted in large groups according to color. Also, select nectar plants that bloom over several seasons. Larvae plants are those used by larvae (caterpillars) as food. Most larvae don't feed on the same plants as adults. Following is a list of some of the plants that will work for a butterfly garden. For more information and a large selection of plants, see Extension Fact Sheet HLA-6430, "Landscaping to Attract Butterflies, Moths, & Skippers."



Nectar Trees & Shrubs

Azalea, Butterfly Bush, Eastern Redbud, Glossy Abelia

Nectar Perennials

Columbine, Aster, Butterfly Weed, Cornflower, Coreopsis, Daffodil, Gaillardia (Blanket Flower or Indian Blanket), Liatris (Gayfeather), Goldenrod

Nectar Annuals

Aster, Rudbeckia (Black-eyed Susan), Cosmos, Marigold, Pentas, Petunia, Spider Flower, Sunflower, Verbena, Zinnia

Larval Food Plants

Dill, Parsley, Milkweed, Passion Vine

Step 7—Build the Garden According to Plan

This is the big moment when teachers, volunteers, students, and parents pool their resources and build this permanent addition to the school. Begin by marking the area to be used. Spray paint can be used to mark the boundaries of the garden. Use string as a straightedge. Here is an excellent opportunity to put geometry to practical use. If the garden is to be square or rectangular, calculate the hypotenuse of each corner to be sure that the corners are 90° angles. (Remember the Pythagorean theorem for a right triangle... $a^2 + b^2 = c^2$. For example, if side "a" equals 3' and side "b" equals 4' and the corner is to be a right angle, then the hypotenuse "c" equals the square root of 9+16, which is 5'.) Once the area is defined then preparation begins. It is a good idea to distribute the garden plan to all involved at this time. This allows all to see what will be built and enables one to assign responsibilities.

Site preparation is probably the most important step in establishing a garden. Start by removing all trash, rocks, and debris. If working in an area with existing turfgrass or perennial weeds, begin by killing the grass and weeds with a product containing glyphosate. Several applications may be required before all the grass/weeds are dead. When working with Bermudagrass, common in most of Oklahoma, it is suggested that the dead sod be removed before tilling the area. Bermudagrass forms long runners, which can become entangled in the tines of a tiller. Sod may be removed by hand using a small spade or sod lifter or, if working with large areas, a gas powered sod cutter. It is important to begin with a weed-free area because weeds will compete for water, light, and nutrients.

After the site has been cleared of debris, grass, and weeds, mark pathways and planting areas. If working with a large area containing pathways, then till only the planting areas.

It is important to make sure adequate soil is available for growing the plants chosen. Poor soils are one of the most common causes for failure of plants to grow vigorously. Natural topsoil varies greatly from one location to another. The ability to grow plants can vary even within a garden where underlying rock may prevent water percolation, or a nearby sidewalk or driveway may adversely affect the pH.

Tools and Equipment

In planning a garden, don't forget to include tools and equipment required to install and maintain the garden. If trel-

lises, arbors, or fencing are part of the design, a list of tools and materials will be needed to construct these structures. Equipment such as tillers and sprayers are always handy to have; however, the high cost of tillers may be prohibitive. Tillers are most likely to be used when establishing a garden, and they can be rented or perhaps borrowed at planting time.

Each child or volunteer should have access to the required equipment when working in the garden. Items needed include spades, rakes, trowels, buckets, watering cans, water hoses, and gloves. Children's gardening tools should be sturdy and sized to fit them. A general rule of thumb for sizing garden tools is that the handle should be at shoulder height to 1 foot above to allow for growth of the child. For older kids, try the mid-sized tools labeled as lady-sized or patio tools.

Of course, all gardening tools and equipment will need a sturdy convenient place to be stored. When designing or choosing the site for the garden, consider storage facilities and access to these facilities. It may be necessary to construct a tool shed near the garden area to house tools and equipment.

Improving Soils

The garden will be in place for many years, thus it is important to get the soil well prepared before planting.

Dark color and crumbly texture may indicate good soil but do not guarantee that the soil contains all the necessary nutrients. Have soil tested before the soil is prepared so fertilizer deficiencies may be corrected as well as pH. After the soil test results have been returned, work any recommended materials into the upper 6" of soil. County Extension Educators can help with submitting a soil test and, then, providing recommendations based on the soil test. For more information, see Extension Leaflet L-249, "Soil Testing...The 1st Right Step."

Organic matter is very important to successful plant growth. Most garden plants will thrive in a soil with about 5% organic matter. To add organic matter, spread 1"- 6" of peat moss, compost, or well-rotted manure over the soil. Work amendments into the top 6" of existing soil. Surface applications of organic matter do not provide the soil aeration, moisture regulation, and deep root penetration that is possible when organic matter is mixed into the soil.

Many kinds of materials are available for soil improvement. Thorough blending of these amendments with the soil is very important. Plant roots may not cross a boundary between distinctly different types or textures of soil or soil amendment



materials. Heavy top-dressing, poor mixing or other practices that cause distinct layering should be avoided. For additional information on soil improvements see Extension Fact Sheet HLA-6007, "Improving Garden Soil Fertility" and HLA-6436, "Earth-Kind Gardening Series—Healthy Garden Soils."

Irrigation and Planting

Install an irrigation system before planting. After the irrigation system is in place, fill the pathways, if any, with the chosen material to make planting a little easier. Now, planting can begin.

Proper planting is important for plant success. Generally, most plants should be placed in the ground at the same level as they were growing in the pot or field. Planting too deeply can lead to plant decline because of a lack of air exchange in the root area. Plants should also be watered immediately following planting. Water needs of shrubs, trees, and perennials should be monitored closely the first year after planting.

Seeds should be planted at a depth that is about two times their diameter. Check seed packages for proper planting depths for each variety. Seedlings should be watched closely for water needs when first emerging from the soil, as this is a critical time for the plant.

Step 8—Maintenance

Maintenance is as important to the garden's success as proper installation. Watering and weeding are the two biggest maintenance demands; however, mulching, fertilizing, and, in the case of a vegetable garden, harvesting are also important to a garden's success.

Water needs of each plant will vary as will water needs at different times of the year. While a newly seeded vegetable garden will require frequent "misting" or small amounts of water, an established garden will be better served by deeper, less frequent waterings. Newly planted trees and shrubs will also require close monitoring for water requirements until their roots have a chance to grow into the surrounding soil.

The garden area should be kept as weed-free as possible. Weeds compete with garden plants for needed moisture, nutrients, and sunlight. Weeds can be eliminated through manual weeding or hoeing, or through the use of mulches or herbicides. It is probably best not to use too many herbicides in a school garden setting, and if the proper measures are taken and weeds are controlled before reaching an overwhelming point, they are not needed.

Mulches can go a long way in the ease of maintenance of a garden. A layer of organic mulch 1"-2" deep will help by shading out weed seeds, eliminating the need for cultivation and the resulting damage to plant roots, reducing moisture evaporation, increasing water absorption and retention, decreasing runoff and soil erosion, and regulating soil temperatures. Other benefits include cleaner, more easily harvested crops; the reduction of disease; and easier movement through the garden during very wet periods. For more information on mulches, see Extension Fact Sheet HLA-6005, "Mulching Garden Soils."

A healthy garden is the best defense against pests and if the garden is maintained well, the number of insect/disease pests in the garden may not be plentiful enough to warrant the use of pesticides. Maintaining a garden without the use of pesticides may be the best and easiest choice for a school-



yard setting. Sometimes, however, pest populations may be so high that it may be necessary to use pesticides to control them before they seriously damage the garden. Check with the local County Extension Office for the best method of control. Be sure to read and follow pesticide labels for rates, proper protective equipment, re-entry times, and interval before harvest.

If planning to use compost in a garden, consider adding a composting station to the garden. Composting is the process by which organic matter is broken down by organisms into a rich compost material that can then be utilized in the garden. A composting station can provide a valuable teaching aid in the investigation of the breakdown of organic matter and life cycles. It is also a great way to recycle plant material from the garden at the end of the season. For more information on making a compost pile, see Extension Fact Sheet HLA-6014, "Making a Compost Pile."

Conclusion

An outdoor garden classroom empowers teachers and their students to utilize non-traditional classroom space to supplement their educational curricula in areas including but not limited to science, history, economics, agriculture, literature, geography, art, and math. The depth and breadth of lessons that can be incorporated into the outdoor classroom setting are limitless. The garden also serves as a tool to unite a community by providing opportunities not only for students to grow plants, but also for them to develop their relationships with classmates, teachers, parents, and garden volunteers. It is critical that a school's students develop a sense of ownership of the garden. This attitude and its resulting enthusiasm will be carried forward as the children advance through their grade levels, and it will be passed down to younger siblings and neighborhood children who are just starting their schooling.

For additional information, consult these fact sheets, which are available at local County Extension Offices or visit <http://agweb.okstate.edu/pearl/> for a complete listing of Extension Publications:

- HLA-6004 Oklahoma Garden Planning Guide
- HLA-6005 Mulching Vegetable Garden Soils
- HLA-6007 Improving Garden Soil Fertility

- HLA-6009 Fall Gardening
- HLA-6012 Growing Tomatoes in the Home Garden
- HLA-6013 Summer Care of the Home Vegetable Garden
- HLA-6014 Making a Compost Pile
- HLA-6020 Growing Vegetable Transplants
- HLA-6032 Vegetable Varieties for the Home Garden in Oklahoma
- HLA-6033 Raised Bed Gardening
- HLA-6211 Propagation of Fruit and Nuts by Seed
- HLA-6214 Growing Strawberries in the Home Garden
- HLA-6215 Blackberry and Raspberry Culture for the Home Garden
- HLA-6218 Peanuts in the Home Garden
- HLA-6222 Home Fruit Planting Guide
- HLA-6246 Growing Grapes in the Home Garden
- HLA-6248 Blueberry Production for the Home Garden
- HLA-6400 Roses in the Landscape
- HLA-6401 Gardening With Kids — Classroom Activities in Horticultural Science, Growing Under Lights
- HLA-6403 Rose Culture in Oklahoma
- HLA-6404 Winter Protection of Landscape Plants
- HLA-6405 Gardening With Kids — Classroom Activities in Horticultural Science, Oklahoma Map Garden
- HLA-6408 Landscape Maintenance Schedule
- HLA-6409 Pruning Ornamental Trees and Shrubs
- HLA-6410 Perennial Flowers for Specific Uses in Oklahoma
- HLA-6411 House Plant Care
- HLA-6412 Fertilizing Shade and Ornamental Trees and Shrubs
- HLA-6414 Planting Shade Trees and Shrubs
- HLA-6415 Training Young Shade and Ornamental Trees
- HLA-6417 Landscaping for Energy Conservation
- HLA-6419 Establishing a Lawn in Oklahoma
- HLA-6420 Lawn Management in Oklahoma
- HLA-6425 Annual Flowers for Specific Uses in Oklahoma
- HLA-6430 Landscaping to Attract Butterflies, Moths, and Skippers
- HLA-6431 Earth-Kind Gardening: Cultural Control Practices
- HLA-6432 Earth-Kind Gardening: Mechanical Pest Controls
- HLA-6432 Earth-Kind Gardening: Botanical Pest Controls
- HLA-6434 Earth-Kind Gardening: Biological Pest Controls
- HLA-6435 Landscaping and Gardening for Birds
- HLA-6436 Earth-Kind Gardening: Healthy Garden Soils
- HLA-6705 The Hobby Greenhouse
- EPP-7307 Beneficial Insects
- EPP-7313 Home Garden Insect Control
- EPP-7640 Solar Heating (Solarization) of Soil in Garden Plots for Control of Soilborne Plant Diseases

References and Resources for School and Youth Garden Projects

There are numerous resources available, too many to list in any one publication. For a more extensive list of resources

see the OSU Department of Horticulture & Landscape Architecture homepage at <http://www.hortla.okstate.edu>.

Publications and Other Resources:

Children's Gardens; A Field Guide for Teachers, Parents and Volunteers, 3rd Edition. Bremner, E. and Pusey, J. (1999). Oakland: University of California Cooperative Extension, Common Ground Garden Program. Part One, "The Process," takes you through the basic concepts and techniques that are important to successful gardening. It is arranged in a sequence of steps from the moment you decide to have a garden through harvest. Part two, "The Activities" is a series of exercises that encourage creativity and experiments that develop skills in scientific observation. The Guide to Resources lists seed companies and sources of technical assistance. HUGE new annotated bibliography, website, and resource listing. The Bibliography reviews 18 publications on school gardens. Library of Congress Catalog Number: 82-60296. For more information contact: 323-838-4540

Digging Deeper: Integrating Youth Gardens into Schools and Communities, a comprehensive guide. Kiefer, J. and Kemple, M. (1998). Montpelier, VT: Food Works. Sections on organizing, planning, designing and building a garden; seasonal activities; evaluating the program, ecological education, and sustainable cultures.

Gardening Bulletin: A Gardening Newsletter for Teachers, Parents, Administrators and Volunteers. Cornell Cooperative Extension, 246 Griffing Ave., Riverhead, NY 11901-3086.

Gardens for Growing People: Resources for Garden Based Education. PO Box 630, Point Reyes, CA 94956. An essential resource for tools, books, habitat gardening kits, seed packs, videos, and inspiration. Order the free catalog, which also includes information about events and organizations, by calling 415-663-9433. Receive a quarterly e-mail newsletter full of wonderful articles and networking resources for children's gardening by sending e-mail to growpepl@nbn.com and including only the word "subscribe" in the message's text.

"Growing Ideas" A Journal of Garden-Based Learning. National Gardening Association. "Growing Ideas" newsletter is sent three times each year to educators interested in using

plants to help young minds grow. This 12-page newsletter features thematic, investigative project ideas — from worms to wildflowers, activity highlights from participating classrooms nationwide, free resource and funding information, and articles on effective inquiry-oriented instructional strategies. 180 Flynn Ave, Burlington, VT 05401, 1-800-538-7476, email: eddept@garden.org

Grow Lab: A Complete Guide to Gardening in the Classroom. National Gardening Association (1990). This 128-page teachers' guide offers comprehensive information on successfully gardening indoors with students. It includes information on setting up an indoor garden, locating supplies, planting, and providing good conditions for growing vegetables, flowers, and herbs indoors. It also features some horticultural project ideas and plans for a build-it-yourself wooden GrowLab Indoor Garden. ISBN 0-915873-31-1

Kid's for Saving Earth – International Headquarters, PO Box 47247, Dept. FG, Plymouth, MN 55447-0247

Let's Get Growing! 1900 Commercial Way, Santa Cruz, CA 95065. Web: www.letsgetgrowing.com Ph: 1-800-408-1868. A great resource for parents and teachers, this company distributes books, children's gardening tools, and Smithsonian-endorsed curriculum materials. The National Gardening Association's GrowLab supplies and equipment also are offered.

Oklahoma Gardening for Kids (Video). Agricultural Communications, OSU, Room 111B PIO, Stillwater, OK 74078-02222

The National Gardening Association Guide to Kids' Gardening. Ocone, L. (1990). A complete guide for teachers, parents and youth leaders with chapters on "The six basic challenges: leadership, land, money, vandalism, continuity, motivation;" planning for success; developing your site; designing the gardens; the fun of gardening; basics of indoor gardening and container gardening; a world of youth gardens; and resources. ISBN 0-471-52092-6

Success with School Gardens: how to create a learning oasis in the desert. Guy, L. Cromell, C. and Bradley, L. (1996). Phoenix: Arizona Master Gardeners, Inc. How to: involve administrators, parents and volunteers; obtain funding and donated supplies; use free publicity to increase community support; improve your soil and choose the best vegetables, flowers and herbs to plant each season; and grow healthy, vigorous plants; water effectively for arid climates. ISBN 0-9651987-0-7

Oklahoma Sources for Information and Educational Programs

City Park and Recreation Departments – Check local listings

Junior Master GardenerSM Program – David Hillock, 360 Ag Hall, Stillwater OK 74078. 405-744-5158

Myriad Botanical Gardens – 100 Myriad Gardens, Oklahoma City, OK 73102. 405-297-3995

National Junior Horticultural Assoc. – 401 N 4th, Durant, OK 74701

Oklahoma Botanical Garden & Arboretum – OBGA, 360 Ag Hall, OSU, Stillwater, OK 74078-6027. For an affiliate garden nearest you contact 405-744-6460 or <http://www.hortla.okstate.edu>.

Oklahoma City Zoo – Oklahoma City Zoological Park, 2101 NE 50th Street, Oklahoma City, OK, 73111. 405-425-0218



Oklahoma Cooperative Extension Service/4-H Youth Program
– Check local County Extension Offices.

Oklahoma Science Teachers Association – Chris Moseley,
(moseley@okstate.edu) OSTA President-Elect, College
of Education, 230 Willard, OSU, Stillwater, OK 74078.
405-744-9515.

OSU-OKC Trial Gardens, John E. Kirkpatrick Horticulture
Center – 400 N. Portland, Oklahoma City, OK 73107.
405-945-3358

Tulsa Garden Center – 2435 S. Peoria, Tulsa, OK 74114.
918-746-5125

Tulsa Zoo & Living Museum – 5701 E. 36th Street North, Tulsa,
OK 74115. 918-669-6202



The Oklahoma Cooperative Extension Service

Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

Oklahoma State University, in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal laws and regulations, does not discriminate on the basis of race, color, national origin, gender, age, religion, disability, or status as a veteran in any of its policies, practices, or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 0507 GH.